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Understanding Public-Private Partnerships: Strategic Alliances, Risk Aversion, and Policy Diffusion

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

UNDERSTANDING PUBLIC-PRIVATE PARTNERSHIPS:
STRATEGIC ALLIANCES, RISK AVERSION, AND POLICY DIFFUSION

A dissertation submitted in partial fulfillment of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

PUBLIC AFFAIRS

by

Min Xiong

2021

To: Dean John F. Stack, Jr.
Steven J. Green School of International and Public Affairs

This dissertation, written by Min Xiong, and entitled Understanding Public-Private Partnerships: Strategic Alliances, Risk Aversion, and Policy Diffusion, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Florida International University, 2021

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ABSTRACT OF THE DISSERTATION
UNDERSTANDING PUBLIC-PRIVATE PARTNERSHIPS:
STRATEGIC ALLIANCES, RISK AVERSION, AND POLICY DIFFUSION

by

Min Xiong

Florida International University, 2021

Miami, Florida

Professor Shaoming Cheng, Major Professor

Public-private partnerships (PPPs) have experienced tremendous growth worldwide since governments in the UK utilized private financing for public infrastructure in the 1990s. Throughout the past few decades, scholars have researched the concept, development, drivers, and performance of PPPs. However, the extant research stems predominately from the lens of governments and focuses on how governments screen and select private partners. A neglect of the private sector's preference toward and selection of governmental partners would hinder scholarly understandings of PPP formation. Such overlook may also hinder the utilization and development of PPPs in public service delivery.

This dissertation presents three essays to theoretically and empirically explore the factors that influence the formation of PPPs, from three distinct perspectives, namely, network, organizational, and spatial views. The first essay innovatively develops a network of PPPs and depicts preferences among public and private entities. The second essay, from an organizational angle, centers on private partners' risk aversion toward

fiscally constrained governments. The third essay, at a macro level, explains how PPP formation diffuses and expands over time and across space. All analyses use data from China, where PPPs have seen a rapid and exponential rise since 2014.

The first essay draws on the resource-based theory and uses social network analysis to investigate government preferences for private partners. The results show that private entities with greater access to and control over unique resources are the most influential and powerful partners, and therefore are the most preferred partners. The second essay utilizes a causal mediation analysis and finds that a higher level of government fiscal gap may signal higher fiscal risk and thus trigger risk aversion of private partners. The third essay, based on policy diffusion theories and methodological advances in spatial econometrics, suggests that geographic spread of PPPs is a result of policy emulation among governments that are geographically, economically, or administratively proximate. Through eclectic yet holistic examinations, this dissertation advances scholarly understandings of drivers of and barriers to PPP formation from both public and private sides. It provides policymakers with practical insights on PPP formation by addressing both public and private actors' preferences and priorities.

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INTRODUCTION

The past three decades have seen an increasing interest of government entities in collaborating with the private sector to deliver public products and services in both advanced and transitional economies. Such collaboration is generally referred as to public-private partnerships (PPPs). With access to private financing and expertise, PPPs are expected to reduce budget deficits, transfer risk, and achieve greater efficiency, effectiveness, and equity (Van Ham & Koppenjan, 2001; Hodge, Greve & Biygautane, 2018; Wang et al., 2018). However, existing studies largely concentrate on the motivations of governments in PPP formation, government preferences for the private partners have received limited attention in the empirical literature. Even fewer studies have examined the private entities' considerations of the selection of government partners. The predominant focus on the public sector would be problematic for providing policy implications for promoting PPP adoption and realizing the expectations of PPPs. Therefore, it is time to address a pressing need now for a better understanding of PPP formation and its adoption, and that allows a more extended exploration of participants' preferences and priorities in the collaboration.

The purpose of this dissertation is to theoretically and empirically explore the underlying factors that influence the formation and diffusion of PPPs. This research is important because it will advance scholarly understandings of drivers and barriers to the PPP formation both from the public and private sides, by examining government preferences for private partners as well as the private sector selection of public governments. Furthermore, exploring the spread of PPPs based on a macro policy diffusion perspective leads to a comprehensive understanding of both governments'

internal attributes and external emulating mechanisms among others. More importantly, it will provide policymakers with practical insights for promoting PPP adoption and improving PPP performance by properly addressing both public and private sector's preferences and priorities in the partnerships. With this goal in mind, this dissertation is organized into three independent yet interconnected essays.

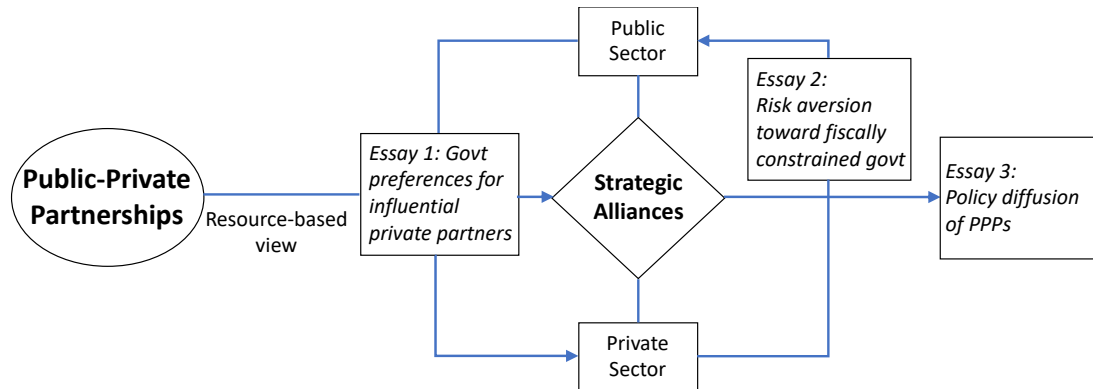


Figure 1. Relation of the Three Essays in the Dissertation

Figure 1 illustrates the relation of the three essays in this dissertation. The common theme of the three essays is the formation of PPPs. The first two essays explore participants' preferences in PPP formation at the organizational level. Built upon the resource-based view (RBV), both public and private participants' motivations in forming PPPs are explained. Essay one focuses on government preferences for private partners, and essay two examines the private sector's selection of governments. The third essay, at a macro level, explains the PPP formation over time and across space. It draws on the policy diffusion theories and explores the driving forces of the proliferation and spread of PPPs from one government to others.

The first essay establishes a theoretical framework derived from the RBV, which posits that public and private entities participate in PPPs by forming strategic alliances to

access each other's unique resources and to share mutual benefits. The actors in strategic alliances present power imbalance because their possession and control over resources vary. Therefore, this essay attempts to draw the theoretical framework and identify governments' preferences for private partners. The second essay, on the other hand, investigates the private sector's preferences toward their public partners. Particularly, this essay deals with private firms' risk aversion in PPPs based on government financial resources and constraints. Fiscally constrained and stressed governments are in urgent need of PPPs to close fiscal gaps, yet at the same time, a larger fiscal gap of governments may signal higher risks for private entities when scanning and screening the potential public partners. It advances and complements the existing research that predominately focuses on the government demands for PPPs. Since the preferences of both public and private sectors in forming PPPs are discussed, the third essay then, in a broader sense, explores the drivers of the proliferated formation of PPPs over time and across space. Based on policy diffusion theories, this essay focuses on both internal government characteristics and external policy emulation that lead to the transmission of PPPs from one location to others.

This dissertation contributes to the extant literature in the following ways. It develops a multi-faceted conceptual framework that explains the formation and proliferation of PPPs. First, it not only examines PPP formation at the organizational level but also incorporates a more macro level to explore the spread of PPPs as a policy innovation. Drawing on the RBV, the PPPs can be viewed as strategic alliances linking public and private organizations. The first two essays focus on both public and private sector's motivations and preferences for participating in PPPs. Then the third essay goes

beyond the perspective of specific organizations and reveals the diffusion mechanisms of PPP proliferation. Second, this research captures participants' preferences in PPP formation, both in terms of the public and private sides. Most notably, it introduces a lens of private sector when governments participate in PPPs as potential collaboration candidates. Based on the lens of private sector, the preferences of private entities can be better addressed, which has been underexplored in the previous studies.

In addition, this dissertation exploits multiple methodologies to examine PPP formation based on the research question in each essay, including the social network analysis, causal mediation analysis, and spatial econometric models respectively. First, it innovatively uses the social network analysis in the study on PPPs. Existing studies generally focused on individual, isolated PPP transactions and overlooked the interdependence and interconnection among the PPP participants. Second, using a causal mediation analysis enables a separate investigation of the lens of governments and the private sector in PPP formation and to estimate their respective effects, which are often lumped together in the extant literature. And third, by incorporating the spatial econometric models, it will enrich the methodologies used in the policy diffusion study and improve the identification of diffusion mechanisms.

This research uses the experience in the context of China to study the formation of PPPs. The reasons for using data on China's PPPs are threefold. First, China has a larger number of PPP projects compared to other countries, which provides an abundance of available data for the analysis. With a total amount of nearly 15.5 trillion RMB yuan, there are 10,034 PPP projects across Chinese cities by the end of 2020 (China Public Private Partnerships Center [CPPPC], 2021). China has been one of the largest PPP

markets globally. Second, the unprecedented rapid growth of PPPs in China since 2014 creates an ideal environment to test the lens of private sector and policy diffusion of PPPs. The number of total PPP projects increased from 451 in 2015 to 2,566 in 2017 (BRI data, 2020). There are a vast number of local governments that are motivated to adopt PPPs within three years. It offers an ideal research setting for the second essay to test the risk aversion through a lens of private sector in PPP collaboration. Also, the sudden rise of PPPs in China in 2015-2017 facilitates the analysis in the third essay on the policy diffusion of PPPs among cities. And third, the characteristic of PPPs in China is the engagement of state-owned enterprises (SOEs). The imbalance in the possession and control over resources between SOEs and private firms across sectors fits well for the exploration of governments' preferences for the partners in the first essay. Although the empirical analysis applies to the context of China, the evidence collected from this dissertation may likely be applied to other countries in that the fundamental elements of PPP participants' preferences and priorities, as well as the mechanisms of PPP diffusion, are shared internationally.

Essay 1: Government Preferences for Influential Private Partners

While there is considerable research on the initiatives of both public and private sector for using PPPs (Van Ham & Koppenjan, 2001; Hodge, Greve & Biygautane, 2018; Klijn & Teisman, 2003), our understandings of participants' preferences and priorities in PPP formation remains limited. From a resource-based view, this essay contends that forming PPPs indicates establishing strategic alliances between government entities and private parties. PPPs are initiated when governments and private partners seek to access each other's unique resources and to share mutual benefits (Barney, 1991; Eisenhardt &

Schoonhoven, 1996). In addition to the explanations of the collaborative motivations, this research further identifies the power asymmetries between actors in partnerships.

Informed by the resource-dependency theory (Pfeffer & Salancik, 2003), which suggests that power imbalance exists within strategic alliances because the possession of resources, control over resource flows and dependence on resources differ, this research posits that participants that own resources to which others do not have access will likely be sought-after partners. In other words, both governments and the private sector that consider participating in a PPP prefer to collaborate with those having greater access to and control over strategic resources.

This research uses PPPs at the Chinese local government level as an example to test the above theoretical framework. PPPs in China provide an ideal context for this research, this is because both private firms and state-owned enterprises (SOEs) collaborate with Chinese local governments in the form of PPPs. SOEs have the advantage of resource possession and control over financial capital, expertise, and government support, compared to private firms. The capacity of SOEs to control and influence resource flows is amplified especially in centrally administered SOEs (CSOEs). This work innovatively distinguishes CSOEs from other SOEs that are directed by provincial or municipal governments. The power imbalance may emerge among CSOEs, SOEs, and private firms. Furthermore, this research proposes that CSOEs' power may vary across industrial sectors, throughout time and space geography. This is because local governments' demand for the types and the magnitude of resources varies.

Using the information on PPP transactions at the local government level in the transport and environmental protection sector in the period of 2015–2017, this research

builds PPP networks for each sector using methods from social network analysis. A network analysis is appropriate because PPP participants are interdependent and interconnected in a network in which resources flow among participants as they cluster to share and exchange resources. Existing studies generally focused on individual, isolated PPP transactions and overlooked interdependence and interconnection across PPP transactions and among the PPP participants.

In PPP networks, each organization serves as a node and each pair-wise relationship derived from an actual contractual PPP transaction serves as an edge between two nodes. The network position of a given participant in the network is primarily determined by its control over and dependence on resources. This research includes two measures, i.e., eigenvector centrality and betweenness centrality, to assess different groups of PPP participants' influence and control. This work suggests that CSOEs may be more influential and powerful in sectors that rely more on property-based resources (transport), while private firms may be more influential and powerful in sectors that rely more on knowledge-based resources (environmental protection). In addition, CSOEs' dominance in PPP networks has increased over time, and geographically, it is aligned with the provincial distribution of Chinese CSOEs. This research will provide policymakers with lessons to reduce resource gaps between SOEs and private businesses, and only in so doing it is likely that the presence and involvement of non-SOEs in China's PPPs can be enhanced. This research has been turned into a peer-reviewed journal article and has been published in *Area Development and Policy*.

Essay 2: Risk Aversion toward Fiscally Constrained Governments

The second essay focuses on private partners' consideration and preferences in selecting governmental entities based on their potential fiscal risks signaled by financial demands and shortfalls. On the one hand, governments with high budgetary gaps have an urgent demand for PPPs. On the other hand, fiscally constrained governments may carry substantial financial risks, which could trigger risk aversion and deter private entities from entering into PPPs. Existing research has directed attention to government demand for PPPs to access financial resources and close budgetary gaps (Casady et al., 2020; Cepparulo, Eusepi, & Giuriato, 2019; Hodge, Greve, & Biygautane, 2018). However, such analyses have overlooked how private entities screen and select governmental partners, and this knowledge gap is noteworthy because private entities enjoy a “buyers’ market” in which a large number of governments are assessed as potential collaboration candidates. Therefore, this research expands the extant research by introducing a lens of private sector, which will complement and greatly enrich our understandings of PPP formation beyond the sole demand of governmental entities.

A causal mediation analytic framework (Imai, Keele, & Tingley, 2010) is developed to delineate and estimate the effects of local government fiscal gaps on PPP collaboration through the lenses of both governments and the private sector. Through the lens of governments, their needs to form PPPs to close the budgetary gaps may be mediated by debt financing. External borrowing is another method used by governments to acquire financial resources, and it is often pursued before equity financing—according to the pecking order theory (Frank & Goyal, 2008; Myers & Majluf, 1984). The debt-mediated relationship represents governments’ tiered preference of own-source revenues

over external debts and then over PPP collaboration (Zhao, Su, & Li, 2018). Through the lens of the private sector, government fiscal gap is characterized as a risk factor, which may deter risk-averse private entities from entering into PPPs.

Using data on China's prefecture-level cities from 2015 to 2017, this research adopts a causal mediation analysis to integrate, measure, and compare the effects of local government fiscal gap on PPP collaboration, through the lens of governments and private entities. This work uses four different measurements to capture various effects on PPP collaboration from different angles, including the probability of PPP adoption, the number of PPP projects, the value of PPP projects per capita and on average. Control variables include governments' other revenue sources, level of economic development, and public management capacity. The surge of PPPs in China in 2015-2017 offers an ideal research setting because a vast number of local governments were motivated to adopt PPPs within a very short timeframe, which provides an abundance of available data to test the lens of private entities in the PPP collaboration and hence their risk aversion decisions. The evidence collected from this work can be applied to other countries, as the paradoxical effects of government fiscal gaps are intrinsic to the PPP mechanism.

This research finds that the adverse effects of fiscal gaps associated with financial risks are greater than the positive effects of the fiscal gaps that would motivate governments to participate in PPPs for additional resources. Besides, the largest adverse effects are associated with PPP investment value, while the adverse impact on the probability of forming PPPs is very small. This may suggest that private partners may still consider collaborating with fiscally constrained local governments, but their investment decisions would be much cautious and conservative. Policymakers should be

aware that PPPs are not the solution to aggressive and unconstrained spending, in light of risk aversion toward government fiscal gaps. It is necessary to build a stronger and more independent risk assessment, monitoring, and reporting system to facilitate private investors' screening and selection of governmental partners, mitigate their risk aversion, and improve their confidence in collaborating with financially constrained governments. This research has been submitted to *International Public Management Journal* and is under revise and resubmit.

Essay 3: Policy Diffusion of Public-Private Partnerships

With an augmented understanding of both public and private sector's preferences and priorities in participating in PPPs in the first and second essays, the third essay moves to the question on the drivers of the spread of PPPs from a policy diffusion perspective. Policy diffusion theories explain that the transference of a policy from one government to another is a function of both internal characteristics and external mechanisms like learning, emulation, competition, and coercion (Berry & Berry, 1990; Graham et al., 2013). In policy diffusion research, scholars often test the external mechanisms based on geographic proximity (Karch et al., 2016; Maggetti & Gilardi, 2016). This is because policymakers tend to look to "similar" governments when adopting a policy innovation and the "similarity" can be inferred from geography (Walker, 1969). In addition to geographic similarity, some research finds that policy diffusion likely arises from ideologically similar governments even when they are geographically distant and apart (Grossback, Nicholson-Crotty, & Peterson, 2004; Mallinson, 2021). However, the existing evidence largely focuses on geographic proximity and political or ideological similarity. It neglects other similarities based on a comprehensive comparison of

economic, demographic, and administrative conditions and overlooks the role of such holistic similarity in diffusion of public policies.

Built upon the existing literature on policy diffusion, this research uses data on Chinese local governments to examine how the convergence of PPP investments is reached among prefecture-level cities. The unprecedented rapid growth of PPPs in China since 2014 provides an ideal environment to test and expand the policy diffusion theory. Mainstream policy diffusion studies are operated in a non-spatial setting, which typically use the number or proportion of prior adopters of a policy to test the diffusion mechanisms (Drolc, Gandrud, & Williams, 2019). This approach, however, omits the spatially correlated covariates that persist over time. In addition, the traditional binary outcome event history models utilized in the policy diffusion literature fail to interpret the diffusion process beyond time and probability. A more insightful approach of policy diffusion outcomes emphasizes the extent a policy is implemented to augment the conventional binary indicators and probability methods.

This research seeks to expand the extant literature with spatial modeling techniques and by focusing on the value of investments to examine the policy diffusion of PPPs. It builds a panel dataset of PPP investments between 2015 and 2017 as well as a database of the fiscal capacity of Chinese cities. First, the spatial distribution of PPP investments is examined to assess the spatial manifestations of diffusion. Second, this work incorporates three distinct measurements of similarities between governments in terms of the geographic proximity, economic resemblance, and parallel position in the administrative hierarchy. The inclusion of the comparable tiers in the administrative hierarchy, which provides a comprehensive benchmarking index, will greatly enrich our

understandings of policy diffusion among alike governments not only based on geography or a single indicator but from a holistic likeness index. Finally, this research uses the spatial autoregressive (SAR) panel models with different spatial weight matrices to reflect the three unique similarity-based diffusion mechanisms and test and compare their respective roles in the spread of PPPs among Chinese cities. The dependent variable is each city's per capita PPP investment amount. The explanatory variables include local government fiscal capacity measured by the own-source fiscal gap, public revenue per capita, and land transfer revenue per capita. It also controls for the level of economic development, public management capacity, and other demographic variables.

Evidence from the SAR models suggests that PPP investments in China converge when local governments emulate their geographic, economic, and administrative neighbors or peers. Local governments tend to have comparable PPP investments if they are spatially adjacent, have comparable levels of economic development, or have parallel positions in the administrative hierarchy. The diverse policy emulation pathways may offer various policy options to facilitate and promote policy innovations across geographic, economic, and administrative divides and to reduce the regional disparity in public service delivery. This research will take the form of a single-authored journal article for publication in the public policy-oriented journal.

