The moderating role of governance environment on the relationship between risk allocation and private investment in PPP markets: Evidence from developing countries

Huanming Wang [a,1], Yuhai Liu [b,*,2], Wei Xiong [c,3], Jinbo Song [b,4]

[a] Faculty of Humanities and Social Sciences, Dalian University of Technology, Dalian, Liaoning Province, China
[b] Faculty of Management and Economics, Dalian University of Technology, Dalian, Liaoning Province, China
[c] School of Economics and Management, Tongji University, Shanghai, China

Abstract

PPPs have become a popular way to supply infrastructure around the world. However, compared with developed countries, most developing countries have failed to attract private investment over the past years. Risk allocation and governance environment (e.g., the extent of public participation, the level of political stability, the quality of public services, the ability of regulations, abiding the law, and the extent of corruption) may be important factors. To test the hypotheses, using about 4560 PPP projects in 138 developing countries from 2002 to 2015, this paper applies the Tobit regression model to investigate the interaction effect of governance environment and risk assumed by private partners on private investment. Results indicate that private partners assume that less risk can attract more private investment, and that a higher level of governance (control of corruption, government effectiveness, regulatory quality, and rule of law) reduces the negative influence of risk assumed by private partners on private investments.
© 2018 Elsevier Ltd, APM and IPMA. All rights reserved.

Keywords: Control of corruption; Regulation; Government effectiveness; Rule of law; Private investment; Risk allocation

1. Introduction

Public-private partnerships (PPPs) have been widely used in the world to achieve sustainability goals over the past 30 years. PPPs are a contractual form of cooperation between public and private sectors in the development of infrastructural facilities, and refers to allocation of risks and rewards (Villani et al., 2017). According to the World Bank's Private Participation in Infrastructure (PPI) database[5], from 1990 to 2016, Brazil, China, and India are the top three developing countries adopting infrastructure PPP projects. PPP involves cross-sector cooperation, achieved easily with a proper risk-allocation strategy. Risk is seen as an uncertain possibility, and risk allocation refers to which parties assume the risk. Generally, private firms are willing to accept appropriate risks arising from the design, construction, operation, and maintenance of a project, but it is reasonable to assume that a governance environment in a region where the

* Corresponding author.
    E-mail addresses: whm715@dlut.edu.cn (H. Wang),
liuyuhai2449@dlut.edu.cn (Y. Liu), kevinxiong@tongji.edu.cn (W. Xiong),
songjinbo@dlut.edu.cn (J. Song).
    [1] His research area includes PPPs, governance and privatization.
    [2] His research area includes PPPs and risk allocation.
    [3] His research area includes PPPs and sustainability.
    [4] His research focuses on PPP.

[5] https://ppi.worldbank.org/data.

project is located will strongly affect this willingness (Baker, 2016). Governance is defined as the traditions and institutions by which authority in a country is exercised (Kaufmann et al., 2011). Therefore, governance environment is the extent of rules and requirements that have been conformed by individuals and organizations. If a country's governance environment is weak, private firms are exposed to risks of contract cancellation or opportunistic renegotiation (Percoco, 2014). Compared with developed countries, developing countries have greater difficulty attracting private investors to PPP projects, because investors must assume more uncertainty and risk (e.g., demand risk and policy risk) in developing countries with poor governance environment (Birner and Wittmer, 2006). For example, Osei-Kyei and Chan (2017) showed that few local PPP markets in developing countries have attracted a number of private investments over the past decades. Therefore, it is valuable to study private investment in developing countries' PPP projects from a risk-transfer perspective under a specific governance environment, because conclusions could reveal which kinds of risk transfer strategies and governance are necessary to attract private investment to those countries.

In the PPP literature, countless studies have addressed risk transfer or governance. The extant literature is enlightening in many ways, but is not without problems. First, most literature about risk allocation describes how it impacts PPP performance (e.g., success or failure); few researchers discussed whether risk transfer strategies impact private investment. For example, Albalate et al. (2013) showed that the risk to private participants regarding cost recovery is an important driver of private investment in the U.S. water industry. It is necessary to reduce risk to encourage private involvement in PPP projects. Second, most literature focuses on how to impact PPP development through risk allocation or governance, but the interaction between the two fields is still rare with just a few studies focused on both topics. For example, Percoco (2014) showed that governance is important in the allocation of risk to private partners, because a better governance environment positively impacts the allocation of risk to private partners. Third, the extant literature focuses on single PPP case studies, comparative case studies, or small sample investigation studies to develop theories; few use medium to large-N samples to theoretically and empirically explore risk transfer and governance influence on private investment in PPP projects. Conclusions drawn from case studies and small sample investigations are inspiring, but their generalizability is limited.

Consequently, this paper aims to address the following research questions: what is the effect of risk transfer on private investment in PPP markets in developing countries? Further, does governance environment of a developing country moderate the relationship between risk allocation and private investment?

This article proceeds as follows. The next section presents basic assumptions about the relationship among governance, risk allocation, and private investment. Following is the method, the discussion and conclusions.

2. Risk allocation, governance environment and private investment: theories and hypotheses

2.1. Risk allocation and private investment in PPPs

Before entering the PPP market in (e.g., in PPP procurement stage), private investors pay particular attention to risk allocation, because sharing or transferring some risks to private partners is one main motivation for governments to adopt PPPs (Girth, 2014). PPP projects have many kinds of risk, including project-level risks (e.g., design, construction, finance, and ownership risks) and market-level risks (e.g., demand and investment environment risk). The allocation, transfer, and management of risk impact the quality of public and private partner relationships (Burke and Demirag, 2017). The smaller the degree of risk misallocation, the more successful PPP projects would be in attracting private investment (Ke et al., 2009). Prospect theory, developed by Kahneman and Tversky (1979), can be used to explain investors' decision choice. The prospect theory is as a more correct theory of decision-making under risk, and is concerned with examining under what conditions people prefer to take risky or riskless decisions to potentially achieve a better economic outcome (Baekgaard, 2017). In project management and PPP fields, project sponsors or funders will estimate the gains and losses before they make the final decision to start a PPP project initiative. Only when gains are bigger than losses, private sponsors will invest the projects. According to the prospect theory, individuals are risk averse in the gain domain. Generally, if investors assume more risk, there may be more gains for them. However, Kahneman and Tversky (1979) showed that individuals were more likely to choose certain gains rather than probable outcomes even if the probable outcome has a higher utility. Therefore, project investors are risk-averse in the project procurement or initiation stage. Less risk indicates higher degrees of certainty about return on investment. In the water industry, private sectors or foreign investors invest in a project only when it is easier to recover costs and commercial risk is relatively low (Albalate et al., 2013). For example, Suez, one of the largest water multinationals, announced in 2003 that it would withdraw from many investments in developing countries, except from activities that offered better risk allocation (Tecco, 2008). Compared with developed countries, developing countries' local government officials are unfamiliar with the management of PPPs, which makes PPPs risky (Shrestha et al., 2017). In addition, when the cost sharing rate for private partners is low, the project may attract private investment in infrastructure earlier (Takashima et al., 2010). Hence, the first Hypothesis follows:

Hypothesis 1. Private investors assume low risk will encourage more private investment in PPP projects.

2.2. The moderating role of governance environment

As an institutional factor, governance can be described as narrow or broad. The narrow focus describes well-functioning

market mechanisms and efficient resource management, positioning the relationship between government and market at the core of economic growth and development. A broad focus emphasizes governance that includes citizen participation (Krawczyk and Sweet-Cushman, 2017). This article sees governance in both ways, calling for improvements that touch all aspects of the public sector (e.g., institutional settings, decision making, public service delivery, and civil participation) (Grindle, 2004). Kaufmann et al. (2011, p,222) argues that governance includes *(a) the process by which governments are selected, monitored and replaced; (b) the capacity of governments to effectively formulate and implement sound policies; and (c) the respect of citizens and the state for the institutions that govern economic and social interactions among them*. The above three respects of governance include six dimensions: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. The definition of governance and its six dimension provide a useful way to think about a governance environment for a country, as well as a useful way to organize an empirical governance study, because data in all six dimensions of governance are publicly available in the World Bank's Worldwide Governance Indicators (WGI) database[6]. This study uses the Kaufmann et al. definition of governance.