ESSAY 1 CENTRALLY ADMINISTERED STATE-OWNED ENTERPRISES'
ENGAGEMENT IN CHINA'S PUBLIC-PRIVATE PARTNERSHIPS: A SOCIAL
NETWORK ANALYSIS

Introduction

The past decades have seen an increasing interest of public governments' collaborating with non-public sectors, such as private corporations and non-profit organizations, to deliver public goods and services. In China this phenomenon is particularly marked as by the end of 2018, there were 8,654 public-private partnership (PPP) projects, valued at nearly RMB13.2 trillion, approximately USD1.89 trillion (China Public Private Partnerships Centre [CPPPC], 2018). China has become the country with the largest number of PPP projects and the highest PPP investment amount (Zhao, Su, & Li, 2018).

PPPs, in the Chinese context, refer to long-term contractual collaboration between the governments and *societal capital organizations* in various areas of public service provision. The societal capital organizations consist of state-owned enterprises (SOEs), privately-owned companies, and foreign businesses. The involvement of SOEs has become a salient characteristic of China's PPPs. SOEs are state owned or controlled and, especially in the case of centrally administered SOEs (CSOEs) that are affiliated with and controlled by China's central/national government (other SOEs are directed by provincial or municipal governments) leverage ample resources, and possess extensive political and financial access, compared to their private counterparts. Different from SOEs and CSOEs, private firms in China usually have limited financial capacities and access to resources, and thus higher financing costs than CSOEs (Cheng, Ke, Lin, Yang, & Cai,

2016; De Jong, Mu, Stead, Ma, & Xi, 2010; Mu, De Jong, & Koppenjan, 2011). Given the low rates of return and the long duration of cost recovery in PPPs, high financing costs may render many PPP opportunities less profitable, and then restrict private firms' participation in PPPs. A total number of 981 societal capital organizations have participated in 597 national PPP demonstration projects by the end of 2017. Among these organizations there were 569 SOEs, accounting for nearly 60% of all the societal capital partners (CPPPC, 2018).

The overall question of the paper is whether CSOEs exercise dominant influence and control over China's PPPs because of their superior access to and control over resources. To answer this question, insights from the resource-based view (RBV) framework and resource-dependency theory (RDT) are combined. RBV serves as the foundation for understanding and analysing various participants' motivations, preferences, and priorities in PPP formation (Barney, 1991; Eisenhardt & Schoonhoven, 1996). CSOEs, other SOEs, and non-SOEs (private corporations) possess distinct assets and resources that may be respectively sought after in the establishment of PPPs by various public governments which may have unique needs for various types and/or amount of resources. In light of CSOEs' superior access to and control over strategic assets, they may then be preferred partners in PPP collaboration and partnering. RDT suggests and predicts a power asymmetry in partnering relationships if and when some participants depend heavily on other participants' resources (Pfeffer & Salancik, 2003). The overall hypothesis, informed by RBV and RDT, is that CSOEs, being resource abundant PPP partners, tend to exert a dominant influence in PPP relationships and exercise control power over other participants. The overall hypothesis is further

decomposed and tested across industrial sectors, over time, and across geographical space.

Methodologically, a Social Network Analysis (SNA) is applied for examining PPP network structures and positions in two sectors, namely, transport and environmental protection, in the period of 2012-2017 and across all Chinese provinces. A SNA approach is appropriate because local governments and societal capital partners are interdependent and interconnected in a governance network in which resources flow among PPP participants as they cluster to share and exchange resources. Furthermore, SNA has advantages when compared with approaches in other existing studies in that it investigates the entire PPP governance network and examines PPP participants' embedded network positions. Existing studies have generally focused on individual, isolated PPP transactions and overlook interdependence and interconnection across PPP transactions and among the PPP participants.

The paper advances scholarly understandings of CSOEs' engagement in China's PPP formation. Theoretically, the RBV framework, which is often used to explain private sector motivations in relation to external partnerships (i.e., whether or not to establish a partnership), is extended to examine governments' priorities and preferences (i.e., with whom to partner). Further, the RDT approach is introduced in China's PPP context for a better understanding of asymmetrical relational connections in PPP networks as a consequence of local governments' high dependence on resources and assets possessed by CSOEs. The methodological contribution derives from the holistic network approach capturing and measuring interdependence and interconnection among PPP participants.

This complements but improves on existing literature which relies solely on descriptive statistics of CSOEs' involvement in individual PPP projects.

In addition, datawise, this paper uses a novel data source for exploring CSOEs' roles in PPP networks. In a response to China's national government's emphasis on developing PPPs, in 2015 China's Ministry of Finance (MOF) created a public database to improve transparency in China's PPP development. This new database includes PPP projects across all sectors, invested in either by private firms or SOEs. Previous quantitative research on PPPs in China's context primarily collected data from the World Bank Private Participation in Infrastructure Project Database (Wang, Chen, Xiong, & Wu, 2018; Zhang, 2015). However, this database is confined to infrastructure projects and projects in which mainly private firms invest. This research also seeks to illustrate the ways in which connections between governments and societal capital organizations as well as CSOEs dominance are distributed over China's complex geographical landscape, by integrating social network data with GIS techniques.

This paper analyzes CSOEs' influence and control power in PPP networks in two different industrial sectors, over time in 2012-2017, and across all Chinese provinces. Participants' influence and importance within a network is measured by the extent to which they are connected with well-connected nodes. Control power refers to a participant's control over the network by bridging various participants and facilitating information exchange. The multifaceted analyses will greatly enrich our understandings of the involvement and roles of CSOEs in China's PPP formation and network.

The rest of the paper is organized as follows. The resource-based theoretical framework of PPPs is first introduced, and it is followed by an overview of China's PPP

development. Hypotheses pertaining to CSOEs' dominant roles in PPP networks across sectors, over time, and across geography are developed. The results of a social network analysis using the PPP data collected from the CPPPC are presented identifying the influence and control power of CSOEs in PPP networks. Empirical analysis and findings on the influence and control power of CSOEs are presented and discussed, and conclusions and policy options for future PPP development are developed.

Research Background and Theoretical Framework: A Resource Possession and Acquisition Perspective on PPPs

PPPs bring together resources from both public and private sectors (Hodge & Greve, 2005; Klijn & Teisman, 2003). Heterogeneous possession and diverse acquisition of resources and different degrees of dependence on them, as embodied in the resource-based view (RBV) and resource-dependency theory (RDT), characterize the formation of PPP networks as well as the relationships of network participants. RBV focuses on an internal analysis of organizations' strengths and weaknesses which are defined as the 'resources' of a given organization (Barney, 1991). Such resources may be tangible, such as financial, physical, or human capital, but may also include intangible resources such as knowledge (Grant & Baden-Fuller, 2004). Barney (1991, p. 99) contended that the 'resources are heterogeneously distributed across firms and these differences are stable over time'. By forming strategic alliances, organizations can gain access to others' valuable resources, facilitate resource integration, and achieve mutual benefits (Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996). Such strategic alliances are characterized by mutual recognition and understanding of the long-term dependence of success on each

partner's resources (d'Alessandro, Bailey, & Giorgino, 2013; Roumboutsos & Chiara, 2010).

PPPs as strategic alliances are built upon mutual benefits to both public and societal capital partners. For governmental participants, PPPs permit the acquisition of financial capital, technical expertise and know-how, enabling them to provide public services more effectively and/or efficiently (Kivleniece & Quelin, 2012; Martin, 2018). For societal participants, in addition to projected profits, the governments usually provide political support, government sponsorships, financial assistance, government guarantees, tax exemptions or reductions, and new market opportunities, reducing possible losses and ensuring remuneration. In a study of the Beijing Metro Line 4 Project, Liu, Wang, and Wilkinson (2016) suggested that societal capital organizations may even seek market reputation and legitimacy at the expense of short-term profits.

While RBV explains collaborative motives deriving from resource sharing and mutual benefits, RDT emphasizes the power asymmetries based on the dependence of organizations on resources that are unequally distributed (Pfeffer & Salancik, 2003). RDT suggests that there are potential power imbalances between PPP participants within strategic alliances, because their possession of resources, control over resource flows and dependence on resources differ. Klijn and Koppenjan (2016) distinguished five main types of resources: 1) financial resources including money and budgets, 2) production resources like advanced equipment and human capital, 3) competencies such as formal authority, 4) knowledge such as technical expertise and know-how, and 5) legitimacy like political support. Any public or societal capital organization, which owns resources to which others do not have access, will likely be a sought after partner. This organization,

naturally and consequently, will exert dominant influence and exercise power over its partners. Singh and Prakash (2010) by studying PPPs in health service delivery in India found that governments are influential because their partners, mainly small NGOs, are dependent on governmental resources and have to comply with all administrative requirements and regulations.

Dominance and power imbalances among PPP participants can be indicated and measured using Social Network Analysis (SNA), specifically, governance networks for exchanging resources within strategic alliances. Klijn and Koppenjan (2016) defined governance networks as social relations between mutually dependent actors which cluster to share and exchange resources. Based on collaborative relationships between governments and societal partners in PPPs, a network of interdependent actors can be discerned (Hodge & Greve, 2007; Klijn & Koppenjan, 2000; Koppenjan, 2005). Each organization serves as a node and each pair-wise relationship derived from an actual contractual PPP transaction serves as an edge between two nodes. The network position of a given participant in the governance network is primarily determined by its control over and dependence on resources (Benson, 1975).

In SNA, the network position of nodes exhibiting prominence, popularity, or power is normally characterized by network centrality (Wasserman & Faust, 1994). Network centrality ranks nodes based on their connections to other nodes in the network (Lü et al., 2016). Two network centrality measures were used, specifically, eigenvector centrality and betweenness centrality. Eigenvector centrality represents the influence of a node in the network. It assesses the extent of a node's connection particularly to well-connected nodes (Borgatti, 2005). Hence, a node's influence is not only determined by its

number of direct neighbours but also by the influence of its neighbours (Lü et al., 2016). Additionally, betweenness centrality assesses the degree to which one node connects the shortest path between other nodes (Freeman, 1977). Nodes with high betweenness centrality values have high control power and act as brokers on bridges connecting other organizations in the network (Wu, Tian, & Liu, 2018).

China's PPP Development

The development of PPPs in China has experienced significant fluctuation. China's legal and regulatory framework for PPPs was established in the 1980s when the central government encouraged and promoted foreign investment in public infrastructure development (Zhao, Su, & Li, 2018). Promotion of the involvement of foreign investment at the time was designed to supplement local governments' limited fiscal capacity in infrastructure construction in order to meet the growing demand for local economic development after China's 'reform and open-up' policy. However, PPP engagements with foreign investment was interrupted by the Asian Financial Crisis in 1998 when foreign capital was scarce (Zhang, Gao, Feng, & Sun, 2015).

The second wave of PPPs in China started in 2000, when both domestic and foreign private capital were encouraged to support rapid urbanization in China. The Beijing Metro Line 4 project and the main stadium for the Beijing 2008 Olympic Games were two successful examples leading the second-wave of PPP projects. However, the growth of PPP projects was suspended after the Global Economic Crisis in 2008 when many private firms went bankrupt. Instead, local governments were encouraged to borrow through the quasi-governmental entities, i.e., local government financing vehicles, as well as to issue governmental bonds to sustain infrastructure development

(Gao, Dunford, Norcliffe, & Liu, 2019; Mu, De Jong, & Koppenjan, 2011). Debt finance started as a supplement to China's local governments' own-source fiscal revenues but saw a tremendous growth after the 2008 Global Economic Crisis when the central government massively expanded credit to stimulate economy (Zhao, Su, & Li, 2018).

The most recent PPP surge in China started in 2014 when the government took stringent measures to contain China's local municipalities' alarmingly high debts. Municipal debt and land transfer fees had been the predominant means for financing local and municipal infrastructure and services before 2014. In that year local debts reached an alarming level and threatened fiscal sustainability, and so China's central government restricted local governments from borrowing and capped local debt (Thieriot & Dominguez, 2015). Also, with less available land left, revenues from land leasing are not sustainable (Liu, 2019). In the meantime, PPPs naturally became an alternative financing source for profitable public projects. Figure 2 reports trends in PPP projects and investment amounts in 2012-2017. Tan and Zhao (2019) suggested that the sudden spike of PPPs in 2015 as shown in Figure 2 corresponded with the central government's 2014 decision to curb the growth of local debts in light of considerable risk of local government insolvency.

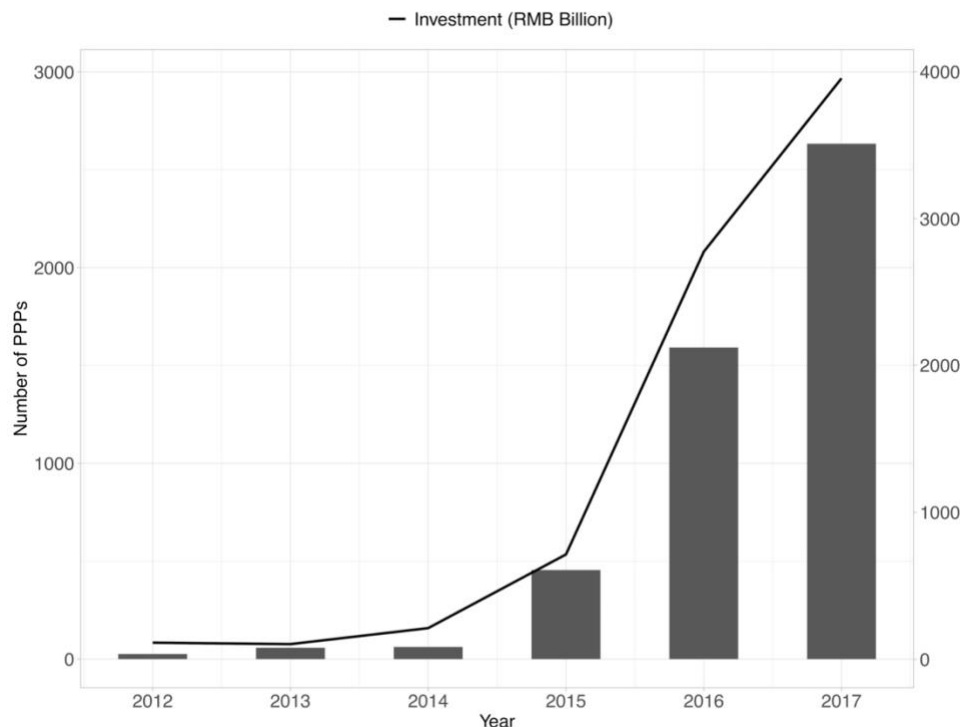


Figure 2. Total Number and Investment of Public-Private Partnership (PPP) Projects, 2012-2017

Source: National PPP database, China's Ministry of Finance.

Roles of State-Owned Enterprises in PPPs

Local governments and societal capital organizations in China exchange resources, establish strategic alliances, and achieve mutual benefits by establishing PPPs. PPPs in China are characterized by the extensive involvement of SOEs. The strengths of SOEs, as major societal capital partners, are derived from five factors. First, SOEs have close ties to the government. Close relationships may offer SOEs greater access to and more opportunities to participate in PPP projects with a strong cash flow, and may also indirectly benefit local governments that collaborate with SOEs in PPP projects (Tan & Zhao, 2019; Thieriot & Dominguez, 2015). Second, SOEs tend to have stronger financial capacities than private firms. Commercial banks prefer to provide loans to SOEs as they

are endorsed by the governments (De Jong et al., 2010). Third, SOEs may be preferred partners in forming PPPs because of their accumulated experience, expertise, human capital assets and management skills (Mu, De Jong, & Koppenjan, 2011). Fourth, SOEs are more stable partners in contrast to private firms. Regardless of government transition, leadership mobility, and policy change, SOEs may be far more likely than non-SOEs to carry out PPP projects which usually last more than ten years (Mu, De Jong, & Koppenjan, 2011; Tan & Zhao, 2019). Last, SOEs are likely to enter a PPP contract with a lower profit expectation than private firms, because SOEs also bear political and social responsibilities in addition to economic missions (Li & Zhang, 2010).

The capacity of SOEs to control and influence resource flows are amplified especially in CSOEs. By the end of 2017, there was a total of 96 CSOEs in China, all of which were ‘extremely large firms concentrated in resource-intensive industries’ (Eaton & Kostka, 2017, p. 2), such as ‘finance, power and utilities, petrochemicals and energy, and aircraft and telecommunications’ (Wang, Mao, & Gou, 2014, p. 232). Recognized as the backbone of the economy, CSOEs have more access to strategic resources than SOEs (Huang, Xie, Li, & Reddy, 2017). In addition to strong financial capacities, some CSOEs have set up their own engineering design and research institutes to focus on R&D processes to improve their expertise. In contrast, local governments only exercise control over the limited resources which they can provide to local SOEs (Li, Cui, & Lu, 2014). Hence, CSOEs have greater access to and control over resources, compared to SOEs and other societal capital partners.

Acquiring financial resources and overcoming financing constraints, as emphasized by the RBV, have been predominant drivers of China’s local governments’

enthusiasm for establishing PPPs. Figure 3 presents a conceptual framework, derived from the RBV and RDT, for analysing China's PPPs. PPPs may be initiated when local governments and/or societal capital organizations seek to access each other's unique resources. On the one hand, local governments gain access through societal capital organizations to financial capital, physical resources, and knowledge or know-how which are necessary for governments to deliver public infrastructure and services. Such public infrastructure would not have been completed in the absence of partnering with societal capital organizations. Delivering public infrastructure such as highways and railroads and harnessing such infrastructure for local economic development are primary measures used to assess local governments' effectiveness, gain an edge in inter-city competition, and make decisions about career advancement of local officials (Tan & Zhao, 2019; Zhu & Jiao, 2012). On the other hand, societal capital organizations will not only obtain remuneration and profits for designing, constructing, and/or operating PPP projects, but also gain legitimacy by associating and partnering with local governments (Eisenhardt & Schoonhoven, 1996; The World Bank, 2017). Access to political and policy authorities will greatly elevate societal capital organizations' competitive positions and further development. Furthermore, as the RDT suggests, different types of societal capital organizations' heterogenous possession of resources may lead to power imbalances among organizations. Organizations which possess resources and/or are not dependent on others' resources will exercise control power over the network, though these relationships may vary across different sectors as sectoral resource demands vary.

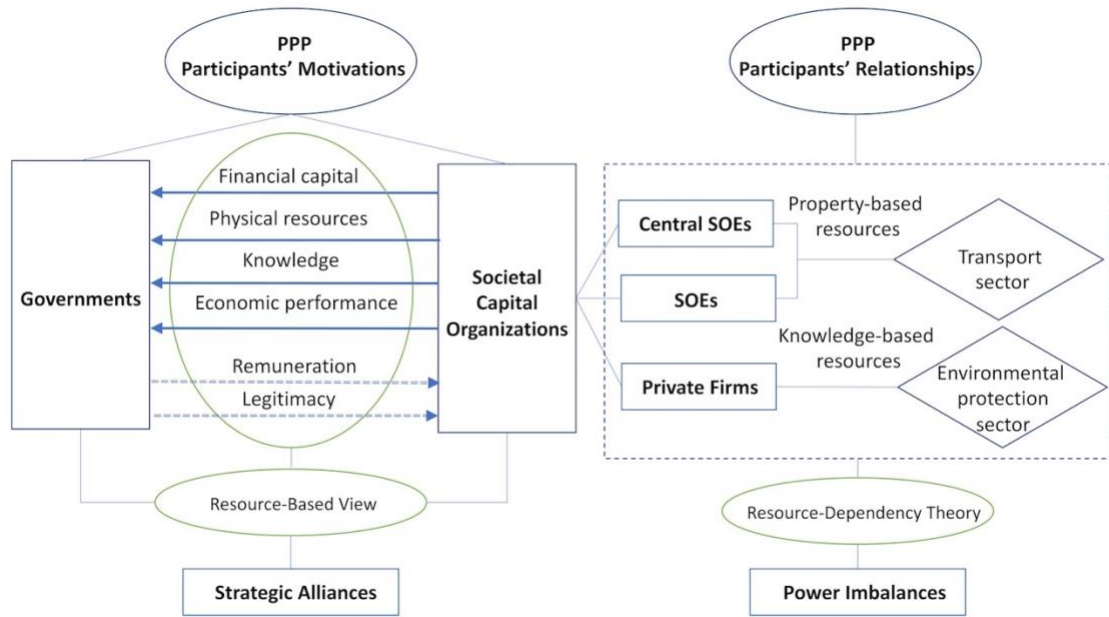


Figure 3. Theoretical Framework of PPPs in China from a Perspective of Resource Possession

Research Question and Hypotheses

This research asked whether CSOEs would exercise greater influence and control power than other participants in PPP governance networks. The overall hypothesis was that CSOEs have dominant influence and control power. This overall hypothesis was decomposed and tested across industrial sectors, throughout time, and space geography.

Across various industrial sectors, the demand for the types as well as magnitude of resources varies. CSOEs' influence and control power in PPP networks may vary accordingly in different industries. Das and Teng (2000) broadly classified the resources into property- and knowledge-based. Property-based resources include financial, physical, and human capital, while knowledge-based resources refer to the expertise and skills which are usually intangible. The key distinction between property- and knowledge-based resources is the degree to which these resources can be protected from

potential appropriation by alliance partners. Different types of societal capital organizations may vary in their ability to influence flows of the two distinct types of resources.

CSOEs in China are designated to produce the public goods related to national security and the national economy. Thus they have superior access to financial, physical, and human capital and monopolize key national sectors (Hubbard, 2016). CSOEs can primarily mobilize and exchange resources that are property-based and capital-intensive. Therefore, in property-based industrial sectors that require tremendous financial, physical, and human capital, such as transport and utilities, CSOEs might be expected to assume a much stronger and influential network position. Private firms generally lack property-based resources (De Jong et al., 2010; Mu, De Jong, & Koppenjan, 2011), and hence may have a stronger motivation to improve technology, optimize management, and lower costs. Private firms tend to possess knowledge-based resources and are likely to play a significant role in the knowledge-based sectors. Therefore, the first sub-hypothesis pertaining to cross-sectoral variations in CSOEs' dominant roles is that: *CSOEs' influence and control power in PPP networks are greater in sectors that rely more on property-based resources (transport) than in sectors dependent on knowledge-based resources (environmental protection).*

Temporally, CSOEs' influence and control power in PPP governance networks may have increased. There may be a learning process as local governments match their demands with resources provided by different types of societal capital organizations. By forming a strategic alliance, PPP participants aim to access the others' unique resources. The success or performance of a strategic alliance is likely to be influenced by the

learning process deriving from interaction among partners (Zollo, Reuer, & Singh, 2002). Based on continuous collaborations, the CSOEs' competitive advantages may be expected to increase. Consequently, CSOEs' dominance in PPP networks may increase over time. Therefore, the second sub-hypothesis pertaining to variations in CSOEs' dominant roles over time is: *CSOEs have greater influence and control power in PPP networks over time in both transport and environmental protection sectors.*

From a geographical perspective, CSOEs are not evenly distributed across Chinese provinces. It is natural that CSOEs' influence and control power are greater in provinces that have higher concentrations of CSOEs, mainly because of spatial proximity which reduces information search costs and encourages within-province PPP collaboration. Such a geographical constraint may however be less restrictive for sectors such as environmental protection that rely heavily on knowledge-based resources and where local governments may have greater flexibility and discretion and therefore may be able to co-operate with non-CSOEs with strategic access to key technology and skills. In contrast, in the sectors that rely on property-based resources, proximity may lead local government to collaborate with CSOEs and their subsidiaries. Thus, the third sub-hypothesis pertaining to geographical variations in CSOEs' dominant roles is: *CSOEs' influence and control power in PPP networks are less constrained by the provincial distribution of CSOEs in the environmental protection sector than in the transport sector, i.e., local governments may have greater flexibility and discretion and therefore may be able to seek non-CSOEs in the environmental protection sector than in the transport sector.*

Data and Methods

Data on PPP projects during 2012-2017 in the transport and environmental protection sectors were collected from the public dataset of the China Public Private Partnerships Centre (CPPPC). This dataset is managed by China's Ministry of Finance (MOF), which is the official organization authorized by the central government to ensure the success of PPP projects in China.

The transport sector was chosen as a property-based sector and environmental protection as a knowledge-based sector to test the above hypotheses. According to the statistics from the CPPPC (2018), the top five sectors adopting PPPs are utilities, transport, environmental protection, urban development, and education. Transport infrastructure projects, such as subway lines and huge bridges, are usually large scale and involve complicated technology. PPP projects pertaining to transport infrastructure require intensive expertise, experience, management skills and financial and human capital (De Jong et al., 2010; Mu, De Jong, & Koppenjan, 2011). The average investment amount of a transport infrastructure PPP project was nearly RMB700 million (Shao, 2018). As a result, a large portion of infrastructure construction enterprises in China are CSOEs and SOEs which have sufficient property-based resources. Taking Beijing Metro Line 4 project as an example, the societal capital partner was a joint-venture composed of Mass Transit Railway owned by Hong Kong Government, Beijing Capital Group Company Limited and Beijing Infrastructure Investment Company Limited which are two SOEs owned by Beijing Municipality Government (Liu & Wilkinson, 2013). On the contrary, PPP projects pertaining to environmental protection usually involve high-tech activities (Lee, 2010). Private firms are likely to have more opportunities and play a

significant role in the environmental protection sector because they may possess technical know-how though they may lack credentials, experience, and financial capital for infrastructure construction (De Jong et al., 2010; Mu, De Jong, & Koppenjan, 2011).

Social Network Analysis (SNA) was conducted to explore and compare the characteristics of transport and environmental protection PPP networks. The units of analysis were pair-wise PPP transactions. All governments and societal capital organizations were nodes in the network, and linkages or edges referred to contractual interactions between city governments and societal capital partners. The contractual relationships among various governments and societal capital organizations were extracted from actual PPP agreements and contracts, which are recorded in the MOF's CPPPC dataset. Transport and environmental protection sectors networks are first described independently and then compared.

Measures of network size, interconnectedness, and community structure were used to describe whole network characteristics. The network size was measured by the total number of nodes in each network. Average degree and network density indicate the interconnectedness of the network. Average degree means the average number of edges per node in the network (Barabási, 2016). Network density is the proportion of observed to potential network edges. A high value of average degree and network density are indications of structural cohesion (De Nooy, Mrvar, & Batagelj, 2018). Average degree is robust to size differences, but comparison of density measures for networks of different sizes is problematic. To investigate the community structure of a network, modularity was adopted. Modularity of a network is a measure of the cohesion of clusters within the network relative to the connections between clusters (Newman, 2006). A highly modular

network has clusters which are disconnected from each other, while a network with lower modularity has more connections between clusters in the network.

To measure the influence and control power of CSOEs in PPP networks eigenvector centrality and betweenness centrality were used, respectively. Eigenvector centrality and normalized betweenness centrality were calculated using the free software Gephi (Bastian, Heymann, & Jacomy, 2009). Furthermore, Wilcoxon Rank Sum significance tests (adopted as the distribution of network centrality indicators is not normal invalidating parametric t tests) were used to examine the differences in CSOEs' dominance across sectors as well as over time.

The PPP networks are visualized abstractly in Figure 3 and geographically in Figure 4. Governments and societal capital organizations in the networks are geocoded based on their geographical locations and addresses in each city. For all subsidiaries of a societal capital organization own addresses rather than those of their parent corporations were used.

Network Analysis Results

Characteristics of PPP Networks across Sectors

PPP transport networks were larger and more cohesive than environmental protection networks. Table 1 compares the major network measures for these two groups of PPP networks. Compared with the network of environmental protection sector, transport PPP networks involved nearly 300 more actors and thus had far more PPP transactions during 2012-2017. Specifically, in the transport sector, 479 city governments and 630 societal capital organizations participated in a total number of 2,130 pair-wise PPP transactions. In the environmental protection sector, there were 338 city

governments and 458 societal capital partners, which together entered into 1,250 PPP contracts in total. However, it should be noted that many governments and organizations were present and overlap in both networks. On average, there were nearly three societal capital organizations per PPP contract in both sectors. A network with a high average degree and network density is an indication of structural cohesion. Transport PPP network had a higher average degree, which suggests that a participant in the transport sector realized more PPP transactions on average than one in the environmental protection sector. The density of an environmental protection PPP network was a little higher than that in the transport sector. However, network density is sensitive to differences in network size, with density decreasing as more nodes are added. Therefore, the transport PPP network was more cohesive than the environmental protection network. Compared with its counterpart, the transport PPP network had a lower modularity value, as shown in Table 1. This suggests that the transport PPP network was less partitioned into communities of densely connected nodes and hence was more interconnected and cohesive.

Table 1. Comparative Analysis of PPP Networks of Transport and Environmental Protection, 2012-2017

	Transport	Environmental protection
Nodes	1129	827
Edges	2130	1250
Average degree	3.773	3.023
Network density	0.003	0.004
Modularity	0.812	0.915

Figure 4 provides a visualization of these two PPP networks, and shows that transport PPP network incorporated more actors (city governments and societal capital

organizations in total) and more transactions than environmental protection network. Furthermore, the transport PPP network formed a large densely connected community, while the communities in the environmental protection network were more partitioned. Network visualization supports the results presented in Table 1, namely that the transport PPP network was larger in size and more cohesive than environmental protection sector network.

The traditional Social Network Analysis (SNA) visualization shown in Figure 4 was supplemented by the use of GIS tools to demonstrate specific geographical locations and patterns of all actors in PPP networks. Each actor in the transport and environmental protection PPP networks had a specific geographical location (city), but traditional SNA visualization randomly assigns network actors and is unable to show their spatial distribution. Given that regional disparity, regional economic complexity (Gao & Zhou, 2018) and differential urbanization (Chen et al., 2014) are significant features of China's economy, spatial analysis of PPPs is of added value. Figure 5 plots the provincial distribution of PPP transactions in the transport and environmental protection sectors respectively in the period of 2012-2017. The linkage weights (i.e., width) correspond to the number of PPP transactions between a local government and a societal capital partner, based on their geographical locations. The PPP networks in these two sectors present similar spatial patterns. Provinces located along the coast tend to have more PPP transactions in both the transport and environmental protection sectors, while provinces located in Southwest and Northwest of China had relatively more transactions in the transport sector. The results also suggest that municipalities in provinces with a lower level of per capita CSOEs endowment tend to go beyond provincial boundaries to

collaborate with CSOEs, reflecting their desire draws on CSOEs' unique assets through their participation in PPP projects.

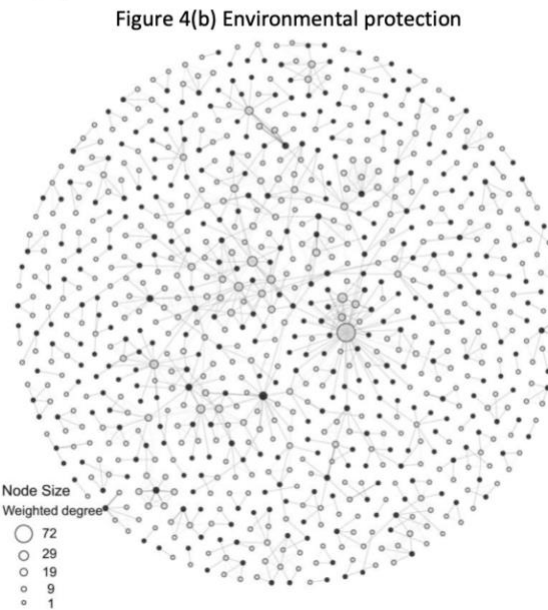
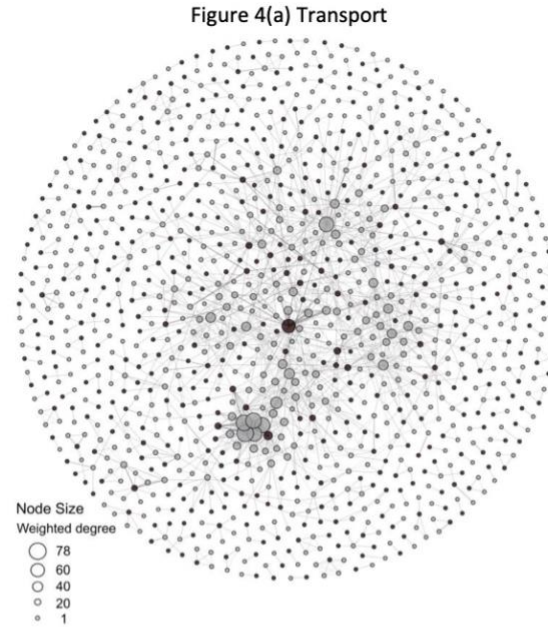


Figure 4. PPP Networks of Transport and Environmental Protection, 2012-2017
Figure notes: The black nodes refer to local governments at the city level. The grey nodes refer to CSOEs, SOEs, and private firms. The node size is ranked by the weighted degree (number and frequency of connections) of the node. Edges are sized by the rank of the edge weights (frequency of connections).

Figure 5(a) Transport

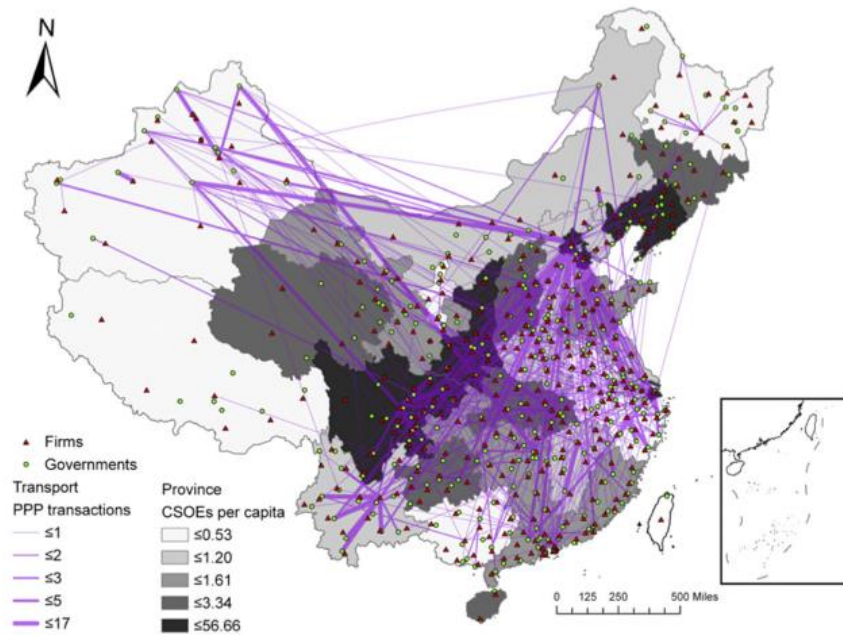


Figure 5(b) Environmental protection

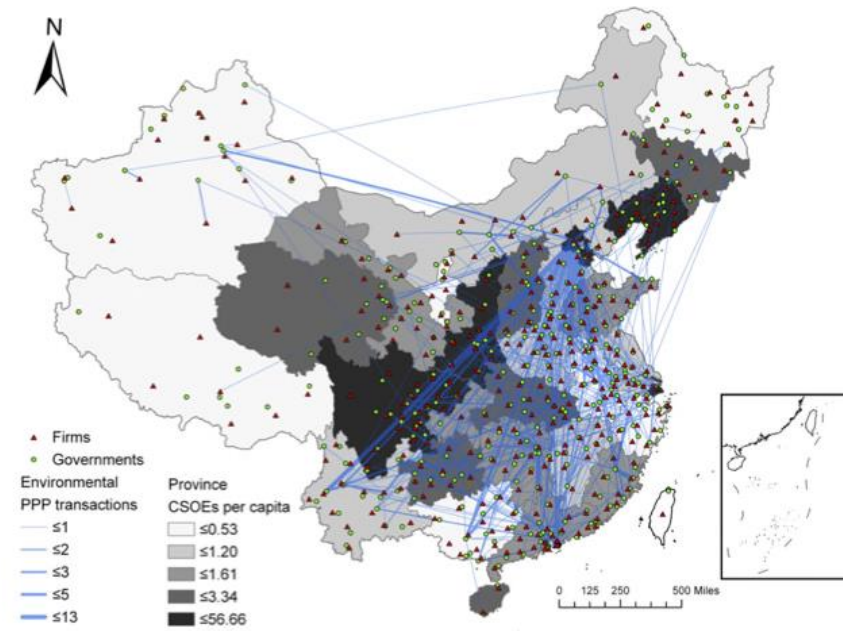


Figure 5. Distribution of PPP Transactions in the Transport and Environmental Protection Sectors across China, 2012-2017

Source: National PPP database, China's Ministry of Finance

CSOEs' Dominance in PPP Networks across Sectors

CSOEs play a relatively dominant role in PPP networks of both transport and environmental protection sectors. Figure 6(a) reports the influence of different types of actors as measured by eigenvector centrality which measures the degree to which an actor in the network is allied with other well-connected actors. As the figure shows, CSOEs are more influential actors in these two networks than local government participants, other SOEs, and private firms. This suggests that CSOEs in both two sectors are dominant and exert influence over other participants. CSOEs' eigenvector centrality in the transport sector is twice that large as in the environmental protection sector, indicating in accordance with the first sub-hypothesis that CSOEs are more dominant and influential in the property-based transport sector than in the knowledge-based environmental protection sector.

Similarly, as shown in Figure 6(b), CSOEs exercise much more control power than other types of participants in both sectors. Betweenness centrality was used to measure the network control power of actors. Betweenness centrality denotes the number of times an actor resides on the shortest path between other actors. As indicated, CSOEs' betweenness centrality was lower in the environmental protection than in the transport sector, suggesting less control power over the former network.

A Wilcoxon Rank Sum test showed that the mean influence and control power of CSOEs in these two sectors were significantly different. Therefore, the first sub-hypothesis pertaining to cross-sectoral variations in CSOEs' influence and control power is supported.

Figure 6(a) Influence of different actors

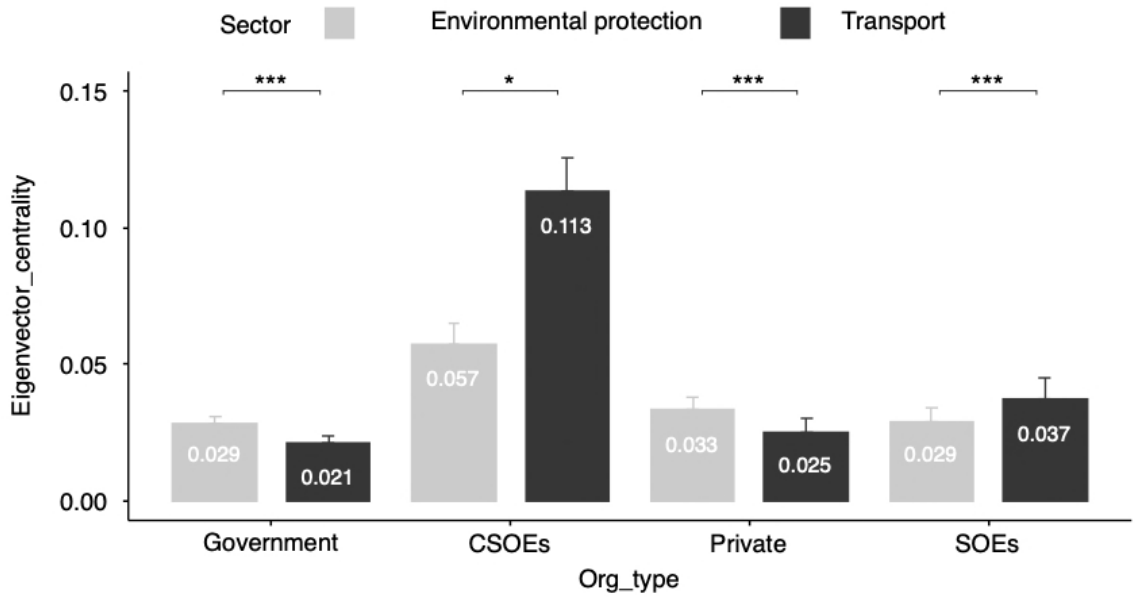


Figure 6(b) Control power of different actors

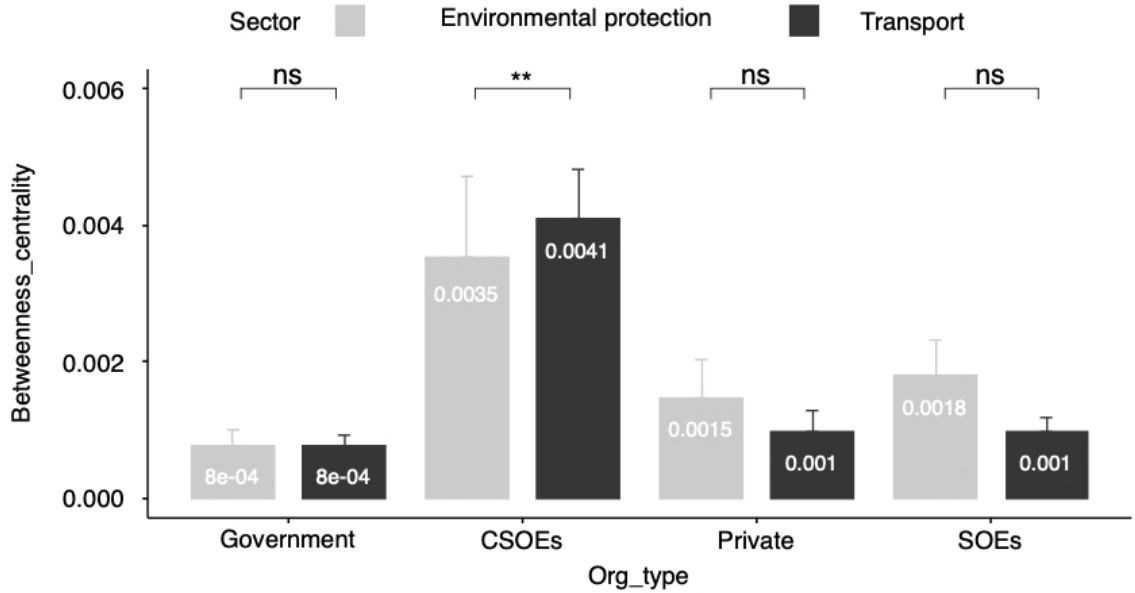


Figure 6. Influence and Control Power of Different Types of Actors in PPP Networks, 2012-2017

Note: n.s., Non-significant, *p < 0.10, **p < 0.05, ***p < 0.01.