Risk allocation affects private investment in PPP projects, moderated by the governance environment of a country. PPP markets in countries with good governance environment have matured, and thus private investors have full confidence in their cooperation with governments. However, this confidence is rather different in a poor governance county (Osei-Kyei and Chan, 2017). In the PPP procurement phase, good governance environment will increase project investors' expected utility, but poor governance environment may increase their extrabudget expenditures and reduce the expected gains. Confronting the expected gains, investors are unwilling to give up what they will have and act in a risk-averse way. People can experience loss aversion for goods they never owned (Novemsky and Kahneman, 2005). Therefore, the governance environment may be the moderator of loss aversion.

2.2.1. Control of corruption and risk allocation

Corruption has been broadly defined as the misuse of public offices for private gain (Neshkova and Kostadinova, 2012), including petty and grand forms of corruption, as well as "capture" of the state by elites and private interests (Kaufmann et al., 2011; Thomas, 2010). Generally, high levels of corruption distort government decision-making and increase market risks (e.g., immature juristic system risk and illegal risk), thereby affecting private investors' decisions. Compared with developed countries, corruption is viewed as a major barrier to development and negatively impacts the level of domestic private investment and foreign direct investment (FDI) in developing countries (Pusok, 2016). Therefore, a country with high level of corruption has increased risk for

private investors doing business with such governments, hindering and damaging private sectors' investment in PPP projects. For example, certain PPP projects are opposed politically, possibly induced by allegations of corruption in developing countries (e.g., Ghana) (Osei-Kyei and Chan, 2017). In China, private investors are under great pressure to spend a great deal of money to establish the culture of *guanxi* (relationship) with local governmental officers, and this has hampered the investment efficiency (Chan et al., 2015). In Eastern European countries, administrative reform facilitates transparent governance, which contributes to curbing corruption and attracting foreign investment (Neshkova and Kostadinova, 2012). Hence, the second hypothesis follows:

Hypothesis 2. *The effect of H1 is intensified in countries with greater control of corruption.*

2.2.2. Government effectiveness and risk allocation

Government effectiveness represents the quality of public services and the capacity of governments. Government effectiveness also reflects the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (Kaufmann et al., 2011; Thomas, 2010). Highly valued government effectiveness indicates that the government adopts effective and proactive managerial behaviors, actions, and strategies to elicit high performance in various economic sectors (Panayides et al., 2015). PPP projects involve long-term collaboration. If developing countries' governments have a fragmented administrative structures, and low technical and management capacity of the relevant organization would cause private partners to assume more risk to negotiation with the government (Mathur, 2017). Higher risk (e.g., poor political decision-making risk, government-intervention risk, and improper-contracts risk) leads to prudent investments for private investors (Janssen et al., 2016). Therefore, it is unsurprising that ineffective governments often have few PPP projects and few private investments. For example, private investment in public services is far from enough to satisfy the needs for sub-Saharan African countries (e.g., Ethiopia) due to their poor capacity in managerial and technical expertise (Shiferaw et al., 2012). On this basis, this paper hypothesizes that government effectiveness would be the moderator.

Hypothesis 3. *The effect of H1 is intensified in countries with higher government effectiveness.*

2.2.3. Political stability and risk allocation

Political stability means government's durability and integrity; such a government would not be destabilized by unconstitutional or violent means (Kaufmann et al., 2011). Political stability is quite vital, because stability provides favorable securable investment environments (Cheung et al., 2012). Political instability causes the application of PPPs in transition countries (e.g., countries in the central and western part of Africa, South East Asia, and the Middle East) to be slow and limited (Osei-Kyei and Chan, 2017). For example, political instability in Thailand (e.g., a fragile political coalition with

---
[6] http://info.worldbank.org/governance/wgi/index.aspx#home.

governments holding about one-year terms of office) was a major obstacle to the use of the Build-Operate-Transfer (BOT) undertaking (Tam, 1999). Political crisis in Libya in 2011 has caused large financial damages of foreign investors (e.g., Chinese constructors) in infrastructure sectors. The political instability made a tougher business climate and leaded to reduction of private investment (Zhang and Wei, 2012). If a country had a more stable political environment, private sectors would be likely to invest because political stability can reduce nationalization risk, currency risk, inflation risk, financing risk, payment risk, and so on. Therefore, the fourth hypothesis that can be inferred from the above theories follows:

Hypothesis 4. *The effect of H1 is intensified in countries with higher political stability.*

2.2.4. Regulatory quality and risk allocation

Regulatory quality is the ability of government to provide effective regulations that permit and promote private sector development (Kaufmann et al., 2011). In public and private collaboration, governments not only provide service for private sectors, but also to monitor the market (e.g., price regulation). Therefore, a sound regulatory institution and environment is essential (Pongsiri, 2002). High quality regulation provides the basis for the development of private capital, protects the private sector's rights and property, and respects contractual agreements. Petersen (2010) found that regulatory difficulties caused PPPs in Denmark to fail to begin. In PPP markets, a country's regulatory institution can safeguard the PPP contractual agreement to reduce risks assumed by private partners (e.g., uncompetitive tender risk, operation cost overrun risk, and opportunistic behavior risk). For instance, in 2001 Brazil established a regulatory agency to monitor irresponsible behavior of governments and markets to avoid situations of inappropriate risk allocation (Queiroz et al., 2013). Unbiased and non-discriminative regulatory policies in Indonesia sustained the long-term partnerships, and increased the chance to achieve a more successful partnership (Abednego and Ogunlana, 2006). Thus, regulatory quality will be a positive determinant to attract private investors by reducing private investor risks:

Hypothesis 5. *The effect of H1 is intensified in countries with higher regulatory quality.*

2.2.5. Rule of law and risk allocation

Rule of law is the extent to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement, property rights and judicial independence (Kaufmann et al., 2011; Thomas, 2010). Rule of law means governments treat public and private sectors equally when disputes arise caused by an unforeseen event (Baker, 2016). A clear legal institutional framework offers private partners certainties about the legal protections they may expect (Koppenjan and Enserink, 2009). If a country or a region does not obey the law, it increases risk for private companies engaging in the PPP market (e.g., change in law risk, immature juristic system risk, payment credit risk, and tariff change risk). For

example, South Korea has substantially strengthened the legal framework for PPPs to prevent the PPP failure. Taiwan has officially released the "Act for the Promotion of Private Participation in Infrastructure Projects", thus its development of PPPs is progressing rapidly. Although China's central government has not issued a central PPP law, many PPP policies have been released to govern and standardize the procurement process to reduce cooperation risks. In sum, because of the laws, PPPs have been successful in the Asia-Pacific region (Chou and Pramudawardhani, 2015). Higher rule of law can protect markets from expropriation risk, thereby fulfilling concession contract agreements, which would help increase private investors' confidence and attract more private participation.

Hypothesis 6. *The effect of H1 is intensified in countries with higher compliance with the law.*

2.2.6. Voice and risk allocation

Voice means a country's citizens are able to participate in selecting their government, and participate in the decision-making process of their government, as well as having freedom of expression (Kaufmann et al., 2011). Voice also reflects whether citizens can hold governments accountable for actions taken (Panayides et al., 2015). Through public participation, governments, markets, and society can know citizens' voice (e.g., views and needs). Some studies show that public involvement can improve support from citizens and political leaders for PPPs in the US transportation sector, thereby attracting more private investment (Boyer et al., 2016). However, Osborne (2010) pointed out that governments very seldom invite the public to have their say in the process of PPPs, especially in developing countries. Clearly, in the planning, tendering, and contracting stages of PPPs, limited opportunities for citizen voice in China would increase the risk of ignoring public interest (Chen et al., 2013). Lack of public engagement would transfer more risk to private partners (e.g., public/political opposition risk). In sum, in developing countries, the citizen and private sector's concerns for transparency and accountability need to be accommodated, and the private sector needs reassurance about the safety of investments (Jamali, 2004). With public participation, PPP projects can minimize the risk of conflicts with critical stakeholders like customers and non-governmental organizations (NGOs) (Jones, 2001). Therefore, the seventh hypothesis, inferred from the above studies, follows:

Hypothesis 7. *The effect of H1 is intensified in countries with higher voice.*

Considering each of the above factors, Fig. 1 depicts the analytical framework. This paper is a correlational field research, which is an empirical design to test a research question. According to the research questions, several independent, dependent, moderators and control variables combine to form research hypotheses. Then, methods are selected to help test hypotheses, and answer the research question.
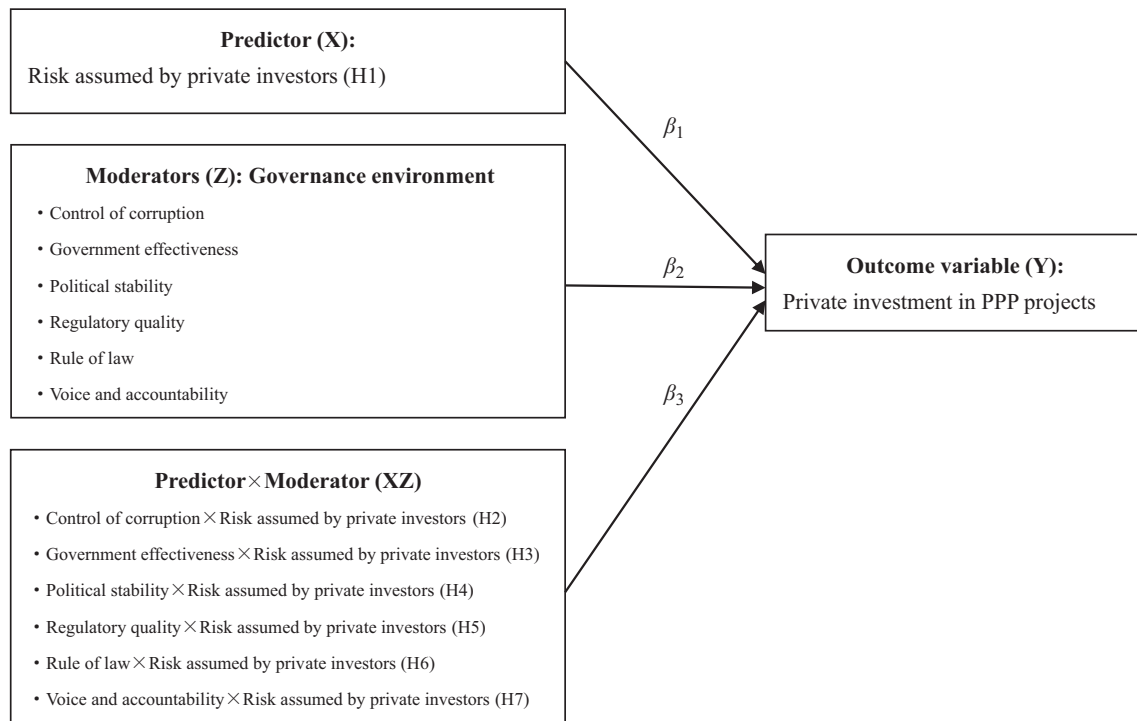
Fig. 1. Research framework. Note: The basic moderation model: $Y = a + \beta_1 X + \beta_2 Z + \beta_3 XZ + e$. Where β_1 is the coefficient relating the predictor variable, X, to the outcome, Y, when Z = 0. β_2 is the coefficient relating the moderator variable, Z, to the outcome Y, when X = 0. β_3 is the coefficient relating the interaction variables, XZ, to the outcome Y. β_3 provides an estimate of the moderation effect. a is the intercept in the equation, and e is the residual in the equation.

3. Variables, data and method

3.1. Dependent variable: private investment in PPP projects

This paper explores risk allocation and governance impact on private investment in developing countries. Private investment in a PPP project is measured as the percentage of Special Purpose Vehicle (SPV) owned by private sponsors (*percentage private*) (Panayides et al., 2015). A SPV is a legal entity created for narrow, specific or temporary objectives. A higher percentage of the SPV owned by private sponsors means higher degrees of private investment. The dependent variable data (*percentage private*) comes from the PPI database. The value of *percentage private* ranges from 0% to 100%. The entry of each PPP project in the PPI database yields the percentage of private equity of project investment.

3.2. Independent variable: risk allocation

The independent variable is risk allocation. Contracts display various risk assumptions that can be displayed in contracts because contracts define residual control rights. Residual control rights indicate control of ownership, and ownership determines who assumes risk and who benefits from service delivery (Hefetz and Warner, 2012). The higher the degree of residual control rights and ownership, the higher the degree of risk assumption. A private investor who assumes greater risk would have more residual control rights over the asset.

According to the PPI database, PPP contracts can be classified into 10 subtypes and grouped into three categories

(see Appendix Table A1). These PPP contracts can be ranked by risk transfer from governments to private partners. Table 1 shows the PPP risk ranking index. The index is a subjective ranking of risk transfer across types of PPPs. A higher index indicates a higher degree of risk transfer from public to private partners. For the type of contracts: (1) the risk transfer indices of management and lease contracts are 1 and 2 respectively. Private investors do not have ownership; rather, they are only responsible for operations and maintenance risk over a short time (e.g., 3–5 years). (2) The indices of rehabilitate-operate-transfer, rehabilitate-lease/rent-transfer and build-rehabilitate-

Table 1
Classification of PPP contracts according to risk transfer.

Type	Subtype	Risk ranking index for the subtype
Operations and maintenance (public ownership of the facilities)	Management contract	1
	Lease contract	2
Concessions (public ownership of the facilities)	Rehabilitate-operate-transfer (ROT)	3
	Rehabilitate-lease/rent-transfer (RLT)	4
	Build-rehabilitate-operate-transfer (BROT)	5
Greenfield projects (private ownership of the facilities)	Build-lease-transfer (BLT)	6
	Build-operate-transfer (BOT)	7
	Build-own-operate (BOO)	8
	Merchant	9
	Rental	10

Source: Adapted from Percoco (2014) and Zhang (2014)

operate-transfer are 3, 4 and 5 respectively. Private investors do not have ownership, but they are responsible for operation and maintenance risk over a long period (e.g., 20–30 years). (3) The indices of build-lease-transfer, build-operate-transfer, build-own-operate, merchant and rental are 6, 7, 8, 9, and 10 respectively. Private investors have ownership over a long period (e.g., 20–30 years), and are responsible for building, operating, and maintaining risk during this period.

This paper used the subjective ranking index to stand for risk allocation for two reasons. First, the subjective ranking index of risk transfer has an advantage. For example, according to the type of contract, it can reflect the risk allocation from a macro perspective. Thus, the ranking index can make a risk-allocation comparison among PPP projects and provide the possibility for large-N sample studies. Second, previous studies has used the same research design (Percoco, 2014; Zhang, 2014; Wang et al., 2018). For instance, Wang et al. (2018) used the subjective ranking index to compare China's PPP projects risk allocation.

3.3. Moderate variable: six dimensions of governance environment

A moderator is a variable that influences the strength or direction of relationships between independent and dependent variables (Tharenou et al., 2007, p.52). In this paper, moderator variables are governance-environment factors, operationalized using the World Bank's WGI database: *control of corruption, government effectiveness, political stability and absence of violence, regulatory quality, rule of law,* and *voice and accountability*. The data on those factors combine the views from a variety of credible sources (enterprise, citizen and expert survey respondents in industrial and developing countries), and are produced by a variety of survey institutes, think tanks, NGOs, international organizations, and private sector firms[6]. Those indicators have been scrutinized by academics and policymakers, and found to have validity and reliability (Panayides et al., 2015). The value of these indicators ranges from 0 (poor performance of governance) to 100 (strong performance of governance). This paper uses the natural logarithm of these scores to represent moderator variables.

3.4. Control variables

Control variables include two aspects: project-specific and country-specific. Project-specific variables are variables from a micro-perspective to depict PPP project information. Country-specific variables are variables from a macro-perspective to depict a country's situation.

3.4.1. Project-specific variables

3.4.1.1. PPP experience. Earlier experiences of PPP adoption by the state affect the probability of attracting private investment to PPPs, because the government can learn about earlier PPP experiences. Two variables measuring past PPP experiences of a country were created: *success* and *failure*. *Success* counts the number of projects "concluded" in the

country of the PPP at the moment of the PPP's financial closure; in contrast *failure* counts the number of projects "cancelled/distressed" in the country of the PPP at the moment of the PPP's financial closure. If a country has no prior experience, the variable is set to 0 (Galilea and Medda, 2010). The entry for each PPP project in the PPI database shows the project status, including active, cancelled, concluded and distressed.