CSOEs' Dominance in PPP Networks over Time

The dominant role of CSOEs varied between 2015 and 2017 in both the transport and environmental protection sectors (see Figure 7 and Appendix Table A.1 for the mean comparison statistics).¹ In the transport sector, CSOEs were the most influential actor and their influence as measured by eigenvector centrality increased steadily from 2015 to 2017. However, in the environmental protection sector, CSOEs' influence initially decreased and then rose significantly in 2017. The increases of CSOEs' influence in 2017 in both sectors is suggestive of the existence of a learning process for governments as they search, screen, and match resources based on their demands and needs. Ongoing collaborations and observations of PPP transactions may strengthen CSOEs' competitive advantages and their dominant positions.

Figure 8 shows that CSOEs' control power increased in both sectors in the 2015-2017 period (the mean-comparison statistics reported in Appendix Table A.2). CSOEs have played an important brokerage role in both sectors, bridging various actors information sharing and exchange networks. CSOEs' betweenness centrality values in both sectors rose steadily in 2015-2017 and were higher than those for other PPP network participants, suggesting dominant CSOEs' control power in brokerage and bridging. Accordingly, the second sub-hypothesis pertaining to variations in CSOEs' dominant influence and control power over time in both sectors is supported.

¹ As the total number of PPP projects before 2015 is almost negligible, here we only explore the trend over the period of 2015-2017.

Figure 7(a) Transport

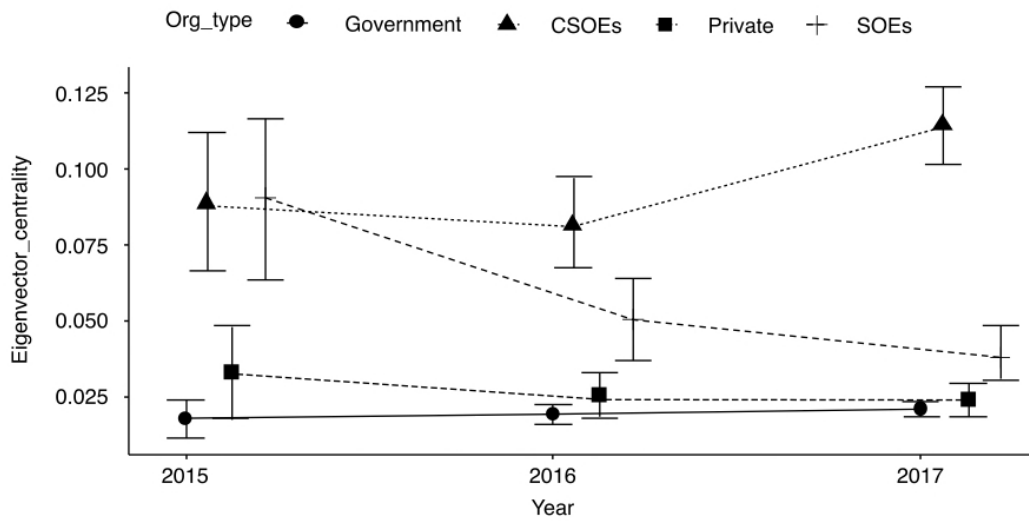


Figure 7(b) Environmental protection

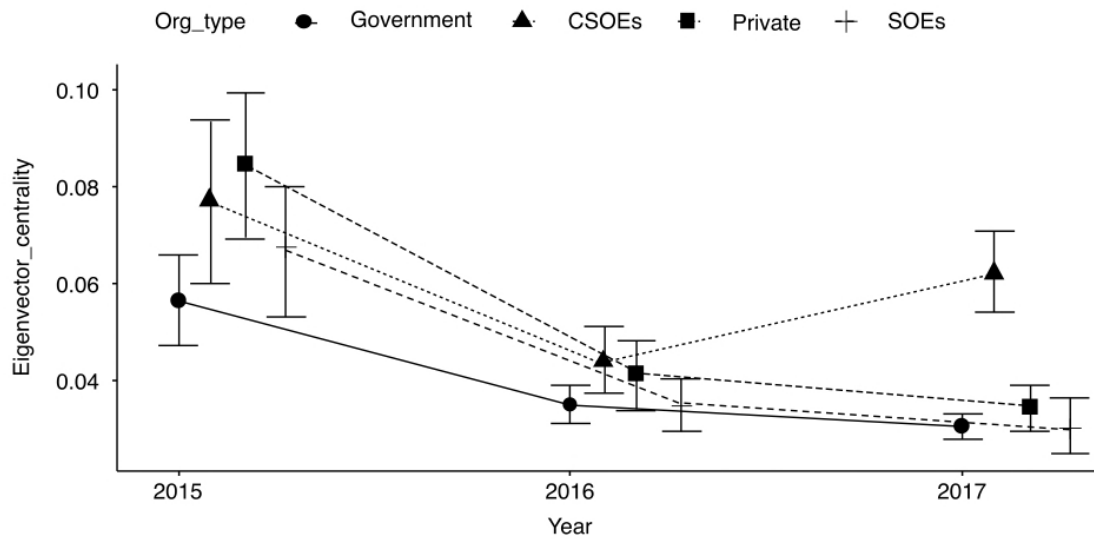


Figure 7. Influence of Different Types of Actors in Transport and Environmental Protection PPP Networks, 2015-2017

Source: National PPP database, China's Ministry of Finance

Figure 8(a) Transport

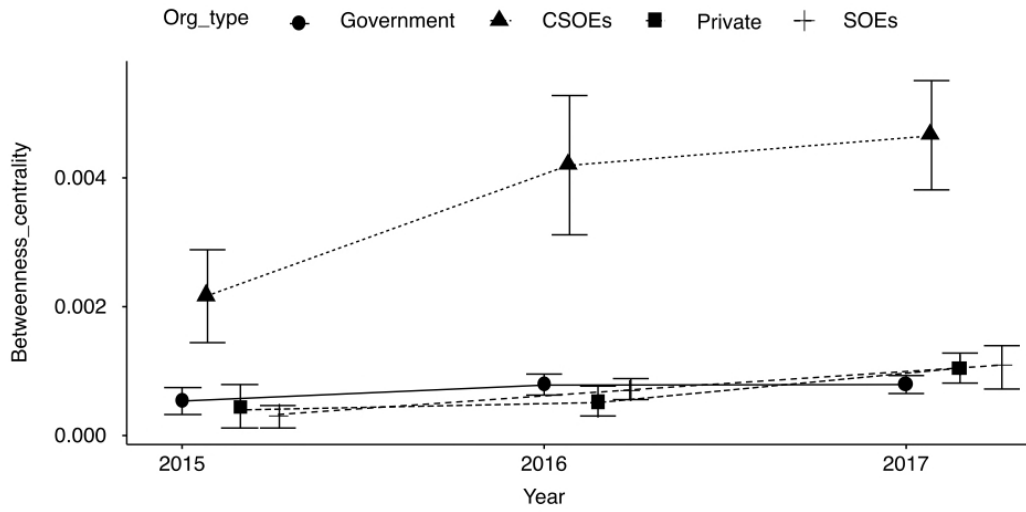


Figure 8(b) Environmental protection

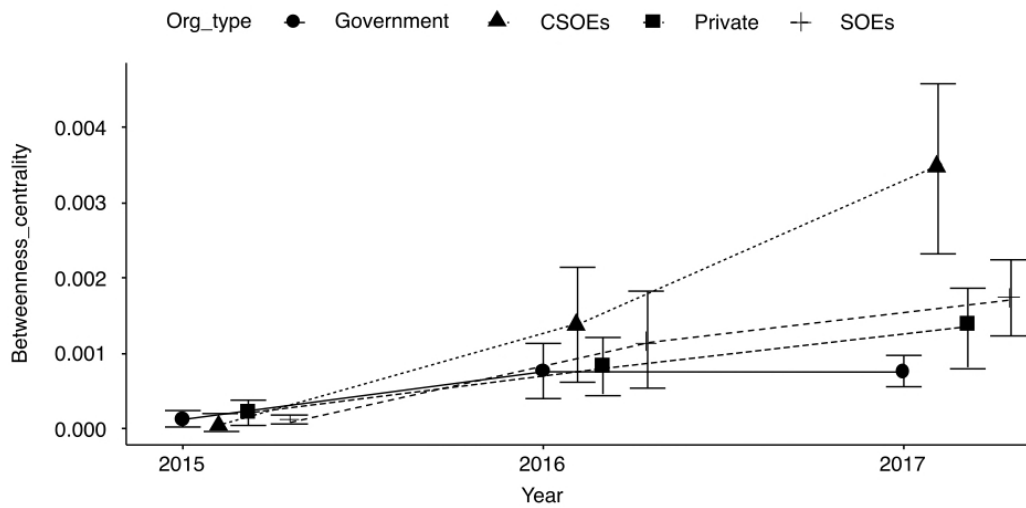


Figure 8. Control Power of Different Types of Actors in Transport and Environmental Protection PPP Networks, 2015-2017

Source: National PPP database, China's Ministry of Finance

CSOEs' Dominance in PPP Networks across Geography

The spatial distribution of CSOEs' dominance was also explored. Figure 9 identifies the median centres of CSOEs' influence and control power in the two sectors from 2015 to 2017. Median centre is a spatial statistic recoding the central tendency of geographically distributed values. CSOEs' average eigenvector centrality and betweenness centrality by provinces in the two sectors are reported in Figure 9(a) and 9(b) and were compared with the median centre (number of CSOEs per capita in each province) of eight major CSOEs and all of their subsidiaries across Chinese provinces (a total number of 356 firms).²

Figure 9 shows that the median centres of CSOEs' transport sector eigenvector centrality in 2015-2017 were closer to the median centre of provincial endowment of CSOEs than in the case of the environmental protection sector. Similarly, the median centres of CSOEs' transport sector betweenness centrality in the three years were closer to the median centre than in the environmental protection case. It suggests that the spatial distribution of CSOEs' dominance in the transport sector more closely parallels or is restricted by the spatial distribution of major CSOEs across China's provinces. On the contrary, although environmental sector PPP networks are dominated by CSOEs the geographical distribution of participants was less dominated by the geographical distribution of CSOEs perhaps facilitating collaboration with non-CSOEs actors. These results confirm the third sub-hypothesis pertaining to geographical variations in CSOEs'

² There are 21 CSOEs participating in PPP projects in the transport and environmental protection sectors. Subsidiaries of CSOEs are included as separate enterprises. In total, there are 175 CSOEs and their subsidiaries acting as societal capital organizations in the two sectors. Eight major CSOEs are selected as more than three of their subsidiaries participate in PPP projects. The proportion of subsidiaries participating in PPPs from those eight CSOEs is near 85%.

influence and control power. Because of a high dependence on CSOEs in the transport sector, the geography of network participants was closely aligned with the provincial distribution of CSOEs.

Figure 9(a) Influence of CSOEs

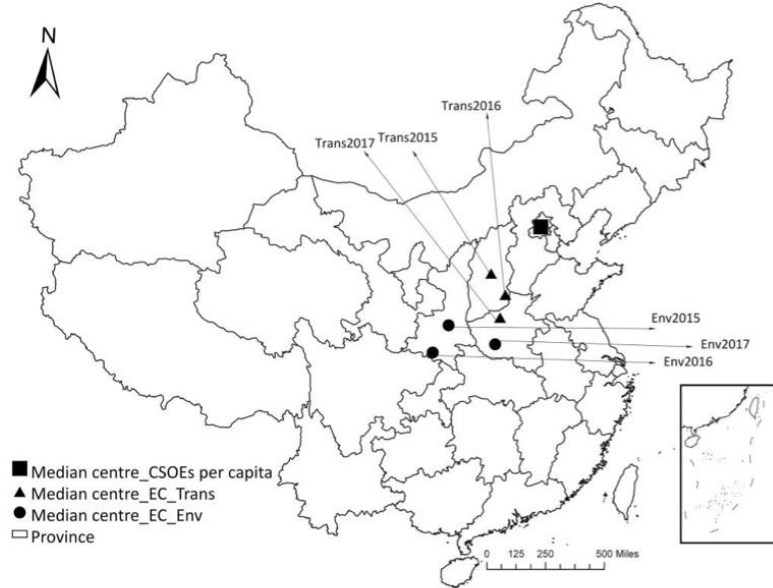


Figure 9(b) Control power of CSOEs

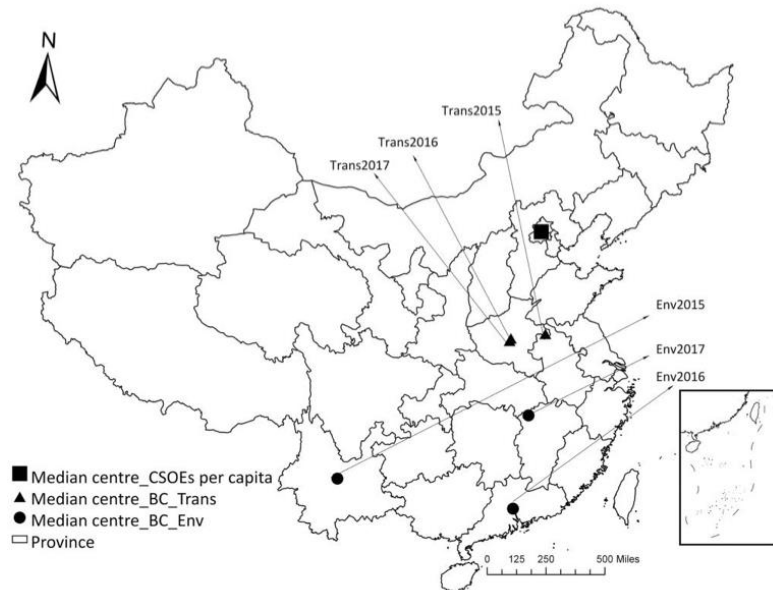


Figure 9. Central Tendency of Influence and Control Power of CSOEs in Transport and Environmental Protection PPP Networks versus Major CSOEs in China, 2015-2017
Source: National PPP database, China's Ministry of Finance

Conclusions and Policy Implications

Informed by the resource-based view (RBV) and resource-dependency theory (RDT), this research examined whether CSOEs would exert influence and control over other participants in PPP networks. A Social Network Analysis (SNA) of transport and environmental protection sectors PPP projects in 2012-2017 showed that the transport sector PPP network was larger and more cohesive than that of the environmental protection sector and that the influence and control power of CSOEs was greater in the former. This result corresponds with the RBV suggestion that transport PPPs rely and depend more than environmental protection PPPs on resources and assets possessed by CSOEs, such as credentials, financial and human capital, while greater dependence on CSOEs in transport suggests in the light of the RDT that CSOEs' control power in this sector is greater than in the environmental protection sector.

CSOEs' influence and control power have increased since 2017 in both sectors. Because of a sudden surge in the number and value of PPP projects, in 2017 China's central government tightened PPP qualifications and approval requirements, possibly further strengthening CSOEs' network influence and control power as a result of their competitive advantages over sub-national SOEs and private firms in terms of financial capacity, expertise, human capital, and credibility.

Geographically, the spatial concentration of CSOEs' influence and control power in the transport sector is more aligned with the geographical distribution of Chinese CSOEs than in the environmental protection sector where CSOEs' dominance is somewhat less. Closer alignment in the former than the latter may suggest local

governments in the environmental protection sector have greater flexibility and discretion and can seek non-CSOEs participants with strategic access to key technology and skills.

CSOEs' dominant role in PPP networks in both transport and environmental protection sectors are indicative of their superior possession of strategic assets.

Policymakers should reduce resource gaps between SOEs and private businesses, and only in so doing, it is likely that the relative importance of CSOEs will be reduced, and the presence and involvement of non-SOEs in China's PPPs can be enhanced.

The significance of this research is that it provides an analytical framework to identify the differing roles and different degrees of access and control over resources of different actors in Chinese PPP networks by drawing on SNA to examine governance networks. In this way PPP projects and collaborations are not isolated or independent from each other. From a network perspective, the interactions among different types of participants are better discerned. A number of limitations remain to be addressed in future research. First, one must take care not to generalize from just the transport and environmental protection sectors. Second, attention should be paid to the distinctive characteristics of different local governments.

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Appendix
Mean comparison statistics for Figures 7-8

Table A.1 The mean-comparison test results of eigenvector centrality of different types of actors in PPP networks, 2015-2017

Year	Group1	Group2	Transport		Environmental protection	
			p	p.signif	p	p.signif
2017	Government	CSOEs	6.24E-30	****	6.06E-07	****
2017	Government	Private	6.53E-01	ns	1.80E-01	ns
2017	Government	SOEs	4.19E-01	ns	9.67E-01	ns
2017	CSOEs	Private	2.68E-24	****	1.08E-05	****
2017	CSOEs	SOEs	1.47E-21	****	1.12E-05	****
2017	SOEs	Private	2.19E-01	ns	2.70E-01	ns
2016	Government	CSOEs	5.06E-18	****	1.31E-02	*
2016	Government	Private	9.96E-01	ns	2.29E-01	ns
2016	Government	SOEs	1.79E-01	ns	5.97E-02	ns
2016	CSOEs	Private	5.06E-15	****	7.82E-02	ns
2016	CSOEs	SOEs	7.47E-11	****	6.48E-01	ns
2016	SOEs	Private	1.96E-01	ns	2.37E-01	ns
2015	Government	CSOEs	3.92E-10	****	8.24E-02	ns
2015	Government	Private	4.46E-01	ns	1.15E-01	ns
2015	Government	SOEs	5.87E-02	ns	1.47E-02	*
2015	CSOEs	Private	3.21E-07	****	6.16E-01	ns
2015	CSOEs	SOEs	1.60E-03	**	7.95E-01	ns
2015	SOEs	Private	3.80E-01	ns	4.25E-01	ns

Note: ns= non-significant, *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0.0001.

Table A.2 The mean-comparison test results of betweenness centrality of different types of actors in PPP networks, 2015-2017

Year	Group1	Group2	Transport		Environmental protection	
			p	p.signif	p	p.signif
2017	Government	CSOEs	6.63E-16	****	9.45E-05	****
2017	Government	Private	7.21E-01	ns	8.20E-01	ns
2017	Government	SOEs	1.58E-02	*	1.25E-01	ns
2017	CSOEs	Private	6.95E-12	****	9.20E-05	****
2017	CSOEs	SOEs	1.68E-07	****	6.15E-02	ns
2017	SOEs	Private	1.94E-02	*	1.06E-01	ns
2016	Government	CSOEs	1.92E-08	****	1.01E-01	ns
2016	Government	Private	2.56E-01	ns	9.94E-01	ns
2016	Government	SOEs	1.24E-01	ns	1.05E-01	ns
2016	CSOEs	Private	2.02E-08	****	1.13E-01	ns
2016	CSOEs	SOEs	1.63E-04	***	9.70E-01	ns
2016	SOEs	Private	1.81E-02	*	1.17E-01	ns
2015	Government	CSOEs	7.93E-04	***	7.82E-01	ns
2015	Government	Private	5.92E-01	ns	7.56E-01	ns
2015	Government	SOEs	4.84E-01	ns	5.22E-01	ns
2015	CSOEs	Private	1.22E-03	**	6.54E-01	ns
2015	CSOEs	SOEs	2.37E-02	*	4.70E-01	ns
2015	SOEs	Private	2.76E-01	ns	7.03E-01	ns

Note: ns= non-significant, *p < 0.05, **p < 0.01, ***p < 0.001, ****p < 0.0001.

ESSAY 2 THE IMPACT OF LOCAL GOVERNMENT FISCAL GAPS ON PUBLIC-PRIVATE PARTNERSHIPS: GOVERNMENT DEMAND AND PRIVATE SECTOR RISK AVERSION

Introduction

Collaboration with private partners enables public governments to expand access to financial, technical, and physical resources and to deliver public goods and services more efficiently and effectively. One salient manifestation of such collaboration is the public-private partnership (PPP), which is prevalent in both advanced and emerging economies, including the United Kingdom (e.g., Private Finance Initiatives), the United States (e.g., design-build projects), and China, which has seen a rapid increase in partnerships between local governments and societal capital organizations³ (Hale et al., 2009; Spackman, 2002; Tan & Zhao, 2019a).

Existing research has directed attention to government demand for PPPs to access financial resources and close budgetary gaps (Casady et al., 2020; Cepparulo, Eusepi, & Giuriato, 2019; Hodge, Greve, & Biygautane, 2018). However, such analyses through the lens of governments have overlooked how private entities screen and select governmental partners, and this knowledge gap is noteworthy because private entities enjoy a “buyers’ market” in which a large number of governments are assessed as potential collaboration candidates. High budgetary gaps, which underscore governments’ urgent demand for PPPs, may signal escalated risks to potential private collaborators. In essence, there is a

³ Researchers use the term of societal capital organizations (*shehui ziben*) in China’s PPP context because, in addition to partnerships with private corporations and foreign businesses, governments also partner with state-owned enterprises that have various extents of public ownership. For a thorough review of engagement and influences of different types of societal capital organizations in China’s PPP projects, please refer to Xiong et al. (2021).

paradoxical relationship. Local governments with large fiscal gaps, which are in dire need of PPPs, may carry substantial financial risks, which could trigger risk aversion and deter private entities from entering into PPPs. A perspective from private partners, focusing on their consideration and preferences in selecting governmental entities to institute PPPs, will complement and greatly enrich our understanding of PPP formation beyond the sole demand of governmental entities.

This paper seeks to disentangle and decompose what the fiscal gap embodies and represents to public and private partners by developing a conceptual model that integrates the lenses of both governments and private investors. A causal mediation analytic framework (Imai, Keele, & Tingley, 2010) was developed to delineate and estimate the effects of fiscal gaps on PPPs from the respective perspective of governments and private partners. Through the lens of governments, governments' need to form PPPs to close their budgetary gaps is mediated by debt financing. External borrowing is another method used by governments to acquire financial resources, and it is often pursued before equity financing—according to the pecking order theory (Frank & Goyal, 2008; Myers & Majluf, 1984). The debt-mediated relationship represents governments' tiered preference of own-source revenues over external debts and then over PPPs (Zhao, Su, & Li, 2018). Through the lens of private investors, government fiscal gap is characterized as a risk factor in line with the vast literature on municipal bonds and rating of creditworthiness (Palumbo, Shick, & Zaporowski, 2006; Standard & Poor's, 2013). Enlarged fiscal gaps may signal elevated risks and may deter risk-averse private entities from entering into PPPs. Through the causal mediation framework, the total effect of fiscal gaps on PPP formation can be deconstructed into a debt-mediated, indirect effect capturing the

demand for resources through PPPs as well as a direct effect measuring governments' fiscal worthiness or quality in PPPs.

Two essential hypotheses are derived from the causal mediation analytic framework. From the government perspective, fiscal gaps may induce municipal debt borrowing, and high debt positions may then induce greater PPP participation. In other words, government fiscal gap, as a need for additional resources, is positively correlated with PPP participation, which is mediated by government debt ratios. However, from the private sector's perspective, due to risk aversion, government fiscal gap is adversely correlated with PPPs. Because the signs of the two hypothesized relationships are opposite, they may cancel each other out when not properly specified and identified. Dependent on the relative magnitudes of the two opposite effects, the total effects may be zero, negative or positive, and/or statistically insignificant (MacKinnon, Krull, & Lockwood, 2000).

The developed causal mediation framework and the two derived hypotheses were tested with a dataset pertaining to China's PPP projects. The surge of PPPs in China in 2015-2017 offers an ideal research setting because a vast number of local governments were motivated to collaborate with potential private PPP partners within a very short timeframe. The total number of PPP projects rose from 62 to 4,742 and the total amount of PPP investment rose from RMB 0.2 trillion to 7.66 trillion (approximately USD 1.19 trillion) over a three-year span (BRI Data, 2019). Under such circumstances, private entities' risk aversion decisions may likely be captured when they have relatively greater discretion and flexibility in screening and selecting governmental PPP partners. Though the empirical analysis and hypothesis testing apply to the context of China, results and

findings may likely be applied to other countries and economies because the fundamental effects of government fiscal gap through the lenses of governments and private partners are shared and common internationally.

In addition to integrating, measuring, and comparing the effects of fiscal gaps on PPPs from perspectives of both governments and private investors, the present research is important because it will advance scholarly understanding of private partners' risk perceptions in the pre-PPP phase. Unlike PPP implementation, the pre-PPP phase is an informal stage where public and private partners explore and assess potential uncertainty and risks before deciding to enter into formal PPP agreements (Van Ham & Koppenjan, 2001; Koppenjan, 2005). Such pre-PPP risk perception and aversion differ from risk assessment and management during PPP implementation—in which private partners bear significant risk management responsibilities (World Bank, 2017). While risk management in implementing PPP agreements has been extensively examined in the literature (Burke & Demirag, 2019; Rybnicek, Plakolm, & Baumgartner, 2020; Wang et al., 2018), conditions that determine the private sector's risk perceptions and PPP participation decisions *ex ante* have been underexplored.

The rest of this paper is organized as follows. The next section draws theoretical insights from risk aversion considerations and behaviors in the municipal bond and PPP market as well as the pecking order theory. Two central hypotheses are developed to characterize and test the relationships between fiscal gaps, debt positions, and PPP adoption. A conceptual model is built to delineate pathways from fiscal gaps to PPP adoption through the lens of governments and private partners respectively, corresponding to the two hypotheses. We then introduce and explain the causal mediation

method and data used in this paper. This is followed by discussions of empirical results and, finally, conclusions and policy implications.

Research Background and Hypothesis Development

Risk Aversion to Local Government Fiscal Gaps

Private entities' risk aversion behaviors are under-studied in the context of forming PPPs with local governments. However, such risk aversion is well established when private investors assess governments' financial conditions in municipal bond purchasing decisions and behaviors. Municipal bonds are issued by U.S. local governments to finance public infrastructure and then sold to investors who prefer safe assets and high-grade securities (Omstedt, 2020). Investors' risk perceptions in the bond market are largely affected by credit ratings from third-party intermediaries, principally including Moody's, Standard & Poor's, and Fitch. Bonds with higher credit quality indicate a greater possibility for investors to acquire principal and interest in a timely manner, thereby lowering risks. Because of investors' risk-averse behavior, municipalities with low credit rating are forced to offer higher interest rates to attract private capital (Kriz, 2004; Wu, 1991). To reduce the additional interest costs, municipal bond insurance has been widely used in the bond market as a credit enhancement to boost bond ratings and to provide assurance to potential private investors (Denison, 2001; Justice & Simon, 2002; Omstedt, 2020).

Bond-issuing municipalities' fiscal gap is one of the major factors affecting their underlying creditworthiness in the bond market. Fiscal gap is the difference between a government's expenditure needs and its available revenues (Sharma, 2012). Among its credit rating criteria assessing local governments, Standard & Poor's (2013) uses the

revenue/expenditure balance to assess a local government's ability to finance public services. Fitch (2020) considers the relative growth between spending and revenue as well as the government's gap-closing capacities, particularly during economic downturns. Empirically, Palumbo, Shick, and Zaporowski (2006) found that municipalities with a higher ratio of tax revenues to expenditures (i.e., smaller fiscal gap) tend to have higher bond ratings, based on 159 long-term uninsured municipal bonds issued in the 1980s and 1990s.

The notion that risk-averse private investors may rebalance their investments and returns in the bond market with governments that have a large fiscal gap has not been fully explored in the context of PPP formation. Both public and private parties are exposed to substantial risks in PPPs. The collaboration between the public and private sector typically spans a long term more than ten years and involves multiple stakeholders, which would magnify the external, contractual, and behavioral uncertainty in the partnerships (Fleta-Asín, Muñoz, & Rosell-Martínez, 2020). To cope with uncertainties, both public and private entities attach great importance to risk management that consists of risk identification, risk evaluation, and risk mitigation (Rybnicek, Plakolm, & Baumgartner, 2020; Van Ham & Koppenjan, 2001). Rybnicek, Plakolm, and Baumgartner (2020) highlighted disparate solutions to mitigate risks, including actions to avoid, minimize, transfer, and retain risks. Individuals who “seek some guarantee of the attainment of desirable outcomes or insurance against the occurrence of undesirable outcomes” are considered to be risk-averse (Bergen, Dutta, & Walker, 1992, p.4). Although the extent of risk mitigation may vary, PPP participants tend to be risk-averse.

Private entities are assumed to be more risk-averse than governments. Vining and Boardman (2008) contended that private organizations are “risk-adjusted profit maximizers” (p.152). Once potential risks are identified and assessed, private entities may engage in risk aversion behaviors, such as restricting their investments to profitable service areas and sacrificing some expected profits for risk reduction (Koppenjan & Enserink, 2009; Vining & Boardman, 2008). The risk-averse attitude and behavior of private organizations is a result of their desire to secure funders’ investments as well as the public sector’s intention to transfer risks to the private organizations (Barlow & Köberle-Gaiser, 2008). Besides, compared to their public partners, it is the individual investors and managers who bear the possible consequences of risks and uncertainties directly and personally (Vining & Boardman, 2008).

Risk-averse private partners’ identification and assessment of municipal fiscal risks at a pre-PPP stage, which may affect their decisions to enter into formal PPP agreements, are under-studied in the PPP literature. Municipal fiscal gap (i.e., imbalanced and excess expenditures compared to revenues) has been interpreted almost exclusively as a demand of government for motivating and boosting PPP formation (Cepparulo, Eusepi, & Giuriato, 2019; Girth, 2014; Wang et al., 2018). This branch of literature contends that adopting and utilizing PPPs provide an additional financing approach to overcome governmental budget constraints. In the UK, Private Finance Initiative contracts, which are country-specific forms of PPPs, have relieved the pressure on governmental borrowing and spending since the 1990s (Spackman, 2002). In the U.S., Y. Wang and Zhao (2014) found that U.S. states with large demands and limited public revenues are more likely to adopt PPPs for toll road projects. In France, Buso, Marty, and

Tran (2017) confirmed a positive relationship between high debt burden of local municipalities and high PPP adoption. This partial interpretation of municipal fiscal gaps through the lens of governments needs to be supplemented and complemented by a perspective from private parties, in which cities of different levels of fiscal gaps, thus different levels of perceived risks, are linked to private partners' risk-averse considerations before they enter into PPP projects.

The Lens of Private Investors in PPP Formation

Through the lens of private investors, when a large number of governments are trying to initiate PPP projects, private investors—like their counterparts in the municipal bond market—will assess candidate governments' fiscal gaps and risks before they decide whether or not to become involved in specific PPP transactions. Perceived risks at the pre-PPP stage (i.e., prior to signing into a PPP agreement), as suggested by Van Ham and Koppenjan (2001) and Koppenjan (2005), differ from risk assessment and management inherent in PPP implementation but may likely amplify the risks in PPP implementation. PPP implementation risks arise from three sources: project, market, and country (Wang et al., 2018). On the project level, financial risks are commonplace, such as “an insufficient cash flow and the oppressive costs of long-term investments” (Van Ham & Koppenjan, 2001, p.600). Also, the conflict of interests between public and private sector may induce opportunistic behaviors (Lohmann & Rötzel, 2014). Furthermore, PPP implementation is susceptible to uncertain and fluctuated market demand (Rybnicek, Plakolm, & Baumgartner, 2020), as well as country-level political, policy, and administrative interruptions and discontinuity (Van Ham & Koppenjan, 2001; Koppenjan & Enserink, 2009). Governments with large fiscal gaps, which are deemed

high risks during the pre-PPP screening, are significantly crippled to mitigate PPP implementation risks or cope with their adverse consequences. For instance, their financial constraints may make them more vulnerable to market fluctuations or natural disaster emergencies that may delay or interrupt PPP implementation.

Selecting and collaborating with local governments that have a significant fiscal gap is a high-risk proposition to private investors. Unlike the municipal bond market, in which private investors are compensated by higher interest rates when purchasing lower-rated bonds (Afonso, Gomes, & Rother, 2007), the context of long-term PPP agreements lacks an established higher-return compensation mechanism for elevated risks. In many PPP agreements, governments do not guarantee the rate of return, but link private investors' return with their performance. When entering into PPP agreements with governments that have a significant fiscal gap, private companies are exposed to added risks without guaranteed higher returns. Furthermore, there are no authoritative rating agencies, such as Moody's, Standard & Poor's, and Fitch, for assessing local government risks in the PPP market. Instead, private companies often hire external consultants to assess and mitigate risks, including governments' default risk, during the whole lifecycle of PPP projects (Yescombe, 2007). Based on their unique experience and expertise, external advisors may have varying assessment and management standards that are inconsistent and incompatible.

Because of private investors' risk-averse behaviors as well as escalated risks associated with local government fiscal gaps, our first central hypothesis is specified as:

H1: Government fiscal gap is adversely related with PPP participation.

Four different indicators were employed to capture various adverse impacts of PPP participation, ranging from a lower collaboration likelihood to reduced investment amounts. Therefore, four more specific, auxiliary hypotheses were developed and tested respectively. They are:

H1a: Local governments with larger fiscal gaps would have a lower likelihood of entering into PPP agreements.

H1b: Local governments with larger fiscal gaps would have fewer numbers of PPP projects, standardized by city population.

H1c: Local governments with larger fiscal gaps tend to have smaller PPP investment amounts, standardized by city population.

H1d: Local governments with larger fiscal gaps tend to have smaller average investment amounts per PPP project.

Mediating Role of Local Government Debt Positions

Governments may resort to debt financing (Mikesell, 2011) or access private capital through PPPs (Cepparulo, Eusepi, & Giuriato, 2019; Wang et al., 2018) to close their fiscal gaps. Existing studies, however, have often examined the two sources disjointly—overlooking their interactions, sequences, and potential tradeoffs. A conjoint delineation of government budgetary gaps, internal resources, debt financing, and PPP adoption is critical to accurately estimate the relationship between fiscal gaps and PPP participation. Governments have a tiered, preferential ranking over various financial sources, as predicted by the pecking order theory (Myers, 2003; Myers & Majluf, 1984). Debt financing may be sought after first to close financial gaps before PPPs is reached for

private capital. Therefore, debt positions may play a mediating role between government fiscal gaps and PPP involvement.

The pecking order theory, initiated in the corporate finance literature, suggests that firms tend to adhere to a hierarchy of financing sources, prioritizing internal revenues over debt and then over equity. Myers and Majluf (1984) contended that when internal funds are depleted, debt financing is favored over equity because external investors lack information about the true conditions of the firm and tend to undervalue newly issued stocks. Company executives, however, acting in the interest of existing shareholders, are unlikely to issue undervalued shares. Butters (1949) and Frank and Goyal (2008) explained the pecking order as a result of cost-saving behaviors. They indicated that external financing normally involves higher costs and greater difficulty negotiating with investors. Equity financing then becomes the “last resort” only when debt ratios are excessive, and borrowing costs are prohibitively high (Myers, 2003). Butters (1949) maintained that shifts from internal funds to debt and then to equity occur when “one source of funds after another is exhausted” (p.200).

The pecking order theory has been applied to governmental financing to explore the relationships between internal revenues, financial slack, debt, and PPPs. Based on the data of 58 cities in California between 2003 to 2011, Su and Hildreth (2018) found a negative relationship between unreserved general fund balance (i.e., the available financial resource under local government discretion) and short-term municipal borrowing. The paper suggested that when local governments are confronted with cash deficits, they tend to prefer internal financial slack to short-term borrowing. Using China’s infrastructure finance as an example, Zhao, Su, and Li (2018) described that local

governments started with fiscal revenues to finance infrastructure when other resources are unavailable. Later, facing increasing fiscal deficits, governments shifted to debt financing as the primary approach in their investment practices. Until recently, PPPs prevailed among local governments due to the climbing costs and difficulties to issue more debts. While the existing empirical studies mainly test the pecking order theory from a substitution or negative relationship between internal resources and external borrowing, the mediating role of government debt positions in establishing PPPs is understudied.

Drawing from pecking order theory and hierarchical governmental financing sources, we expected local governments with fiscal gaps to prioritize debts over PPPs when utilizing external financing to provide public goods and services. Local government debt positions would play a mediating role in PPP engagement. Thus, pertaining to the mediation process, we proposed the other central hypothesis, specified in two successive statements:

H2a: Local governments that experience larger own-source fiscal gaps tend to have a higher level of the debt position.

H2b: Local governments that have a higher level of the debt position will have a higher likelihood of adopting PPPs.

A Conceptual Model

A conceptual model that links and summarizes the effects of fiscal gaps on PPP participation through the lenses of both governments and private investors is presented in Figure 10. This model delineates a bifurcated, mediated relationship between local government fiscal gaps, debt position, and PPP adoption. Fiscal gap is positioned and

interpreted both as a demand of governments for external funds and as a risk factor to risk-averse private companies. In other words, one indicator carries two distinct meanings, which may suggest different effects on PPPs.

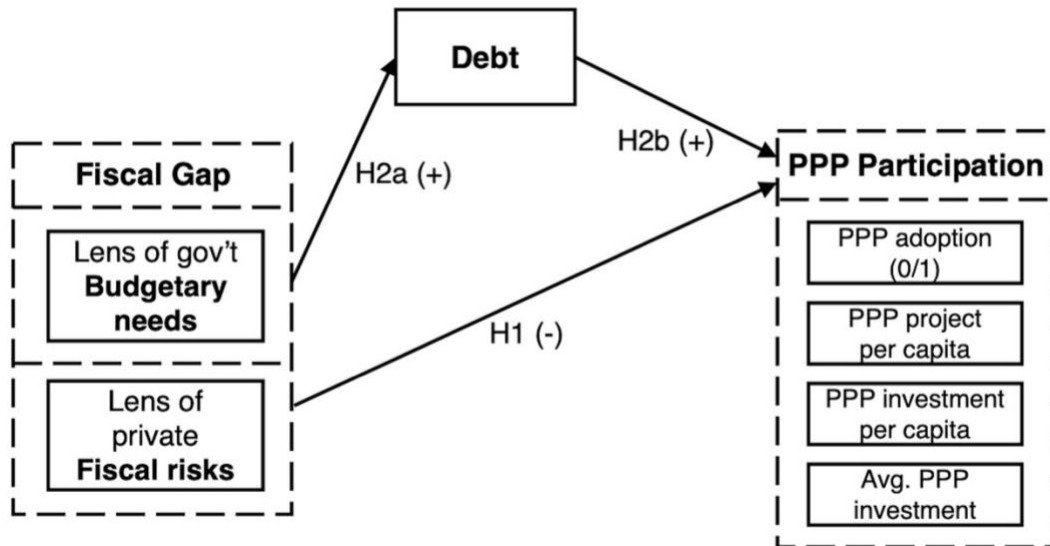


Figure 10. The Conceptual Model

On the one hand, through the lens of private sector, a high level of government fiscal gaps may be perceived as elevated risks by risk-averse private partners. As discussed above, because there is no additional return to compensate for amplified risks related to fiscal gaps, risk-averse private investors may be conservative toward local governments experiencing larger own-source fiscal gaps, either in likelihood of PPP participation or in PPP investment amounts. This adverse relationship corresponds to hypothesis H1 and is labeled as such in Figure 10.