3.4.1.2. Concession duration. This indicator measures if the *contract period* impacts private investment. Longer PPP contracts may allow investors control of the infrastructure asset for a greater period of time, and easily argued, is to the private investor's advantage. However, Wang et al. (2018) show a negative significant correlation between length of contract and private investment. The possible reason is that if a PPP project has a longer concession duration, it means the private consortium needs a longer period to recover its investments. Therefore, a long contract period hinders private investment. The entry for each PPP project in the PPI database shows the contract period of the project.

3.4.1.3. Number of sponsors. This control variable captures the effect of *the number of private sponsors* in a PPP project (Galilea and Medda, 2010). Large numbers of investors form big conglomerates, usually associated with higher complexity, increased need for coordination, and, in turn, increased transaction costs (Blaka, 2017), thereby decreasing the attractiveness of private participation. A consortium with a *foreign private sponsor* has a greater chance of attracting more private investment because the existence of multinational enterprises can indicate a more open market for investors. This is a dummy variable. If a project has a foreign investor, the value of *foreign sponsor* is 1; 0 otherwise. The entry of each PPP project in the PPI database shows the number of sponsors, the names of the sponsors and whether they are foreign companies.

3.4.1.4. Multilateral lenders. This variable reflects whether *multilateral lenders* (e.g., World Bank and Asian Development Bank) participate in a particular PPP project. Normally, multilateral lenders have ample resources (e.g., funds and technology) to support PPP projects. This is a dummy variable. *Multilateral lenders* in a PPP project were assigned 1; 0 otherwise. The entry for each PPP project in the PPI database shows whether there are multilateral banks to support the project.

3.4.2. Country-specific variables

3.4.2.1. Economic growth. This variable was measured as average annual *GDP growth* one year before of the financial closure of the PPP contract. A higher degree of GDP growth means a higher degree demand for private investment in infrastructure. This is a dummy variable. If the GDP growth is negative, the value of this dummy is 0. If GDP growth is between 0 and <3%, the value is 1; between 3 and 6%, the value is 2; if it more than or equal to 6%, the value is 3 (Galilea and Medda, 2010). Data come from World Bank's World

Development Indicators (WDI). Indicators in the WDI are compiled from officially-recognized international sources[7].

3.4.2.2. Country's income. This study argues that richer countries rely less on private investment in developing countries, because these countries have sufficient government funds for infrastructure development. Developing countries can be classified in three groups based on per capita income: *low-income; lower middle-income; and upper-middle-income.* This control variable is a dummy. The upper-middle-income variable was 1 if the PPP project was in an upper-middle-income country, 0 otherwise. The entry for each PPP project in the PPI database shows in which country the project located, and the income level of the country.

3.4.2.3. Country's region. Regions where PPP projects are located usually have various cultural and socioeconomic characteristics. Some regions have more successful PPP experiences and more reliance on private investment than others. For instance, Latin America and the Caribbean region received 50% of worldwide private capital flows to infrastructure sectors during the 1990s (Galilea and Medda, 2010), implying this region has more experience attracting private investment. This paper created three dummy variables: *Asia* was 1 if the PPP project was in southern Asia, eastern Asia, and the Pacific region, 0 otherwise. *Africa* was 1 if the PPP project was in Sub-Saharan Africa, the Middle East, or northern Africa regions, 0 otherwise. *Latin* was assigned 1 if the PPP project was in Latin America and the Caribbean region, 0 otherwise. PPP projects in Europe and Central Asia regions were taken as the base case, represented when the three dummy variables became 0 (Galilea and Medda, 2010). The entry for each PPP project in the PPI database shows in which region the project was located.

3.5. Data sources

Three sets of data were used in this study: the PPI, the WGI and the WDI. In particular, the dependent variable came from the PPI, the independent variable from Percoco (2014) and Zhang (2014), and moderator variables from the WGI. One control variable (economic growth) came from the WDI; others came from the PPI. Because of missing values in the above variables in some countries and in some years, the final cross-sectional data include projects in 138 developing countries from 2001 to 2015. These developing countries are distributed in Africa, Asia, Latin America, and the Middle East. The year means the date of PPP financial closure, representing the amount of private investment stated in the final contract (Panayides et al., 2015). Country specific control variables are in the year preceding financial closure of the PPP contract. Therefore, variables from the WDI are from 2001 to 2014, and variables from the PPI and WGI are from 2002 to 2015. Descriptive statistics of all variables appear in Table 2.

The PPI data system is the most comprehensive catalog of PPP projects available in developing countries, and represents the best efforts of the World Bank to compile publicly available information on those projects. Every project record includes country, region, financial-closure year, primary sector, project status, type of private participation, private sponsors, private ownership, total investment, direct government support, indirect government support, award method (e.g., tendering and negotiation), contract period, multilateral lenders, and so on. Publicly available longitudinal and horizontal data on countries' PPP projects are quite limited; thus, the PPI database provides a remarkable window into PPP projects around the world. Like all data sets, the PPI data system has flaws. Some projects (particularly those involving local and small scale operators) tend to be omitted because they are usually not reported by major news sources; thus, their records are incomplete. This study only drew PPP projects with complete records.

The WGI data system has the advantage of measuring different dimensions of the institution, allowing us to study whether some dimensions of the institution matter for private investment, whereas others do not have that advantage (Daude and Stein, 2007). WGI data sources include surveys of firms and households, as well as subjective assessments of a variety of commercial business-information providers, NGOs, and a number of multilateral organizations and other public sectors (Kaufmann et al., 2011).

The combining of PPI, WDI, and WGI data has the following advantages. First, if the dependent and independent variables were from the same data, this method would cause common-source bias. Thus, the mixed qualitative and quantitative data can address this correlated measurement error. Second, the combining of different kinds of data can make possible a large-N sample study.

3.6. Estimation strategy

The dependent variable, *percentage private*, is a ratio from 0 to 100%. The appropriate statistical model is the Tobit regression model (also called a censored regression model), designed to estimate linear relationships between variables with either left- or right-censoring in the dependent variable (also known as censoring from below and above, respectively). In this paper, all data are at 0 or above 0. Thus, censoring from above takes place. Therefore, this paper applies Tobit model regression.

Dependent (private investment) and independent variables (risk allocation) are at the project-level. Their relationship may have an endogeneity problem. In particular, private-investment decisions may affect a project's risk-allocation strategy ("reverse" causation). To address the possible endogeneity and measurement error biases of the regression model, an increasing number of studies since the 1970s have turned to instrumental variables regression (IV regression). The main requirement for using IV is that the IV should correlate with the endogenous independent variables. If this correlation is strong, then IV is said to have a strong first-stage.

---

[7] http://data.worldbank.org/data-catalog/world-development-indicators.

Table 2
Descriptive statistics.

	Variables	Source	Obs	Mean	S.D.	Min	Max
Dependent variable	Percentage private	PPI	4563	0.925	0.182	0.050	1.000
Independent variable	Subtype	Percoco (2014); Zhang (2014)	4563	6.839	2.1837	1	10
Moderator variables	ln(Control of corruption)	WGI	4556	3.642	0.540	−0.747	4.519
	ln(Effectiveness)	WGI	4554	3.873	0.470	−0.723	4.475
	ln(Political stability)	WGI	4550	3.138	0.761	−0.747	4.561
	ln(Regulatory quality)	WGI	4560	3.791	0.465	−0.747	4.537
	ln(Rule of law)	WGI	4553	3.714	0.500	−0.737	4.494
	ln(Voice and accountability)	WGI	4561	3.361	0.974	−0.756	4.493
Control variables (project specific)	Success experience	PPI	4563	335.00	328.05	0	1213
	Failure experience	PPI	4563	15.105	13.868	0	42
	Contract period	PPI	4563	22.807	9.451	1	99
	Sponsors	PPI	4559	1.330	0.703	0	9
	Foreign sponsor	PPI	4559	0.395	0.489	0	1
	Multilateral lenders	PPI	4563	0.108	0.310	0	1
Control variables (country specific)	GDP growth	WDI	4562	2.392	0.833	0	3
	Country's income	PPI	4563	0.375	0.484	0	1
	Country's region (Asia)	PPI	4563	0.518	0.500	0	1
	Country's region (Africa)	PPI	4563	0.104	0.305	0	1
	Country's region (Latin)	PPI	4563	0.269	0.444	0	1

Notes: PPI = private participation in infrastructure, WGI = Worldwide Governance Indicators, WDI = World Development Indicators.

This paper creates risk allocation at the sector-level as the IV in the Tobit regression model. Sector-level risk allocation (*subtype-IV*) is exogenous to private investment decisions at the project-level. The project-level risk-allocation strategy (*subtype*) is often influenced by its sector's risk allocation (*subtype-IV*). The index of sector-level risk allocation (e.g., transport, water and sewerage, energy, and information communications technology sectors) in a country can be calculated as follows: First, a project's investment accounts for the proportion of total investment in all projects in the sector as a weight coefficient; second, sector-level risk allocation (*subtype-IV*) in a country accrues from the average value of the weight coefficient times

the index of *subtype* for every project. This is an IV-estimation strategy, often used in political science and social science to address the endogeneity problem (Sovey and Green, 2011).

4. Results

4.1. Empirical findings

This study investigated the effects of risk allocation and governance environment on private investment in PPP projects. The empirical models appear in Tables 3 and 4. In particular, Table 3 shows a basic relationship and IV-estimation

Table 3
Effect of risk allocation on private investment: Basic relationship and IV-estimation.

Variables	Model 1a	Model 2a	Model 3a
	Tobit	Tobit	IV-Tobit
Subtype		−0.075*** (0.007)	−0.245*** (0.016)
Success experience	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)
Failure experience	−0.003** (0.001)	−0.002*** (0.001)	−0.002** (0.001)
Contract period	−0.012*** (0.002)	−0.013*** (0.001)	−0.012*** (0.001)
Sponsors	0.022** (0.021)	0.003** (0.021)	0.020 (0.028)
Foreign sponsor	0.150*** (0.030)	0.149*** (0.030)	0.140* (0.030)
Multi lenders	0.028* (0.045)	0.030** (0.044)	0.031*** (0.045)
GDP growth	0.064 (0.020)	0.058** (0.020)	0.065 (0.021)
Country's income	0.150*** (0.042)	0.149*** (0.044)	0.194*** (0.044)
Asia region	0.044 (0.060)	−0.007 (0.059)	−0.014 (0.061)
Africa region	−0.083 (0.059)	−0.151** (0.058)	−0.054 (0.059)
Latin region	0.237*** (0.052)	0.175*** (0.051)	0.228*** (0.052)
Trend	0.083** (0.004)	0.062*** (0.004)	0.064*** (0.004)
Cons	1.597*** (0.078)	2.214*** (0.101)	1.650*** (0.080)
Observations	4558	4558	4558
Pseudo R-squared	0.310	0.343	
DWH Chi^2			10.97***
First-stage F-value			84.66
IV t-value			11.08

Notes: DWH = Durbin-Wu-Hausman. Standard errors are in parenthesis below the coefficient. *, ** and *** denotes 10%, 5% and 1% level of significance, respectively.

Table 4
Moderate effect of governance environment and risk allocation on private investment (IV-Tobit regression).

	Model 1b	Model 2b	Model 3b	Model 4b	Model 5b	Model 6b
Subtype	−0.814*** (0.178)	−1.393*** (0.254)	−0.435*** (0.120)	−1.264*** (0.237)	−0.705*** (0.199)	−0.049 (0.074)
ln(Control of corruption)	0.303** (0.148)					
Subtype*ln(Control of corruption)	0.130*** (0.049)					
ln(Effectiveness)		−0.735*** (0.197)				
Subtype* ln(Effectiveness)		0.271*** (0.065)				
ln(Political stability)			0.261** (0.110)			
Subtype* ln(Political stability)			0.030 (0.036)			
ln(Regulatory quality)				0.657*** (0.191)		
Subtype* ln(Regulatory quality)				0.242*** (0.062)		
ln(Rule of law)					0.257 (0.159)	
Subtype* ln(Rule of law)					0.097** (0.053)	
ln(Voice and accountability)						0.467*** (0.070)
Subtype* ln(Voice and accountability)						0.123 (0.023)
Cons	3.720*** (0.557)	5.497*** (0.780)	3.482*** (0.381)	5.129*** (0.744)	3.594*** (0.598)	1.113*** (0.238)
Project specific control variables	yes	yes	yes	yes	yes	yes
Country specific control variables	yes	yes	yes	yes	yes	yes
Observations	4551	4549	4545	4555	4548	4557
DWH Chi^2	17.20***	16.95**	17.28***	16.88***	17.20**	16.07***
First-stage F-value	86.57	85.02	88.43	85.50	86.21	85.00
IV t-value	9.44	9.86	9.09	9.12	9.65	9.31

Notes: Standard errors are in parenthesis below the coefficient. *, ** and *** denotes 10%, 5% and 1% level of significance, respectively.

between risk allocation and private investment. Model 1a consists of control variables only and demonstrates the appropriateness of the control variables chosen to estimate the dependent variable (*percentage private*). Model 2a reports the results of Tobit regression among the dependent variable, independent variable (*subtype*), and all control variables without controlling for endogeneity and measurement biases. In model 3a, to address possible endogeneity and measurement error biases, this paper added the *subtype-IV*. In model 3a, the Durbin-Wu-Hausman (DWH) Chi^2 test is significant ($p < .01$), which means endogeneity exists between the independent and dependent variables. The first-stage F-value (84.66) is larger than the critical value of 16.38, which is supported by Stock and Yogo (2005). This indicates that *subtype-IV* is an effective instrument variable for the *subtype* variable. In model 3a, risk transfer to private partners has a negative impact on private investment ($\beta = -0.245, p < .01$), which means more risks assumed by private partners would hinder their investment. Thus, *hypothesis 1* is supported.

For control variables, the *contract period* ($\beta = -0.012$, $p < .01$) has negative impacts on private investment, which means long-term contract duration would hinder private investment. The possible reason is that a long-term contract means a large scale and complex project. A large project needs huge investment, more professional technique, and risk-management methods, but private investors do not have the capacity to do it. *Failure experiences* ($\beta = -0.002, p < .05$) also have negative impacts on private investment. However, successful experiences were insignificant. Unsuccessful PPP projects in the past indicated governments engendered long-lived negative perceptions of their operations and management of PPP projects, thereby discouraging future private investments (Galilea and Medda, 2010). According to the prospect theory, individuals are loss averse, because disadvantages of losing it loom larger than advantage of getting it. Losses hurt more than equal gains (Baekgaard, 2017).

Foreign sponsor ($\beta = 0.140, p < .1$), *multi lenders* ($\beta = 0.031$, $p < .01$), *country's income* ($\beta = 0.194, p < .01$), and the *Latin region* ($\beta = 0.228$, $p < .01$) have positive impacts on private investment. The engagement of foreign investors and multi lenders in an SPV can attract private investment, perhaps because it indicates a more open society, where foreign investors and foreign financial institutions may wish to support local infrastructure development. For country-specific variables, private investors prefer to invest in a richer country that has sufficient financial resources to support PPP projects. In addition, the *Latin* region has more experience attracting private investment; this is an important factor in attracting private investment.

Table 4 examines the moderating effects of governance environment on the relationships between risk allocation and private investment. Six models (1b-6b) tested the interaction between six dimensions of governance environment and risk transfer, respectively. The six models detected significant moderating effects for the positive interaction between *control of corruption* and risk transfer ($\beta = 0.130, p < .01$), *government effectiveness* and risk transfer ($\beta = 0.271$, $p < .01$), *regulatory quality* and risk transfer ($\beta = 0.242$, $p < .01$), and *rule of law* and risk transfer ($\beta = 0.097$, $p < .05$). These results show that negative effects of risk assumed by private partners on private investment decreases with a good institutional environment (e.g., control of corruption, high level of government effectiveness, good regulatory quality, and abiding by rule of law). In other words, private investors assuming low risk encourages more private investment in PPP projects, intensified by a higher governance environment. These findings indicate that investors are more likely to reduce risks when they face expected gains in a good governance environment, and confirm that the governance environment plays the moderator for the effect of risk aversion. Thus, *hypotheses 2, 3, 5, and 6* were supported. However, the interaction between *political stability* and risk transfer, and *voice and risk transfer* were not significant. These two governance

indicators cannot enhance or dampen the negative influence of risk allocation on private investment. Therefore, **hypotheses 4 and 7** were not supported.