On the other hand, through the lens of local governments, this conceptual model captures the mediating role of debt position between local government own-source fiscal gaps and PPP adoption. Local governments may choose to issue debts or use PPPs to

close their budgetary gaps. They would follow the pecking order, preferring debt issuance over PPPs. Only when facing increasing costs and difficulties to issue new debts, local governments will partner with private companies through PPPs. Therefore, local governments with larger own-source fiscal gaps tend to have a higher level of the debt position (hypothesis H2a), and local governments that have a higher level of the debt position will be more likely to adopt PPPs (hypothesis H2b).

In the conceptual model, we use four different measurements to capture various effects on PPP adoption, thus allowing us to better examine the effects of fiscal gap and debt position on PPP activities. These are (1) a city's probability of adopting PPPs, (2) a city's total number of PPP projects standardized by population, (3) a city's total PPP investment amount standardized by population, and (4) a city's average PPP investment size per project. Empirical findings of this paper will augment previous results focusing either on the probability of PPP adoption (Buso, Marty, & Tran, 2017; Wang & Zhao, 2014) or on the value of PPP projects (Mota & Moreira, 2015).

Methodological Approach

Causal mediation analysis is utilized to delineate two perspectives (i.e., the lenses of both governments and private investors) and to estimate the respective effects of fiscal gaps on PPP formation. Causal mediation analysis assumes the relationship between an independent variable (treatment) and a dependent variable (outcome) (i.e., total effect) is divided into two causal paths (MacKinnon, Krull, & Lockwood, 2000). One is a direct effect between the independent variable and the dependent variable, and the other is an indirect effect between the independent variable and the dependent variable through a mediator. In our model, the direct effect denotes the relationship between local

government fiscal gap and PPP participation. The indirect or mediated effect is based on government demand for external resources. Debt financing plays a mediating role between local government fiscal gap and PPP participation, due to governments' tiered preferences for debts over PPPs. The sum of the direct and indirect effects constitutes the total effect of fiscal gaps on PPP participation.

Causal mediation analysis helps disentangle competing theoretical explanations of the same or adverse causal effects (Imai, Keele, & Tingley, 2010) and “quantify the effect of a treatment that operates through a particular mechanism” (Hicks & Tingley, 2011, p.606). Specifically, without delineating and separating the debt-mediated effect from the direct effect of the fiscal gap, the two effects will be lumped together. The sign and magnitude of the total effect depend on their relative sizes. Causal mediation analysis has been used in the public performance and management literature, including tests of the mediating role of public employees' internal emotions between public service motivation and customer service behavior (Potipiroon, Srisuthisa-ard, & Faerman, 2019) and the mediating role of public managers' proactive solution-seeking activities between organization performance gaps and performance improvement (Min & Oh, 2020).

The causal mediation regression equations are expressed as follows:

$$Debt_i = \alpha_1 + \beta_1 Fiscal\ gap_i + \xi_1^T Control_i + \delta_1 Provincial\ capital_i + \eta_1 Centrally\ administered\ city_i + \theta_1 Year_i + \epsilon_{i1} \quad (1)$$

$$PPP\ participation_i = \alpha_2 + \beta_2 Fiscal\ gap_i + \gamma Debt_i + \xi_2^T Control_i + \delta_2 Provincial\ capital_i + \eta_2 Centrally\ administered\ city_i + \theta_2 Year_i + \epsilon_{i2} \quad (2)$$

In the mediator equation (1), the relationship between local government fiscal gap (treatment) and debt (mediator) is tested first. *Fiscal gap_i* is the ratio of general expenditure to general revenue of municipality *i*, while *Debt_i* is the mediator measured by the ratio of accumulated amount of government debts to general revenue of municipality *i*. In the outcome equation (2), we estimate the effects of both fiscal gap (treatment) and debt ratio (mediator) on PPP adoption (outcome). *PPP participation_i* is the dependent variable, measured by four indicators—namely: the probability of PPP adoption, the number of PPP projects per capita, the amount of PPP investment per capita, and the average PPP investment size per project. Both *Fiscal gap_i* and *Debt_i* are employed as independent variables. In both equations, *Control_i* is a vector of control variables consisting of revenue, economic, and public management variables of municipality *i*. *Provincial capital_i* denotes whether municipality *i* is a provincial capital, and *Centrally administered city_i* refers to whether municipality *i* is centrally administered.⁴ *Year_i* is a year dummy variable. The symbols α_1 and α_2 denote the intercepts; $\beta_1, \beta_2, \gamma, \xi_1^T, \xi_2^T, \delta_1, \delta_2, \eta_1, \eta_2, \theta_1$ and θ_2 refer to the coefficients to be estimated; ϵ_{i1} and ϵ_{i2} are the error terms. Based on the nature of the four dependent variables in the outcome models—specifically, binary (0/1) for PPP adoption and continuous for the other three—Probit and ordinary least squares linear models are used respectively.

We adopt a two-step procedure suggested by Hicks and Tingley (2011) to test the validity of the mediated relationships. The first step is to test the relationship between the

⁴ There are four centrally administered municipalities: Beijing, Tianjin, Shanghai, and Chongqing.

treatment and the mediator (the mediator equation), specifically, whether there is a statistically significant relationship between fiscal gap and debt ratio. If the mediating relationship is statistically significant, step two is to estimate the respective effects of the treatment and the mediator on the outcome (the outcome equation). The mediator variable—namely, debt ratio—should have statistically significant relationship with the outcome: PPP participation. The total effect of the treatment variable on the outcome variable may be statistically insignificant (Hayes, 2017). MacKinnon, Krull, and Lockwood (2000) suggested that when the direct and mediated effects have similar magnitudes but opposite signs, the two effects may cancel each other out and result in a statistically insignificant total effect.

Traditional mediation analysis does not address with nonlinear models, such as those with a binary mediator and/or an outcome variable (Pearl, 2012). To overcome this, we use the Stata *mediation* package, which is built on a more general mediation approach for both linear and nonlinear models.⁵ This general approach does not rely on a specific statistical model but uses an algorithm based on the quasi-Bayesian Monte Carlo approximation of King, Tomz, and Wittenberg (2000). In contrast to the traditional method which calculates the mediation (indirect) effect by the product of coefficients along the causal paths (MacKinnon et al., 2002), the general approach simulates the average causal mediation effect (ACME), average direct, and total effect and reports their statistical significance. Imai, Keele, and Tingley (2010) validated the new, general mediation estimation and compared effect magnitudes of two approaches. Simulation-

⁵ For a theoretical review of the Stata mediation package, please refer to Imai, Keele, and Tingley (2010); for a technical review, Hicks and Tingley (2011).

based effect estimates are approximate to those derived from the traditional mediation analysis, but they are not identical (Hicks & Tingley, 2011).

Data and Variables

To test the conceptual model and derived hypotheses, we used data on China’s PPP projects supplemented by the prefecture-level city information of fiscal gaps and debt positions during the period of 2015-2017, when PPPs in China had grown rapidly (see Figure 11). The reasons for using data on China’s PPPs are twofold. First, China has a larger number of PPP projects compared to other countries. The context provides an abundance of available data for analysis. Second and more importantly, the surge of PPP projects initiated by a great number of local governments in this short, three-year timeframe created a “buyers’ market” for societal capital organizations to screen and select candidate governmental PPP partners. This is an ideal context to test the risk aversion decisions in the PPPs through the lens of private partners.

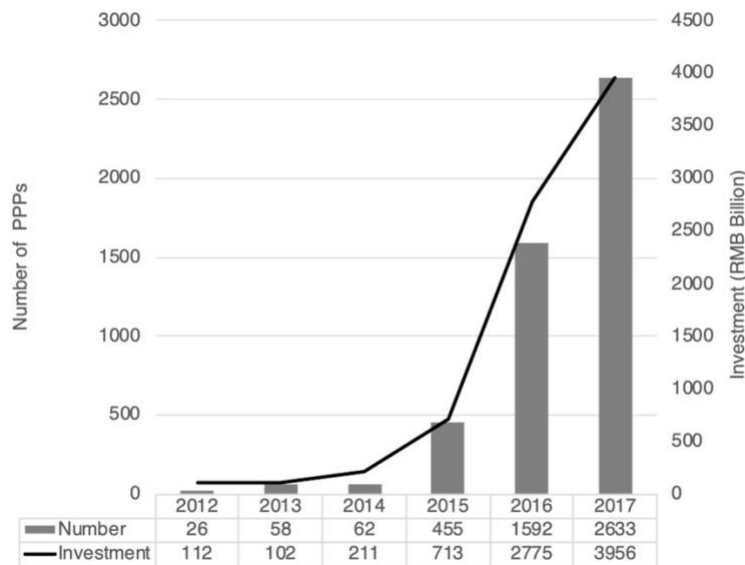


Figure 11. Total Number and Investment of PPP Projects across Years, 2012-2017
Data source: National PPP database by China’s Ministry of Finance

Table 2. Descriptive Analysis of Variables (N=282), 2015-2017

Variables	Description	Mean	Std. Dev.	Min	Max	Expected Sign
<i>Dependent variables</i>						
PPP adoption	Dummy variable for each city's adoption of PPPs	0.926	0.263	0	1	
PPP project per capita	Total number of each city's PPP projects per million population	1.921	1.844	0	9.652	
PPP investment per capita	Total investment amount of each city's PPP projects per capita (RMB)	2346.068	2821.39	0	18716.2	
Avg. PPP investment	Average investment amount of each city's PPP projects (10,000 RMB)	138574.2	214927.6	0	2077400	
<i>Independent variable</i>						
Own-source fiscal gap	Ratio of general fiscal expenditure to general fiscal revenue	2.949	1.791	1.038	11.535	-
<i>Mediator</i>						
Debt	Ratio of accumulated amount of government debts to general fiscal revenue	2.601	2.100	0.201	21.054	+
<i>Revenue variables</i>						
Land transfer REV %	Ratio of Land transfer fees to (General fiscal rev + Land transfer fees + Intergovernmental transfer)	0.175	0.118	0.009	0.647	-
Intergovt transfer REV %	Ratio of Intergovernmental transfer to (General fiscal rev + Land transfer fees + Intergovernmental transfer)	0.361	0.271	0	0.890	-
<i>Economic variables</i>						
GDP	Each city's gross regional product (trillion yuan)	0.266	0.396	0.015	2.818	-
GDP growth	Percent change of each city's gross regional product from the preceding year	0.053	0.083	-0.364	0.273	+
Economic openness	Percentage of FDI in the city's GDP	0.003	0.003	0	0.017	+
<i>Public management variables</i>						
Government size	Percentage of general fiscal revenue in the city's GDP	0.082	0.032	0.034	0.227	-
Fiscal transparency	An index measuring the city's fiscal transparency (0-100)	50.15	17.67	6.64	84.63	+
<i>Other variables</i>						
Population	Total resident population in each city (million people)	4.688	4.267	0.241	30.484	+
Provincial capital	Dummy variable for the capital of the province	0.106	0.309	0	1	-
Centrally administered cities	Dummy variable for the four centrally administered municipalities	0.025	0.156	0	1	-

Dependent variables. Four dependent variables were used: (1) whether or not a government was engaged in a PPP agreement (binary 0/1), (2) per capita number of all PPP projects a government was involved, (3) per capita amount of all PPP investment a government attracted, and (4) average investment amount per PPP project a government attracted. All dependent variables, excluding the binary PPP adoption, were transformed in natural logarithm. The definitions and summary statistics of all variables are provided in Table 2. As shown in Table 2, in each city, there were on average about two PPP projects per million population with a mean investment amount of nearly 2,000 RMB per capita. Data on PPP projects were collected from the China Public Private Partnerships Center of the Ministry of Finance (MoF). MoF is the official organization authorized by the central government to manage PPP projects in China. This official dataset has been used to explain the adoption rate of PPP projects in Chinese provinces by Tan and Zhao (2019b), and Xiong et al. (2020) used it to test why PPPs have become a government response to sustainable urbanization based on the relationship of resources, institutional roles, and institutional rules.

Fiscal gap. The local government fiscal gap was measured by the ratio of general expenditure to general revenue. The focus on the own-source operating ratio highlights and captures local government self-financing capacity (Tong et al., 2019). Other revenue sources, such as revenues from land transfers or intergovernmental transfers, were not included in our calculations of the fiscal gap. The two revenue sources were utilized as control variables instead. This is because local government revenues from land transfers and intergovernmental transfers are relatively uncertain compared to their own-source budgetary income (Su & Hildreth, 2018; Xiong et al., 2020). Data on fiscal gaps of

prefecture-level city governments were collected from the China City Statistical Yearbooks in various years.

Debt position. We used the ratio between accumulated amount of government debts and general revenue to measure local government debt positions—in line with the measurement used in Gorina, Maher, and Joffe (2018). Data on government debts were collected from the Wind Financial Database (www.wind.com.cn). One challenge of data collection is missing data in the Wind Financial Database regarding cities' government debt balances. The Wind database does not specify whether the missing data represent true zero debt balances or if such data are unreported/suppressed. We take a conservative approach; that is, we treat all missing debt balances as true missing data and remove all relevant observations from the data sample. This reduces the sample size to 282 from 867 (289 cities in three years). A less conservative treatment could preserve the full sample size by assuming zero debt balances for all missing data points; however, not only is such treatment arbitrary, it also incurs inflated zeros (65%) in observations.

To compare the full sample and the sub-sample that excludes city-year observations with unreported debt balances, we conducted a series of t-tests with unequal variances for all three years. All dependent and independent variables are compared, and the results are presented in Table 3. It is shown that the sub-sample does not have systematic differences with the full sample regarding key variables in the analysis. The only two exceptions are that, for the year 2015, cities in the sub-sample had a higher intergovernmental transfer ratio (difference=0.005, $p=0.039$) and a smaller government size (difference=0.011, $p=0.044$). The t-test results suggest the sub-sample is not statistically significantly different from the full sample, except for two isolated

differences in a particular year. Because such year-specific isolated differences are likely captured and controlled by the year dummy variable, empirical results derived from the sub-sample could—with reasonable cautions—be generalized to the full sample (i.e., all prefectural-level cities in China).

Revenue control variables. Two variables were included to capture other revenue sources that a city utilizes to supplement its own-source revenue. The first is land transfer fees, and the other is intergovernmental transfers. The data source of land transfer fees is the China Land and Resources Statistical Yearbook, and the data source of intergovernmental transfers is the Wind Financial Database. Land transfer fees, which refer to “revenues from leasing land use rights and charging land use fees” (Zhao & Cao, 2011, p.292), are one of the most important sources of Chinese cities’ fiscal revenues. Since 1994, local governments have been allowed to retain all land transfer revenues as extra-budgetary income. In 2016, around 35% of local government revenues in China came from land transfer fees (Fan, Qiu, & Sun, 2020). Ye and Wu (2014) measured Chinese cities’ dependence on land financing by the share of land transfer fees as a percentage of general revenue and found a significant positive relationship between dependence on land financing and urbanization.

Table 3. Two-Sample T-Test Results of Cities with Debt Balances vs All Cities, 2015-2017

Variables	2015			2016			2017		
	Mean		Sig.	Mean		Sig.	Mean		Sig.
	Cities with debt balances (N=32)	All cities (N=289)		Cities with debt balances (N=94)	All cities (N=289)		Cities with debt balances (N=156)	All cities (N=289)	
PPP adoption	0.813	0.869	0.384	0.926	0.938	0.679	0.949	0.927	0.384
ln (PPP project per capita)	0.095	0.261	0.285	0.383	0.502	0.248	0.628	0.594	0.689
ln (PPP investment per capita)	16.936	18.097	0.409	19.243	19.625	0.563	19.959	19.581	0.488
ln (Avg. PPP investment)	16.841	17.835	0.456	18.860	19.124	0.666	19.331	18.987	0.494
ln (Own-source fiscal gap)	0.840	0.798	0.663	0.952	0.890	0.317	0.938	0.931	0.899
ln (Land transfer REV %)	-1.686	-1.607	0.496	-2.043	-1.970	0.440	-2.079	-1.994	0.312
ln (Intergovt transfer REV %)	-5.296	-9.530	0.039**	-6.434	-7.617	0.336	-6.711	-7.068	0.724
GDP	0.281	0.235	0.425	0.249	0.248	0.989	0.274	0.266	0.830
GDP growth	0.085	0.072	0.223	0.053	0.047	0.414	0.046	0.058	0.143
Economic openness	0.002	0.003	0.165	0.003	0.003	0.522	0.002	0.002	0.702
Government size	0.072	0.083	0.044**	0.083	0.084	0.855	0.083	0.081	0.619
Fiscal transparency	49.522	49.665	0.966	49.789	49.665	0.953	50.497	49.665	0.635
ln (Population)	1.325	1.256	0.604	1.302	1.260	0.613	1.252	1.267	0.833

Note: *** p<0.01, ** p<0.05, * p<0.1.

The intergovernmental transfer was first introduced in China by the tax sharing reform in 1994 (Guo, 2014). In just one year after the reform, revenues collected by the central government increased from 22% in 1993 to nearly 55% in 1994 (Huang & Chen, 2012). Table 2 shows that the average share of intergovernmental transfer as a percentage of local government total revenue is about 36%. Over-dependence on the intergovernmental transfer would be regarded as a risk factor because local governments cannot decide the amount and the time of the aid distribution from the upper level of governments (Hendrick, 2006; Su & Hildreth, 2018).

Economic control variables. Economic variables, such as GDP, GDP growth, and economic openness, were also controlled. Cities with a larger amount of total GDP may present a stronger economic capacity to support local government public provision. Those cities may have greater access to wider funding sources, compared to those with lower GDP. As a result, richer cities tend to have lower participation in PPPs. In addition to the total amount of GDP, GDP growth may signal an increasing demand for resources to finance development. Cities with significant GDP growth may show a great demand for PPPs to acquire infrastructure investment in order to facilitate economic development. Hence, a city's total GDP is expected to be negatively associated with its PPP participation, while a city's GDP growth is expected to be positively associated with PPP participation.

Additionally, a city with higher economic openness also reflects a more friendly environment for societal capital organizations' participation in PPPs. Economic openness was measured by the percentage of foreign direct investment (FDI) in the city's GDP and is expected to have a positive effect on local governments' PPP participation. Wang and

Yu (2017) explored the impact of economic openness on small- and medium-sized enterprises' perceptions of the local business environment in China. They found that an economically open city would promote the view from small- and medium-sized enterprises of local businesses. We collected data on all economic variables from the China City Statistical Yearbook.

Public management variables. Local governments' PPP participation is also influenced by their management capacity and credibility. We used government size, that is, the share of general tax revenue among GDP, to measure government capacity. Larger governments normally have a stronger capacity to collect more tax revenues and, thus, their demand for PPPs will be lower. Therefore, an adverse association between government size and PPP participation is expected. Additionally, government credibility plays an important role in attracting societal capital organizations' participation in PPPs. We used fiscal transparency as a proxy for governmental credibility. A transparent process with adequate disclosure of fiscal information will greatly mitigate societal capital partners' risk aversion in PPPs. Tan and Zhao (2019b), who investigated factors related to PPP adoption rate in China from 2012 to 2016, found that a higher adoption rate of PPPs is associated with a higher degree of fiscal transparency. Thus, a positive effect of fiscal transparency on local government PPP participation is expected. Data on fiscal transparency originate from the Report on Fiscal Transparency of Prefecture-Level Governments in China, which was compiled by Tsinghua University.