4.2. Empirical findings in different sectors

This study tried to distinguish between empirical findings in various sectors. Then it discerned if the governance environment had the same impact on the relationship between risk allocation and private investment in all sectors or only in one sector. Appendix Table A2 (Models 1c-6c) shows empirical findings in four sectors: energy, transport, water and sewerage, and information communications technology (ICT). Findings follow:

First, according to Appendix Table A2, *control of corruption* (Model 1c), *government effectiveness* (Model 2c), and *rule of law* (Model 5c) significantly impact the relationship between risk allocation and private investment in all sectors. These findings are consistent with whole-sample results in Models 1b, 2b, and 5b shown in Table 4. These findings mean that the above three governance environments should be improved in all sectors. Second, a significant moderating effect was detected for the positive interaction between *voice* and risk transfer in the transport sector ($\beta = 0.124$, $p < .1$) and ICT sector ($\beta = 0.106$, p < .01) in Model 6c. However, the whole-sample results shown in Table 4 (Model 6b) show that the moderating effect of *voice* is insignificant. These findings mean that the transport and ICT sectors should improve the quality of public participation. Third, the moderating effect of *regulatory quality* is significant in energy ($\beta = 0.219$, p < .01), transport ($\beta = 0.219$, p < .01) and ICT ($\beta = 0.374$, p < .01) sectors, but is insignificant in the water and sewerage sector (Model 3c). The whole-sample results shown in Table 4 (Model 4b) show that the moderating effect of *regulatory quality* is significant. These findings mean that the energy, transport, and ICT sectors should improve in their regulatory quality. Finally, the moderating effect of *political stability* in every sector remained insignificant. This finding is consistent with results shown in Table 4 (Model 3b). A possible reason is that political stability is not easy for governments to control.

4.3. Robustness checks

This study performed some robustness checks to validate the results and assess their consistency. The robustness check examines how certain core regression coefficient estimates behave when the regression model is modified by adding, removing, or changing variables (Lu and White, 2014). For parsimony, this paper did not tabulate outcomes but summarized them below (Panayides et al., 2015). This research assessed robustness in two ways. First, the robustness of the findings was tested by changing methods. Because the dependent variable was the ration from 0 to 100%, this paper re-ran the regression adopting the generalized linear model (GLM) proposed by Papke and Wooldridge (1996). Comparing the two models adopted (Tobit and GLM models), significant consistency emerged. The independent variable (*subtype*) and moderator variables (*control of corruption*, *government effectiveness*, *regulatory quality*, and *rule of law*) have significant and correctly signed coefficients.

Second, the robustness of the findings was tested by changing data for the moderating variables. In the WGI database, governance environment indicators can be viewed as a percentile rank, ranging from 0 to 100, or a standard normal distribution, ranging from −2.5 (poor performance) to 2.5 (strong institutional performance). In Tables 3 and 4, governance-environment indicators were in the form of percentile rank from 0 to 100. The robustness checks used the data of standard normal distribution (−2.5 to 2.5) to replace the data of percentile rank to check regression consistency. The outcomes of the Tobit regression fully confirmed results disclosed in Tables 3 and 4.

5. Discussion and conclusion

This study analyzed the effect of risk allocation and institutional factors on private investment in PPP projects in developing countries using the PPI, WGI and WDI indicators provided by the World Bank. The study results demonstrate the significant negative relationship between risk assumed by private partners and private investment. In particular, results showed that the larger the private investment in PPP projects, the lower the risk assumed by private partners. This result is in line with prior findings in port literature (Percoco, 2014).

In addition, the statistical models indicate significant interactions between governance and risk allocation in developing countries. Overall, results showed that a better governance environment in developing countries leads to less risk assumed by private partners, thereby attracting larger private investment. Specifically, first, controlling corruption in a developing country can reduce the negative relationship between risk allocation to private partners and private investment. Private investors have to make illegal exchanges or undertake bribery to win bidding in a country with higher levels of corruption, which increases their illegal risk in the future. To mitigate illegal risk, private sectors reconsider where and how to allocate their investments. For instance, when corruption is high, private investors will pursue profit maximization over public needs, which leads investments in sanitation to be low (Pusok, 2016). Second, higher government effectiveness in a developing country dampens the negative influence of risk allocation on private investment. Prior studies showed that a government with lower effectiveness is often forced to leave the majority of investments to private investors (Panayides et al., 2015), but findings from the present research indicate that, due to the higher risk assumed by private partners, countries have difficulty attracting private investment. Third, regulatory quality in a developing country dampens the negative relationship between risk allocation and private investment. Regulation in PPP projects includes oversight of pricing, quality standards and the rate of earned returns (House, 2016). Thus, good regulation can protect private partners against arbitrariness and opportunism risks. Fourth, rule of law in a developing country dampens the negative relationship between risk allocation and private investment because law can uphold the credible commitment between public and private partners, thereby reducing risks of future defection, and attracting private investment.

It is necessary to distinguish between the moderating effect of governance on the relationship between risk allocation and private investment in various sectors. *Control of corruption,*

government effectiveness, and *rule of law* significantly have moderating effects in all sectors. All sectors should improve these three kinds of institutional environments. Also, the energy sector needs to enhance *regulation quality*, such as the supply of electricity at reasonable prices, the licensing of any electrical installations, and the control of any electrical plant and equipment relating to the safety of persons (Urpelainen and Yang, 2017). Transport and ICT sectors should pay greater attention to improving *regulation quality* and *voice.* These two sectors also need to regulate equipment relating to the safety of people. Public facilities in these two sectors seem to need more public participation, because transport and ICT projects are often built inside cities. The construction and operation process influences the daily travel and life of local citizens.

This paper makes some theoretical contributions to the extant literature. The first theoretical contribution is for the study of project risk management. Previous project management studies considered the governance environment as macro-risk, such as policy risk and political risk (Wang et al., 1999). Those studies used case studies, questionnaires, or interview methods to discuss risk identification (e.g., policy risk, demand risk, and construction risk), risk evaluation, risk allocation, risk management, and how each risk impacts private investment respectively (Ke et al., 2009; Loosemore, 2007; Keers and van Fenema, 2018; Shrestha et al., 2017). However, those different kinds of risk may interact with each other and transmit risk. For example, macro-risk (e.g., policy risk and political risk) may affect micro-risk allocation (e.g., demand risk and construction risk). Thus, this paper used a large-N sample to test risk interactions. The findings have enriched previous PPP risk studies in the project management literature by showing the interaction between macro and micro risks.

The second theoretical contribution is to uncover different interaction effects between governance and risk allocation on private investment in four sectors. The value of this study is not only to shine a particular light on governance environment and risk allocation factors that simultaneously influence project investment, but also to identify what types of governance are effective in which sectors. Hence, this study complements current project management literature on risk allocation and management by comparing the difference between sectors.

These results also have relevant managerial implications for PPP project key players (e.g., project owner, project sponsor, and project manager) in developing countries.

First, the findings provide guidance for local governments in designing risk management policy so as to attract private investment in developing countries. Specifically, on the micro-project level, project owners should consider risk allocation, risk mitigation, and risk monitoring. Risks should be allocated to the party best able to control the occurrence and the consequences. Project owners may take a series of actions to design an effective risk allocation plan that the key players can accept, such as negotiating with project sponsors and project manager, conducting expert surveys, inviting public participation to seek for suggestions, and learning experiences from other PPP projects. On the macro-institution level, project owners need to improve their governance environment in various sectors, including a strong and effective legal environment, a good PPP-regulation framework, a fair and transparent competition market, and a proper judicial system. For instance, if a local government has a PPP law (e.g., the state of Texas in America), then it can shape the legal and regulatory environment within the jurisdiction for the PPP development (Wang, 2015). Therefore, the project owners should recommend legislatures to issue PPP relevant legislation. The United Nations Commission on International Trade Law has published a legislative guide on privately funded infrastructure projects in 2000, and the American National Conference of State Legislatures has released a toolkit for PPP legislators in 2010, which may provide expert frameworks to guide PPP law.

Second, these findings provide guidance for project sponsors or funders before they make the final decision to start a PPP initiative. In PPP projects, the main project sponsors (e.g., construction companies, operator companies, and banks) are domestic private investors and foreign investors. They often create a consortium to submit a bid, and have been awarded the tender by the local governments (project owners) (Carpintero and Petersen, 2015). To reduce risk and gain equity return, project investors should consider the governance environment of a developing country where a project is located. Lower levels of governance environment would increase investment risks. This is very important for a transnational investment, especially when planning to invest in an unfamiliar developing country. For example, unpredictable political risk in Libya in 2011 has led to tangible and intangible losses for Chinese project investors (Zhang and Wei, 2012). The Libyan crisis taught Chinese investors to avoid blind transnational investment in host countries and buy political risk insurance. Besides, if project investors intend to bid for PPP projects in a country with poor governance environment (e.g., lack of PPP law), they should try to sign a more detailed and complete concession contract with local government, and pay more attentions to the project viability (Zhang et al., 2015).

Third, the results show that project managers should focus on the management of risks. Project funders are often unable to involve themselves in particular projects (Zwikael and Smyrk, 2015), and they set up the SPV to manage the PPP project. The project manager in the SPV acts on behalf of the funders. If project managers take too many risks, PPP performance is eroded, especially for varying dimensions of governance environment in different sectors. According to our empirical findings in various sectors, project managers in the energy sector should pay more attention to the impacts of corruption, government effectiveness, regulation, and rule of law. In contrast, project managers in the water sector should address concerns about the impacts of corruption, government effectiveness, and rule of law. Besides, project managers should often communicate with all players surrounding the project (e.g., project owners, project funders, project management team, and local citizens) in order to determine the project risks and alleviate the risks together, such as holding multilateral consultations regularly, and conducting project information disclosure (e.g., public posting, audio interaction, and mailing).

Like any empirical study, this study has some limitations. For example, the findings described in this paper are

specific to developing countries. To test the generalizability of the findings of this paper, replication in developed countries is welcome. Also, different countries have various political regimes, voting systems and cultural backgrounds, which may impact the governance environment, and in turn affect risk-allocation strategies and private investment decisions. This knowledge should be incorporated into future studies.

Acknowledgement

Appendix A

Table A1
PPP contracts.

Type	Subtype
Management and lease contracts	*Management contract:* transfer responsibility for managing a utility to a private operator, often for three to five years.
	Lease contracts: an operator is responsible for operating and maintaining the business, but not for financing investment
Brownfields	*Rehabilitate-operate-transfer (ROT):* a private sponsor rehabilitates an existing facility, then operates and maintains the facility at its own risk for the contract period.
	Rehabilitate-lease/rent-transfer (RLT): a private sponsor rehabilitates an existing facility at its own risk, leases or rents the facility from the government owner, then operates and maintains the facility at its own risk for the contract period.
	Build-rehabilitate-operate-transfer (BROT): a private developer builds an add-on to an existing facility or completes a partially built facility and rehabilitates existing assets, then operates and maintains the facility at its own risk for the contract period.
Greenfield projects	*Build-lease-transfer (BLT):* a private sponsor builds a new facility largely at its own risk, transfers ownership to the government, leases the facility from the government and operates it at its own risk, then receives full ownership of the facility at the end of the concession period.
	Build-operate-transfer (BOT): a private sponsor builds a new facility at its own risk, owns and operates the facility at its own risk, then transfers the facility to the government at the end of the contract period.
	Build-own-operate (BOO): a private sponsor builds a new facility at its own risk, then owns and operates the facility at its own risk.
	Merchant: a private sponsor builds a new facility in a liberalized market in which the government provides no revenue or payment guarantees. The private developer assumes construction, operating, and market risk for the project
	Rental: a private sponsor places a new facility at its own risk, owns and operates the facility at its own risk.

Source: World Bank, ppi.worldbank.org

Table A2
Empirical findings in different sectors with IV-Tobit regression (Dependent variable: Percentage private).

Variables	Model 1c	Model 2c	Model 3c	Model 4c	Model 5c	Model 6c
	Gov = Cor	Gov = Eff	Gov = Sta	Gov = Reg	Gov = Law	Gov = Voi
Subtype	−0.834*** (0.177)	−1.489 (0.256)	−0.445*** (0.119)	−1.335*** (0.237)	−0.744*** (0.199)	−0.044 (0.074)
Gov	0.316*** (0.149)	−0.803*** (0.198)	0.271** (0.109)	0.708*** (0.191)	0.286* (0.160)	0.477*** (0.072)
Subtype*Gov*ENE	0.135*** (0.048)	0.204*** (0.065)	0.031 (0.035)	0.219*** (0.062)	0.106** (0.053)	0.125 (0.023)
Subtype*Gov*TRA	0.133*** (0.048)	0.324*** (0.065)	0.030 (0.036)	0.219** (0.062)	0.107*** (0.054)	0.124* (0.024)
Subtype*Gov*WAT	0.140*** (0.049)	0.249*** (0.065)	0.039 (0.036)	0.364 (0.082)	0.172** (0.063)	0.125 (0.025)
Subtype*Gov*ICT	0.146*** (0.049)	0.398*** (0.066)	0.046 (0.036)	0.374*** (0.082)	0.178** (0.064)	0.106*** (0.024)
Cons	3.746*** (0.555)	5.734*** (0.784)	3.486*** (0.379)	5.288*** (0.742)	3.677*** (0.599)	1.069*** (0.240)
Project controls	yes	yes	yes	yes	yes	yes
Country controls	yes	yes	yes	yes	yes	yes
Observations	4551	4549	4545	4555	4548	4557
DWH Chi^2	13.84***	13.27***	14.09**	14.57***	13.90**	14.22**
First-stage F-value	80.21	81.50	85.04	80.93	83.61	82.37
IV t-value	10.35	10.24	11.61	10.00	10.39	11.25

Notes: Gov = Governance environment; Cor = ln(Control of corruption); Eff = ln(Government effectiveness); Sta = ln(Political stability); Reg = ln(Regulatory quality); Law = ln(Rule of law); Voi = ln(Voice and accountability). ENE = Energy sector; TRA = Transport sector; WAT = Water and sewerage sector; ICT = ICT sector. Standard errors are in parenthesis below the coefficient. *, ** and *** denotes 10%, 5% and 1% level of significance, respectively.
In Model 1c, *control of corruption* is as the moderating variable. Rows 2 and 3 report the IV-Tobit regression results of independent variables respectively (*Subtype*, and *control of corruption*). Rows 4 to 7 report results of the interaction in four sectors respectively. Specifically, in Model 1c, the dependent variable is the *percentage private*, the independent variables are *subtype*, *Cor*, *subtype*Cor*ENE*, *subtype*Cor*TRA*, *subtype*Cor*WAT*, and *subtype*Cor*ICT*. This layout in Model 1c is analogous to Models 2c-6c.
Sector is a dummy variable. The projects in the PPI database were classified into four sectors: energy, transport, water and sewerage, and ICT. ENE was assigned 1 if the PPP project was in the energy sector, 0 otherwise. TRA was assigned 1 if the PPP project was in the energy sector, 0 otherwise. WAT was assigned 1 if the PPP project was in the water and sewerage sector, 0 otherwise. ICT was assigned 1 if the PPP project was in the ICT sector, 0 otherwise.

References

Abednego, M.P., Ogunlana, S.O., 2006. Good project governance for proper risk allocation in public-private partnerships in Indonesia. Int. J. Proj. Manag. 24, 622–634.

Albalate, D., Bel, G., Geddes, R.R., 2013. Recovery risk and labor costs in public-private partnerships: contractual choice in the US water industry. Local Gov. Stud. 39 (3), 332–351.

Baekgaard, M., 2017. Prospect theory and public service outcomes: Examining risk preferences in relation to public sector reforms. Public Adm. 95 (4), 927–942.

Baker, N.B., 2016. Transaction costs in public-private partnerships. Public Perform. Manag. Rev. 40 (2), 431–455.

Birner, R., Wittmer, H., 2006. Better public sector governance through partnership with the private sector and civil society. Int. Rev. Adm. Sci. 72 (4), 459–472.

Blaka, S., 2017. Does Cooperation Affect Service Delivery Costs? *Public Administration* Forthcoming.

Boyer, E.J., Van Slyke, D.M., Rogers, J.D., 2016. An empirical examination of public involvement in public-private partnerships. J. Public Adm. Res. Theory 26 (1), 45–61.

Burke, R., Demirag, I., 2017. Risk transfer and stakeholder relationships in public private partnerships. Account. Forum 41, 28–43.

Carpintero, S., Petersen, O.H., 2015. Bundling and unbundling in public-private partnerships: Implications for risk sharing in urban transport projects. Proj. Manag. J. 46 (4), 35–46.