Other control variables. We also controlled for the total resident population in each city, provincial capital dummy, centrally administrated city dummy, and year dummy variables. Cities with a large resident population may indicate a high demand for

economic development and thus a great need for funding resources such as PPPs. Data on the total resident population were collected from CEIC Data (www.ceicdata.com). In addition, a dummy variable representing provincial capitals and a dummy variable representing four centrally administrated municipalities were included.

All independent variables were lagged one year to mitigate issues of endogeneity. This method has been commonly used in public management research, such as examining the effects of diffusion mechanisms on the adoption of different types of PPPs in China (Zhang, 2015), exploring the role of organizational administrative affiliation in moderating the effect of ownership on performance (Liang & Ma, 2020), and analyzing the relationships between governance and public administration quality and economic growth (Nguyen et al., 2021). Although possible factors that impact government demand for PPPs and private partners' risk assessment would likely occur in the previous years prior to investment, given the serial correlation of drivers of PPP adoption, both public and private sector may add weight to the conditions in the most recent year (i.e., one-year lag). Besides, pertaining to the key causal mediation variable, debt position, we used the accumulated amount of government debts to capture its long-term, instead of one lagged year, effect on PPP participation. Therefore, it is appropriate to use one-year lagged independent variables. In addition, key independent variables including the government own-source fiscal gap and debt position as well as the various revenue sources were in natural logarithms.

Casual Mediation Regression Results

The results of causal mediation analyses are presented in Table 4. The validity of a mediated relationship was tested in line with the two-step process described above. Specifically, the test of mediation requires that both the effect of the treatment variable on the mediator in the mediating equation (1) and the effect of the mediator on the outcome variable in the outcome equation (2) are statistically significant (MacKinnon et al., 2002). As shown in model 0, local government own-source fiscal gap has a positive and statistically significant relationship with the debt position variable: the mediator. In addition, the debt position has a statistically significant and positive relationship with each of the four PPP dependent variables in models 1-4. The positive, debt-mediated, demand-driven relationship between fiscal gap and PPP participation is therefore confirmed, and hypotheses H2a and H2b pertaining to mediation are supported. Governments with a fiscal gap, in order to access financial resources, indeed have a great demand for forming PPPs. Such demand, however, is transmitted or meditated through debt financing, which is consistent with the pecking order theory. Local governments will first resort to external debts, as suggested by the positive association between fiscal gap and debt position, and then seek to adopt PPPs, as shown by the positive relationship between debt and PPP adoption.

The effects of the fiscal gap on PPP participation (i.e., hypotheses H1a through H1d), through the lens of private partners, are indicated by the coefficients of natural logged fiscal gap variables in models 1-4. They are all statistically significant and have negative signs, suggesting an adverse relationship between fiscal gap and PPP participation. The adverse, statistically significant relationships confirm hypotheses H1a

through H1d and shed light on private investors' risk aversion consideration and preference in screening and selecting candidate governmental PPP collaborators. Chinese cities with larger fiscal gaps are associated with lower probability of reaching PPP agreements, fewer PPP projects per capita, smaller per capita amount of PPP investment, and smaller average investment amount per PPP project.

Table 4 also presents simulated indirect, direct, and total effects.⁶ All indirect and direct effects are statistically significant, while indirect effects have positive signs but direct effects are negative. All total effects, which are the sum of the two, however, are statistically insignificant, except in model 2. The nulled total effects provide additional evidence and support for MacKinnon, Krull, and Lockwood (2000), who found that opposite signed direct and indirect effects may render their total effects statistically insignificant. Substantively, nulled total effects highlight the importance of the causal mediation framework and its use in delineating and separating distinct causal relationships. The fiscal gap may be mistakenly concluded to have no or limited effects on PPP participation, when the fiscal gap has two disparate and opposite mechanisms affecting PPP formation. Because direct and indirect effects have opposite signs, ratios of their absolute sizes are calculated to measure their relative strengths. It is suggested that, given various models, direct effects are 2.375 to 3.026 times greater than indirect effects.

⁶ Values of simulated direct and indirect effects differ slightly from those derived directly from estimated coefficients. For example, in model 3, the simulated direct and indirect effect are respectively -2.371 and 0.861. But based on coefficient interpretation of the traditional linear mediation model, the direct effect is -2.362 (i.e., coefficient of the fiscal gap in the outcome equation) and the indirect effect is 0.859 [i.e., the product of coefficient of the fiscal gap in the mediation model (0.616) and coefficient of debt in the outcome model (1.394)]. The traditional coefficient multiplication method does not apply to non-linear models, such as model 1, so simulated effects are used and interpreted exclusively in this paper.

The deterrence effects of the fiscal gap through the lens of private investors are therefore much greater than the impacts on resource acquisition of governments.

Direct effects of fiscal gaps vary when different dependent variables are used. The largest direct impact appears in model 3 with respect to per capita PPP investment. All other things being equal, a 10% increase in fiscal gap (i.e., the ratio of a local government's own-source expenditure to revenue) is on average associated with a 20.2% [$1.1^{(-2.371)} - 1 = -0.202$] reduction in PPP investment per capita. Using Table 2's in-sample average PPP investment per capita (RMB 2346.068) and average city population (4.688M), on average, a city has RMB 10.998 billion (approximately USD 1.69B) total PPP investment. A 20.2% decrease associated with a 10% greater fiscal gap would result in about USD 341.80 million PPP investment reduction, for one city in one year alone.

The smallest direct effect of the fiscal gap is associated with the likelihood of forming a PPP shown in model 1. It is estimated that a 10% increase in fiscal gap is related to a 0.7% [$1.1^{(-0.076)} - 1 = -0.007$] decrease in the probability of forming a PPP. The striking magnitude difference between PPP investment amount and likelihood of instituting a PPP may suggest that increased fiscal gap has limited adverse consequences on the probability of PPP collaboration. Though risk-averse private partners would still participate in PPPs, they would invest much conservatively when partnering with governments that experience a significant fiscal gap. The cautious and conservative investment decisions of private partners are further supported by a considerable reduction of average PPP project investment size as result of rising fiscal gaps. Our findings indicate that a 10% increase of fiscal gap is associated with a 16.6% [$1.1^{(-1.903)} - 1 = -0.166$] smaller average PPP investment per project.

Local governments' higher level of dependence on land transfer fees and intergovernmental transfers as revenue sources, to a great extent, will reduce local governments' PPP participation. Both higher ratios of two revenue sources as a percentage of total revenue are statistically significantly associated with all four dependent variables, consistent with our expectations. This suggests that a higher degree of local governments' dependence on these sources would diminish their financial self-reliance capacity and hence discourage societal capital organizations from PPP involvement. Scaled-back involvement may be less likelihood of entering into PPP agreements and/or more conservative investment amounts, as signified by the four distinct dependent variables.

The results regarding the impacts of economic variables on local government PPP participation meet our expectations. The effects of the total amount of GDP and GDP growth are in different directions. Cities with a larger total GDP are statistically significantly and negatively associated with all dependent variables in models 1-4. Cities with faster GDP growth have a positive and statistically significant relationship with all four dependent variables pertaining to local governments' participation in PPPs. Cities with a large GDP would have strong economic capacities and, thus, have great access to alternative financing approaches other than PPPs to provide public goods and services. However, cities experiencing higher GDP growth may reflect an increasing governmental demand for public provisions and, thus, growing demand for additional fiscal resources. Lastly, local governments' economic openness has a positive impact on PPP participation, as we expected, given that economic openness represents a more friendly

business environment and, thus, would encourage societal capital organizations' investment decisions.

Table 4. Causal Mediation Effects Results, 2015-2017

Variables	Mediator: ln (Debt)	DV: PPP adoption (0/1)	DV: ln (PPP project per capita)	DV: ln (PPP investment per capita)	DV: ln (Avg. PPP investment)
	Model 0	Model 1	Model 2	Model 3	Model 4
ln (Own-source fiscal gap)	0.616*** (0.111)	-0.876** (0.352)	-0.468*** (0.134)	-2.362** (1.147)	-1.894* (1.068)
ln (Debt)		0.537*** (0.165)	0.252*** (0.069)	1.394*** (0.486)	1.142** (0.447)
ln (Land transfer REV %)	0.162*** (0.062)	-0.415** (0.197)	-0.032 (0.074)	-0.845* (0.497)	-0.813* (0.468)
ln (Intergovt transfer REV %)	0.009* (0.005)	-0.050** (0.021)	-0.005 (0.005)	-0.090*** (0.032)	-0.085*** (0.030)
GDP	-0.098 (0.163)	-1.824*** (0.525)	-0.743** (0.296)	-7.032** (2.713)	-6.289** (2.487)
GDP growth	-1.023** (0.458)	5.276*** (1.439)	2.004*** (0.530)	17.10*** (5.577)	15.09*** (5.306)
Economic openness	-3.878 (12.79)	70.86 (43.79)	16.01 (18.50)	228.9** (104.4)	212.9** (94.26)
Govt size	0.069 (1.383)	-4.228 (5.857)	-1.441 (1.968)	-8.259 (15.00)	-6.818 (13.74)
Fiscal transparency	0.003 (0.002)	0.006 (0.009)	0.004 (0.003)	0.030 (0.021)	0.026 (0.019)
ln (Population)	-0.115** (0.054)	0.750*** (0.218)	-0.361*** (0.078)	2.478*** (0.808)	2.839*** (0.780)
Provincial capital	0.396*** (0.107)	-0.777 (0.574)	-0.262 (0.207)	-1.194 (1.813)	-0.932 (1.662)
Centrally admin cities	0.031 (0.348)	0.650 (1.152)	-0.301 (0.549)	0.018 (4.499)	0.319 (4.095)
Year 2017	0.091 (0.150)	1.062*** (0.377)	0.588*** (0.141)	3.446** (1.459)	2.858** (1.361)
Year 2016	-0.036 (0.153)	0.660* (0.377)	0.364** (0.148)	2.528* (1.509)	2.164 (1.406)
Constant	0.538** (0.270)	-0.513 (1.002)	0.652* (0.359)	12.03*** (3.321)	11.38*** (3.143)
# of observations	282	282	282	282	282
R-squared	0.253	0.301	0.370	0.202	0.201
Avg. causal mediation effect (ACME, indirect effect)		0.032**	0.155**	0.861**	0.707**
Avg. direct effect		-0.076**	-0.469**	-2.371**	-1.903*
Total effect		-0.045	-0.313**	-1.509	-1.196
Ratio of absolute direct and indirect effects		2.375	3.026	2.754	2.692

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Conclusions and Policy Implications

A causal mediation analytic model was developed to delineate and estimate two distinct causal pathways of fiscal gaps on PPP participation—specifically, through the lenses of both governments and private investors. The perspective of governments depicts that fiscal gaps would motivate and encourage governments to participate in PPPs for additional resources. The perspective of private parties, however, suggests that fiscal gaps may signal financial risks to risk-averse private partners and then discourage PPP participation. We tested the two opposite signed effects in the China’s context by taking advantage of its rapid growth of PPP projects and investments, its abundant data, and its increase in the number of local governments motivated to enter into PPP agreements.

Results show that the fiscal gap has statistically significant effects on PPP participation through the two disparate mechanisms. While greater fiscal gaps may moderately raise probability of forming PPPs and increase PPP investment amounts, the adverse effects of the fiscal gap associated with financial risks are generally two to three times greater and may entirely offset any positive impact. The largest adverse effects of fiscal gap are associated with PPP investment per capita and average PPP investment per project, while the adverse impact on probability of forming PPPs is very small. This may suggest that private partners may still consider collaborating with local governments that have a significant fiscal gap, but their investment decisions would be much cautious and conservative.

In terms of policy implications, PPPs are not the solution to aggressive and unconstrained spending, in light of risk aversion toward government fiscal gaps. Instead, local governments’ self-financing and self-reliance are crucial. This is particularly the

case in the Chinese context, where a large number of local governments aggressively seek PPPs as an alternative financial resource for infrastructure construction in an effort to accomplish unprecedented urbanization. The PPP rush may create double jeopardies for local governments: depleted own-source revenues on the one hand and unattainable PPP involvement on the other. For local governments with a significant fiscal gap and fewer options to provide public goods and services through private investment, the first and foremost solution is to improve the self-financing capacity based on economic growth and development to close the fiscal gaps between spending needs and available revenues. Furthermore, following the pecking order of government financing approaches, governments can issue revenue bonds in addition to general obligation bonds to finance public projects, within the debt limit. Using China's experience as an example, a combination of PPPs and the special local government bonds that earmark proceeds for specific purposes, such as transport, energy, and environmental protection, has been adopted by local governments to deliver public goods.

The other policy insight is related to stronger and more independent risk assessment, monitoring, and reporting system, similar to the credit rating system of the municipal bond market. Though the municipal bond rating system provides a foundation for assessing the credit quality of local governments as a partner, it fails to account for the experience and performance specific to PPP projects of local governments. A PPP risk rating system, ideally offered by third-party intermediaries, should not only consider local governments' fiscal conditions as included in the municipal bond rating system, but also cover the past successes and failures in PPP participation (Tan & Zhao, 2019b), management capacities, political endorsement (Yang, Hou, & Wang, 2013), legal

institutions (Geddes & Wagner, 2013), and so forth. The risk rating system will then facilitate private investors' screening and selection of governmental partners, mitigate their risk aversion, and improve their confidence in collaborating with local governments, including those having large fiscal gaps. In addition, analogous to a bond insurance for governments with unfavorable creditworthiness, PPP default insurance may mitigate government financial risks and encourage PPP participation. The combination of a risk rating system and default insurance will greatly secure private investors' remuneration and profits and will elevate their competitive positions in the market for gaining legitimacy by participating in PPP projects with governments.

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ESSAY 3 POLICY EMULATION BASED ON DIVERSE SIMILARITIES: THE
DIFFUSION OF PUBLIC-PRIVATE PARTNERSHIPS

Introduction

The policymaking of a given government is not only influenced by its internal characteristics, such as economic, political, social, or cultural factors, but also takes cues from other governments' policy choices. Informed by the policy diffusion literature, local governments, when initiating policies, will emulate peers with similar characteristics for learning their success or competing for an advantage (Berry & Berry, 2007). In the context of horizontal diffusion of policies among local governments, scholars have studied distinct similarity-driven diffusion mechanisms in diverse policy settings. However, the existing evidence focuses largely on geographic proximity or political/ideological similarity between governments. It neglects other similarities based on a comprehensive comparison of economic, demographic, and administrative conditions and overlooks the role of such holistic similarity in diffusion of public policies.

This research attempts to theoretically and empirically explore how policy convergence is achieved based on the geographic and non-geographic similarities between local governments. Most of policy diffusion studies have examined the spatial contagion effects based on the geographic proximity. The primary hypothesis is that governments that are geographically adjacent may emulate each other (Berry & Berry, 1990; Makse & Volden, 2011; Mitchell, 2018). Nevertheless, the effects of geographic proximity on policy diffusion may be offset by heterogeneity of other characteristics across governments, such as population size or makeup, economic volumes, or industrial

structures. Scholars have expanded beyond the influence of geographic closeness on policy emulation and elaborated the role of ideological similarity between spatially distant governments (Grossback, Nicholson-Crotty, & Peterson, 2004; Mallinson, 2021). A potential limitation is that such non-spatial similarities are often based solely on a single factor, such as ideology or economy, and hence may not be able to provide a holistic comparison among governments. Methodologically, the extant literature mainly used the number or proportion of the prior adopters in the neighborhood to explore the diffusion mechanisms (Berry & Berry, 1990; Shipan & Volden, 2008). Droz, Gandrud, and Williams (2019) pointed out that this method would be problematic in that it omits the persisting effects of neighboring observations and the spatially correlated covariates in the diffusion models.

We employ formal spatial modeling techniques to capture and test various policy emulation mechanisms based on diverse similarities between governments, and compare relative magnitudes of such mechanisms in a policy diffusion process. By examining the spread of public-private partnerships (PPPs) across Chinese local governments, this research uses the spatial autoregressive (SAR) panel models with different spatial weight matrices to examine the extent to which PPP investments converge, based on governments' geographic and non-geographic similarities. The similarities are measured by three spatial weight matrices which reflect respectively geographic contiguity, economic comparability, and parallel position in the administrative hierarchy. The position or tier in the administrative hierarchy is a composite index as it considers population size, economic development level, administrative arrangement as well as the historical and cultural evolution. Governments with the same tier in the administrative

hierarchy are considered to be similar. The central hypothesis in this research is that governments will achieve per capita PPP investments convergence when governments are alike geographically, economically, or administratively. An auxiliary hypothesis is that parallel positions in the administrative hierarchy, which rest on a holistic comparison of cities, would impose a greater influence on the convergence of PPP investments than spatial closeness or economic resemblance.

This research demonstrates how conceptualizing and calibrating diverse policy emulation mechanisms can enhance the conceptualization of policy diffusion theories and improve the traditional policy diffusion models. This research will contribute to the extant literature in three ways. First, it builds upon the existing policy diffusion literature but expands it with explicit measurements of similarities between governments in terms of the geographic proximity, economic similarity, and parallel position in the administrative hierarchy. The inclusion of the administrative hierarchy and comparable tiers in the hierarchical system, which provides a comprehensive benchmarking index, will greatly enrich our understandings of policy diffusion among alike governments not only based on geography or a single indicator but from a holistic likeness index. Second, the use of spatial modeling techniques better addresses the spatial autocorrelation among governments. It addresses the challenges inherent in the traditional methodologies, such as the event history analysis. And third, this research moves beyond the probability of policy adoption and investigates the diffusion of PPPs based on the investment amounts. The traditional binary outcome models fail to identify the magnitude and extent of policy adoption.

In the following section, built upon policy diffusion theories, hypotheses pertaining to the policy emulation based on similarities between governments are developed. Then the background of the spread of PPPs in China is discussed for testing the developed hypotheses. Next, the data and variables as well as research methods used in this research are presented in section 4. Section 5 then displays the interpretations on the results. Finally, the last section concludes the study with implications of the research findings.

Theory and Hypotheses Development

Policy diffusion theories explain the driving forces that lead to the transference of a policy from one government to another. In terms of the horizontal diffusion mechanisms, Berry and Berry (2007) maintained that governments emulate each other as a result of learning or competition. Governments may learn from others' experience in adopting a policy innovation once they perceive the effectiveness and success of the adoption (Walker, 1969; Volden, Ting, & Carpenter, 2008). Governments may also compete with others by adopting new policies to keep pace with other governments or to achieve a competitive advantage over them (Berry & Berry, 2007; Shipan & Volden, 2008). Therefore, the probability, timing, and magnitude of a given government's adoption of policies may be influenced by other governments.

In the policy diffusion literature, isomorphism models posit that policymakers tend to look to "similar" governments when adopting certain policy innovations. Governments learn from or compete with others that are similar, as they share common characteristics and can predict the likely consequences of adopting a policy based on others' experience (Berry & Berry, 2007). Therefore, this research develops the overall

hypothesis on policy convergence based on similarities, which is governments tend to emulate others with similar characteristics. The similarity between governments can be inferred in a variety of ways, ranging from geographic proximity to non-geographic proximity, or from one single measurement to a composite index. This overall hypothesis, therefore, is decomposed and tested respectively pertaining to geographic proximity, economic resemblance, and administrative hierarchy.

Geographic Proximity

Geographic proximity is the most studied proxy for similarity between governments. Geographically neighboring governments tend to face similar economic and social problems and share similar history and culture (Mallinson, 2021; Mooney & Lee, 1995). The policy adoption in a given government, therefore, is more likely to exert similar effects in its nearby governments. In addition, the close distance enables easier and more frequent communications and interactions between neighboring governments, which would facilitate the transfer of policies (Rogers, 1995). Multiple policy diffusion studies have included geographic proximity as a baseline to examine the mechanisms of the spread of policy innovations (Berry & Berry, 1990; Makse & Volden, 2011; Mitchell, 2018). Hence, this research offers the neighbor-based diffusion hypothesis:

H1: Governments may have a greater propensity to adopt a policy when their geographic neighbors have already adopted it.