Chan, A.P.C., Lam, P.T.I., Wen, Y., Ameyaw, E.E., Wang, S., Ke, Y., 2015. Cross-sectional analysis of critical risk factors for PPP water projects in China. J. Infrastruct. Syst. 21 (1), 04014031.

Chen, C., Hubbard, M., Liao, C., 2013. When public-private partnerships fail. Public Manag. Rev. 15 (6), 839–857.

Cheung, E., Chan, A.P.C., Kajewski, S., 2012. Factors contributing to successful public-private partnerships projects. J. Facil. Manag. 10 (1), 45–58.

Chou, J.S., Pramudawardhani, D., 2015. Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects. Int. J. Proj. Manag. 33, 1136–1150.

Daude, C., Stein, E., 2007. The quality of institutions and foreign direct investment. Econ. Polit. 19 (3), 317–344.

Galilea, P., Medda, F., 2010. Does the political and economic context influence the success of a transport project? An analysis of transport public-private partnerships. Res. Transp. Econ. 30, 102–109.

Girth, A.M., 2014. What drivers the partnership decision? Examining structural factors influencing public-private partnerships for municipal wireless broadband. Int. Public Manag. J. 17 (3), 344–364.

Grindle, M.S., 2004. Good enough governance: poverty reduction and reform in developing countries. Governance 17 (4), 525–548.

Hefetz, A., Warner, M., 2012. Contracting or public delivery? The importance of service, market and management characteristics. J. Public Adm. Res. Theory 22 (2), 289–317.

House, S., 2016. Responsive regulation for water PPP: Balancing commitment and adaptability in the face of uncertainty. Polic. Soc. 35, 179–191.

Jamali, D., 2004. Success and failure mechanisms of public private partnerships in developing countries: Insights from the Lebanese context. Int. J. Public Sec. Manag. 17 (5), 414–430.

Janssen, R., Graaf, R., Smit, M., Voordijk, H., 2016. Why local governments rarely use PPPs in their road development projects. Int. J. Manag. Proj. Bus. 9 (1), 33–52.

Jones, A., 2001. Social responsibility and utilities. J. Bus. Ethics 34, 219–229.

Kahneman, D., Tversky, A., 1979. Prospect theory: an analysis of decision under risk. Econometrica 47 (2), 263–292.

Kaufmann, D., Kraay, A., Mastruzzi, M., 2011. The worldwide governance indicators: Methodology and analytical issues. Hague J. Rule Law 3, 220–246.

Ke, Y., Wang, S., Chan, A.P.C., Cheung, E., 2009. Research trend of public-private partnership in construction journals. J. Constr. Eng. Manag. 135 (10), 1076–1086.

Keers, B.B.M., van Fenema, P.C., 2018. Managing risks in public-private partnership formation projects. *Int. J. Proj. Manag.* 36 (3), 861–875.

Koppenjan, J., Enserink, B., 2009. Public-private partnerships in urban infrastructures: Reconciling private sector participation and sustainability. Public Adm. Rev. 69 (2), 284–296.

Krawczyk, K.A., Sweet-Cushman, J., 2017. Understanding political participation in West Africa. Int. Rev. Adm. Sci. 83 (1S), 136–155.

Loosemore, A.N., 2007. Risk allocation in the private provision of public infrastructure. Int. J. Proj. Manag. 25, 66–76.

Lu, X., White, H., 2014. Robustness checks and robustness tests in applied economics. J. Econ. 178, 194–206.

Mathur, S., 2017. Public-private partnerships for municipal water supply in developing countries. Cities 68, 56–62.

Neshkova, M.I., Kostadinova, T., 2012. The effectiveness of administrative reform in new democracies. Public Adm. Rev. 72 (3), 324–333.

Novemsky, N., Kahneman, D., 2005. The boundary of loss aversion. J. Mark. Res. XLII, 119–128.

Osborne, S.P., 2010. The New Public Governance: Emerging Perspective on the Theory and Practice of Public Governance. Routledge, London.

Osei-Kyei, R., Chan, A.P.C., 2017. Factors attracting private sector investments in public-private partnerships in developing countries. J. Fin. Manag. Property Construct. 22 (1), 92–111.

Panayides, P.M., Parola, F., Lam, J.S.L., 2015. The effect of institutional factors on public-private partnership success in ports. Transp. Res. A 71, 110–127.

Papke, L.E., Wooldridge, J.M., 1996. Econometric methods for fractional response variables with an application to 401(k) plan participation rates. J. Appl. Econ. 11, 619–632.

Percoco, M., 2014. Quality of institutions and private participation in transport infrastructure investment. Transp. Res. A 70, 50–58.

Petersen, O.H., 2010. Regulation of public-private partnerships: the Danish case. Public Money Manag. 30 (3), 175–182.

Pongsiri, N., 2002. Regulation and public-private partnerships. Int. J. Public Sector Manage. 15 (6), 487–495.

Pusok, K., 2016. Public-private partnerships and corruption in the water and sanitation sectors in developing countries. Polit. Res. Q. 69 (4), 678–691.

Queiroz, C., Vajdic, N., Mladenovic, G., 2013. Public-private partnerships in roads and government support: Trends in transition and developing economies. Transp. Plan. Technol. 36 (3), 231–243.

Shiferaw, A.T., Klakegg, O.J., Haavaldsen, T., 2012. Governance of public investment projects in Ethiopia. Proj. Manag. J. 43 (4), 52–69.

Shrestha, A., Chan, T.-K., Aibinu, A.A., Chen, C., Martek, I., 2017. Risks in PPP water projects in China: Perspective of local governments. J. Constr. Eng. Manag. 143 (7), 05017006.

Sovey, A.J., Green, D.P., 2011. Instrumental variables estimation in political science: a readers' guide. Am. J. Polit. Sci. 55 (1), 188–200.

Stock, J.H., Yogo, M., 2005. Testing for weak instruments in linear IV regression. In: Stock, J.H., Andrews, D.W.K. (Eds.), Identification and Inference for Econometric Models: A Festschrift in Honor of Thomas Rothenberg. Cambridge University Press, Cambridge.

Takashima, R., Yagi, K., Takamori, H., 2010. Government and risk sharing in public-private partnerships. Rev. Financ. Econ. 19, 78–83.

Tam, C.M., 1999. Build-operate-transfer model for infrastructure development in Asia: reasons for successes and failures. Int. J. Proj. Manag. 17 (6), 377–382.

Tecco, N., 2008. Financially sustainable investments in developing countries water sectors: what conditions could promote private sector involvement? Int. Environ. Agreements 8 (2), 129–142.

Tharenou, P., Donohue, R., Cooper, B., 2007. Management Research Methods. Cambridge University Press, Cambridge.

Thomas, M.A., 2010. What do the worldwide governance indicators measure? Eur. J. Dev. Res. 22 (1), 31–54.

Urpelainen, J., Yang, J., 2017. Policy reform and the problem of private investment. J. Pol. Anal. Manage. 36 (1), 38–64.

Villani, E., Greco, L., Phillips, N., 2017. Understanding value creation in public-private partnerships: a comparative case study. J. Manag. Stud. 54 (6), 876–905.

Wang, Y., 2015. Evolution of public-private partnership models in American toll road development. Int. J. Proj. Manag. 33, 684–696.

Wang, S.Q., Tiong, R.L.K., Ting, S.K., Ashley, D., 1999. Political risks: Analysis of key contract clauses in China's BOT project. J. Constr. Eng. Manag. 125 (3), 190–197.

Wang, H., Chen, B., Xiong, W., Wu, G., 2018. Commercial investment in public-private partnerships: the impact of contract characteristics. Policy Polit. 46 (4), 589–606.

Zhang, Y., 2014. From state to market: private participation in China's urban infrastructure sectors, 1992-2008. World Dev. 64, 473–486.

Zhang, J., Wei, W.X., 2012. Managing political risks of Chinese contracted projects in Libya. Proj. Manag. J. 43 (4), 42–51.

Zhang, S., Gao, Y., Feng, Z., Sun, W., 2015. PPP application in infrastructure development in China: institutional analysis and implications. Int. J. Proj. Manag. 33, 497–509.

Zwikael, O., Smyrk, J., 2015. Project governance: Balancing control and trust in dealing with risk. Int. J. Proj. Manag. 33, 852–862.