Economic Resemblance

Although geographic proximity, to some extent, explains the spread of policies, its effect on policy diffusion may be offset by the heterogeneity of other characteristics across governments, such as population size or makeup, economic volumes, or industrial

structures. Scholars have expanded beyond the influence of geographic closeness on policy emulation. For instance, Grossback, Nicholson-Crotty, and Peterson (2004) studied ideological similarity among the U.S. states and found states are more likely to adopt a policy if states that are ideologically similar to them have already adopted it. More recently, Mallinson (2021) reviewed 556 policies over five decades in the U.S. and found that the effect of ideological similarity on policy diffusion remained steady while that of geographic proximity declined. Furthermore, based on the idea that similar governments are more likely to emulate each other, Volden (2006) captured the influence of political, demographic, and budgetary similarities on policy changes.

In the same vein with Volden's (2006) study on political, demographic, and budgetary similarities, this research emphasizes the role of economic similarity in terms of the diffusion of a certain policy. Walker (1969) suggested that governments in the wealthier and more industrialized states tend to adopt policy innovations more rapidly than their less developed neighbors. This is because a higher level of economic development often denotes a greater demand for policy change and sufficient resources available to take the risk for the policy experiments. Therefore, the economic development level acts as an important prerequisite to innovate. Governments would look to those with similar economic development levels as a benchmark when adopting a policy innovation, even though they are not geographically proximate. It is thus expected that:

H2: Governments may have a greater propensity to adopt a policy when those are economically similar to them have already adopted it.

Administrative Hierarchy

Using a composite index, rather than a single factor, to identify the similar governments may be more appropriate for governments to take policy cues from others, as the motivations for policy adoption are multifaceted. Scholars have studied the policy diffusion processes at different scales and found that a broad set of factors would contribute to the expansion of policies. Walker (1969) found that policy innovation across the U.S. states is associated with a set of social and economic variables, such as the total population, average income, urbanization level, and educational attainment. In the context of the Latin American policy reform, Weyland (2004) contended the influence of cultural commonality and historic connection on the spread of innovations among nations. Furthermore, Brooks (2005) explored the diffusion of pension privatization around the world. It suggested that governments may seek greater assurance of the viability of the innovation based on the outcomes in their peer nations, where they share the similar geopolitical, economic, and cultural characteristics and belong to the common international organizations.

The administrative hierarchy is a composite index that governments can rely on to screen and select their peers and take cues from the peers' adoption of innovations. Administrative hierarchy refers to a ranking of cities based on their administrative levels. A city's position in the administrative hierarchy is associated with multiple factors, including the population size, economic development level, administrative arrangement as well as the historical and cultural evolution. Cities with higher tier in the administrative hierarchy tend to be better developed and have greater access to the multiple resources for policy adoption. Additionally, the administrative hierarchy is a

relative stable characteristic of cities compared to other attributes that fluctuate year by year.

It is feasible for governments to learn from and compete with others that occupy the same level of tier in the administrative hierarchy. Within the same tier, there is a “specialized set of communication channels through which flow new ideas, information and policy cues” (Walker, 1969, p.898). Berry and Berry (2007) proposed the fixed-region models, which assumed that the nation is grouped into multiple regions based on the geographic contiguity and governments tend to emulate each other in the same region. This research further extends the fixed-region models to the administrative hierarchy models. It hypothesizes that governments belong to the varying tiers in the administrative hierarchy and tend to observe the outcomes of the corresponding policy adopted by governments with parallel administrative hierarchy as a reference. Hence, the policy diffusion hypothesis from an administrative hierarchy perspective is that:

H3: Governments may have a greater propensity to adopt a policy when governments with the same tier in the administrative hierarchy have already adopted it.

In addition, although policy convergence may achieve when governments are alike geographically, economically, or administratively, the respective effect of these diverse similarities between governments may vary. Since the administrative hierarchy is a composite index and rests on a holistic comparison of cities compared to geographic proximity and economic resemblance, the impact of administrative hierarchy on policy convergence is hypothesized to be more significant. Moreover, given the lower barriers to and costs of communication and travel in today’s world, Shipan and Volden (2012) claimed that the role of geographic proximity in policy diffusion is declining. Hence,

governments can overcome the geographic limitations and emulate others that are geographically distant but similar in other non-geographic characteristics, such as the economic resemblance. The specific hypothesis is:

H4: The parallel administrative hierarchy of governments would impose a greater influence on the policy convergence than spatial closeness or economic resemblance. The economic resemblance would impose a greater influence than spatial closeness.

The Spread of PPPs in China

This research examines the spread of PPPs in China based on the aforementioned hypotheses. While the first PPP project in China was emerged in the 1980s, only a small fraction of local governments had adopted PPPs since then. Although there existed a great demand for the private capital for the public infrastructure at that time, both the domestic business environment and the international financial crisis had constrained private enterprises from participating in the PPPs (Zhao, Su, & Li, 2018). The recent wave of PPPs in China began in 2014 when the central government encouraged local governments to use the PPPs as an alternative to finance the public products and services, as the local government debt burden had reached an alarming level (Thieriot & Dominguez, 2015). The number of PPP projects increased from 451 in 2015 to 2,566 in 2017 and the amount of PPP investment rose from RMB 0.72 trillion to 3.98 trillion (approximately USD 0.62 trillion) (BRI data, 2020). Until 2017, there were 99% of prefecture-level city governments in China that have adopted PPP projects. Although PPPs in China has experienced a decline since 2017 due to the severer regulation by the central government, the rapid and exponential rise between 2015 and 2017 has led to the

policy convergence of PPPs. This research, therefore, focuses on the diffusion of PPPs in the China's context and tests the corresponding diffusion mechanisms.

The likelihood of policy diffusion may be determined by policy attributes. Makse and Volden (2011) found that policy diffusion process would be enhanced in terms of those policies with high relative advantage, compatibility, and observability. PPPs, compared to the traditional public procurement approach, are adopted with the expectations to improve the effectiveness and efficiency of public service and to present the relative advantage. Also, as the use of privatization and contracting out has been prevalent in delivering public services, PPPs are not a novel concept and operation for governments. Although PPPs are different from the aforementioned approaches (Wang et al., 2018), they still have some elements in common. The adoption of PPPs, therefore, would be compatible with existing policies on public procurement. Last but not least, PPPs bring private financing and expertise and facilitate the provision of public products and services that are highly observable. The implementation of PPP projects could be easily observed by policymakers in other governments. In the Chinese context, with an increasing number of cities have collaborated with the private entities and entered into the implementation stage of those projects, the observable and relative advantages of utilizing PPPs have attracted more participation. Thus, PPPs have diffused among local governments within a very short time frame.

The policy convergence of PPPs in China is more likely a result of emulation based on the similarities between governments. Within a three-year span, the short time frame cannot provide governments with sufficient time and knowledge to assess the success or effectiveness of PPP projects. Also, the effect of the geographical leadership

mobility that encourages officials to introduce a policy innovation from the original working locality to the new locality, as studied in Zhu and Meng (2020), on PPP diffusion would be limited in that there may not be frequent transfers of leadership in the three-year period. More importantly, PPPs is a long-term contract that normally lasts ten to thirty years between a government and private entities (The World Bank, 2017). With a great demand for PPPs as an alternative financing approach for public service delivery, there is no time for Chinese governments to learn from the “leaders” by a doing process. In order to obtain a competitive advantage or avoid falling behind, local governments would emulate their benchmarking governments that share a set of similar characteristics and adopt PPPs if their “peers” have chosen to utilize it.

Data and Methods

Data

This research tests the theoretical hypotheses by analyzing the spread of PPPs across Chinese local governments at the prefecture level. It builds a panel dataset of PPP investments from 2015 through 2017 as well as a database of the fiscal capacity of Chinese cities. This research illustrates the applicability of policy diffusion theories in the context of China’s PPPs as an ideal candidate for two major reasons. First, China has experienced an unprecedented rapid growth of PPPs since 2014, as a result of the central government’s encouragement to use PPPs to relieve the heavy debt burden of local governments. The exponential increase of local governments adopting PPPs within a very short time frame offers an ideal research setting for testing the policy convergence based on similarities between governments. Second, PPP projects in China are typically located

at the prefecture level, which is appropriate for exploring the horizontal diffusion mechanisms across cities.

Dependent Variable

This research incorporates the total investment amount of each city's PPP projects per capita as the dependent variable to examine the convergence of PPPs among local governments. The binary outcome variable, i.e., a dummy variable to indicate whether a city adopted the specific policy in a given year, was most studied in the policy diffusion literature (see Berry & Berry, 1990; Mitchell, 2018; Zhang, 2015). However, it fails to distinguish between the "superficial" and "deep" adoption (Glick & Hays, 1991). Therefore, the utilization of PPP investments would instead yield more information about the "extent" of PPP adoption. Similar usage has been found in Zhu and Meng's (2020) study on the effects of geographical leadership mobility on social spending per capita in the Chinese provinces. The definitions and summary statistics of all variables are provided in Table 5. As presented in Table 5, the average PPP investment amount per capita among all Chinese cities between 2015 and 2017 was around 2,200 RMB. Data on PPP investments are collected from the China Public Private Partnerships Center of the Ministry of Finance.

Explanatory Variables

This research seeks to explore the diffusion mechanisms of the spread of PPPs among Chinese local governments, it relies on Berry and Berry's (1990) framework that incorporates both internal characteristics and regional effects. In addition to the horizontal diffusion mechanisms of PPPs, this research also controls for the internal characteristics of governments for the adoption of PPPs as a financing approach.

Table 5. Descriptive Analysis of Variables (N=867), 2015-2017

Variables	Description	Mean	Std. Dev.	Min	Max	Expected Sign
<i>Dependent variable</i>						
PPP investment per capita	Total investment amount of each city's PPP projects per capita (RMB)	2,288	2,989	0	30,387	
<i>Independent variables</i>						
Fiscal gap	Ratio of general fiscal expenditure to general fiscal revenue	2.765	1.665	0.904	11.54	+
Land transfer REV per capita	Total land transfer fees per capita of each city (RMB)	1,981	2,292	18.47	21,281	-
REV per capita	Total general fiscal revenue per capita of each city (RMB)	4,510	3,807	777.1	26,475	+
<i>Economic variables</i>						
GDP growth	Percent change of each city's gross regional product from the preceding year	7.654	3.252	-12.30	15.10	+
Capital investment per capita	Total capital investment per capita of each city (RMB)	40,814	21,469	4,610	168,183	-
Economic openness	Percentage of FDI in the city's GDP	0.003	0.003	0	0.019	+
Passenger traffic	Total passenger traffic in each city (10,000 people)	6,911	12,256	57	157,245	-
Freight traffic per capita	Total freight traffic per capita in each city (ton)	35.36	51.74	0.00007	897.7	+
Urban land rate	Land used for urban construction as percentage to urban area	8.266	8.954	0.140	77.32	-
Road density	Ratio of area of roads to area of land	0.163	0.604	0.013	17.78	+
<i>Public management variables</i>						
Government size	Percentage of general fiscal expenditure in the city's GDP	0.209	0.131	0.044	2.060	-
Fiscal transparency	An index measuring the city's fiscal transparency (0-100)	44.94	18.15	2.770	86.51	+
Population	Total resident population in each city (10,000 people)	444.7	340.3	24.13	3,048	+

Fiscal capacity. Local government fiscal capacity is used to test the primary internal determinants of PPP adoption. This research includes three measures for the fiscal capacity: the fiscal gap between public expenditure and revenue, the total land transfer fees per capita, and the total fiscal revenue per capita in each city. The adoption

of PPPs of a certain government is largely motivated by its demand for additional financial resources. The benefits associated with PPPs, including the greater efficiency, effectiveness, and equity of public service delivery, have been well documented (Van Ham & Koppenjan, 2001; Hodge, Greve & Biygautane, 2018). When local governments are in the face of financial constraints, such as accumulated fiscal deficit or limited alternative financial resources, there is a higher probability for governments to adopt PPPs and have greater PPP investments (Cepparulo et al., 2019; Wang et al., 2018). First, the fiscal gap between public expenditure and revenue denotes the government demand for PPPs as an additional financing approach. The larger the fiscal gap is, the more likely to adopt PPP investments (Cepparulo et al., 2019). Second, land transfer fees, which are used as one of the most important sources of Chinese cities' fiscal revenues, refer to an alternative financing approach for local governments to provide public infrastructure (Fan, Qiu, & Sun, 2020). Therefore, the total land transfer fees per capita is expected to have an adverse effect on the PPP adoption.

Additionally, the formation of PPPs requires local governments to have a strong self-financing capacity to reduce the financial risk of projects (Yang, Hou, & Wang, 2013). Given that the private partners participate in PPPs for profit maximization, the risk-averse private entities may be conservative and cautious when collaborating with governments that have lower levels of self-financing capability. In other words, it would be more difficult for local governments with lower levels of own-source financial capability to attract private investments. The self-financing capacity of local governments can be measured by the total general fiscal revenue per capita. It is expected to be positively associated with the PPP investment amount. As shown in Table 5, the average

land transfer fees per capita (1,981 RMB) was less than the average PPP investments per capita, and the average public revenue per capita (4,510 RMB) was more than the average PPP investments per capita. Data on the fiscal capacity of prefecture-level city governments are collected from the China City Statistical Yearbooks and the China Land and Resources Statistical Yearbook in various years.

Economic variables. This research also includes a set of variables for controlling for the local economic condition of each city. The economic variables are grouped into three categories. The first group of variables measure for government demands for PPP investments. It includes the GDP growth and the total freight traffic per capita. Cities with the faster GDP growth and greater freight traffic by various transportation means may have a greater demand for PPPs to facilitate the provision of public products and services. Zhang (2015) used the freight traffic to measure the local demand and studied the horizontal and vertical diffusion mechanisms on the formation of different types of PPPs across Chinese cities. The second group of economic variables focus on the level of economic development. The total passenger traffic, to some extent, can be a proxy for the economic development level in a city. A larger total passenger traffic may indicate a more robust economy. Similarly, using the ratio of the land used for urban construction and urban area, the level of urbanization in the city is assessed. Cities that have a higher level of economic development and urbanization are expected to have fewer PPP investments. Also, the capital investment per capita is used to measure the economic development. A greater amount of the capital investments in a city may lead to a reduction of PPP investments, as the two sources of financing are complementary. The third group of variables include the economic openness that is measured by the

percentage of FDI in the city's GDP and the road density in the city. These two variables are expected to facilitate the formation of PPPs. The data source of the economic variables is the China City Statistical Yearbooks.

Other control variables measure for the public management capacity and population size of the cities. Government size is measured by the ratio between public expenditure and GDP. The larger governments may have a stronger capacity to collect more tax revenues and, thus, their demand for PPPs will be lower. Therefore, an adverse association between government size and PPP investments is expected. Government fiscal transparency is measured by an index compiled by the Tsinghua University. Tan and Zhao (2019), who investigated factors related to PPP adoption rate in China from 2012 to 2016, found that a higher adoption rate of PPPs is associated with a higher degree of fiscal transparency. Thus, a positive effect of fiscal transparency on local government PPP investments is expected. The total resident population size controls for the demand for PPPs and is expected to exert a positive effect. Data on the population are collected from the CEIC Data (www.ceicdata.com). To account for potential endogeneity problems, all explanatory variables are lagged by one year. All dependent and explanatory variables, excluding the GDP growth, economic openness, urbanization rate, and fiscal transparency, are transformed in natural logarithm.

Methods

This research uses a spatial autoregressive (SAR) panel model with fixed effects to examine the emulation mechanisms of the convergence of PPP investments. The spatial model is appropriate because the adoption and magnitudes of PPPs are spatially correlated. Based on the hypotheses in this research, governments may emulate their

neighbors, both geographic and non-geographic ones, to attract PPP investments. Therefore, simply relying on a panel model will omit the spatial correlation among the governments (Anselin, 1988). Scholars often used the temporally lagged spatial lags to investigate the diffusion mechanisms, by including the number or proportion of the neighbors that have previously adopted a specific policy (Shipan & Volden, 2008). However, this method could be problematic. It limits the diffusion effects within one time period and overlooks the long-term evolving impacts of diffusion on the observations. Also, it omits the spatially correlated covariates and thus may lead to false interpretations on the policy diffusion (Droic et al., 2019). Moreover, in the policy diffusion literature, the binary outcome event history models are often utilized (Berry & Berry, 1990; Guo & Ba, 2020; Mitchell, 2018). Nevertheless, this method fails to interpret the diffusion process beyond time and probability.

The utilization of a SAR panel model can avoid the above problems and yield more robust results of the driving forces of the diffusion of PPPs among local governments. The model specification is as follows:

$$\begin{aligned}
 & PPP \text{ investment per capita}_{it} \\
 &= \alpha + \rho W * PPP \text{ investment per capita}_{it} + Fiscal \text{ capacity}_{it} * \beta_1 \\
 &+ X_{it}\beta_2 + \mu_i + \gamma_t + \epsilon_{it}
 \end{aligned} \tag{1}$$

where $PPP \text{ investment per capita}_{it}$ is the dependent variable referring to the per capita PPP investments of government i in year t . W is the row-normalized n by n spatial weight matrix reflecting relationships among cities. $Fiscal \text{ capacity}_{it}$ denotes the key explanatory variables pertaining to local government fiscal capacity. Other control variables are referred to as X_{it} . The symbol a is a constant term, ρ is the spatial

autoregressive coefficient of the spatial lagged dependent variable, β_1 and β_2 are the coefficients of the explanatory variables. Then μ_i and γ_t are the city- and year-fixed effects to control for the potential effects of space and time, respectively, ϵ_{it} is the error term.

In the SAR model, as it contains the spatial lag of the dependent variable, the interpretation of the parameters cannot be as straightforward as that in the ordinary least squares models. A unit change of the explanatory variables for an observation will affect the observation itself as well as its neighboring observations, as the model includes a spatial lag vector Wy . LeSage and Pace (2009) provided a method to explain the variable marginal effects in the spatial regression models. The data generating process for the SAR model is as follows:

$$y = (I - \rho W)^{-1}(\alpha + X\beta) + (I - \rho W)^{-1}\epsilon \quad (2)$$

It can be re-written in:

$$\frac{\partial y}{\partial x_k} = (I - \rho W)^{-1}\beta_k \quad (3)$$

Equations (2) and (3) suggest that a unit change of the explanatory variable x_k for a city will affect the dependent variable of the city itself (direct effects) as well as its neighboring cities (indirect effects). LeSage and Pace (2009) suggested that an average effect should be used as the impacts of the explanatory variables vary across observations. They further suggested that the average direct effect can be represented by the average of the diagonal elements of the matrix $(I - \rho W)^{-1}$ times the coefficient β_k .

And the average indirect effect can be approached by the average of the off-diagonal elements of the matrix $(I - \rho W)^{-1}$ times the coefficient β_k .

For the illustration and comparison of different aspects of similarities between governments that lead to the policy convergence, three spatial weights are incorporated to define variant relationships among governments and to specify different spatial interaction mechanisms. First, a contiguity-based spatial weight matrix is used to measure the geographic proximity between governments. Spatial weights are typically defined by contiguity, where the weight equals 1 if two cities share a common border or a common vertex, and 0 otherwise. In this research, a 283 x 283 matrix is established as six isolated cities are excluded.⁷ Second, an inverse economic distance spatial weight matrix is defined to measure the economic similarity, using the average total GDP in the study period of this research (between 2015 and 2017) as the economic variable. The element of the weight matrix is $1/d_{ij}$, where d_{ij} is the economic distance in terms of the average total GDP between city i and j . Third, a social network spatial weight matrix is generated. Cities with the same tier in the administrative hierarchy are treated as a peer group in the network. Chinese cities can be divided into four tiers based on the administrative hierarchy. The higher the position a city occupies in the administrative hierarchy, the stronger the administrative power it has. The administrative hierarchy from highest to lowest is: four municipalities directly administered by the central government, 15 deputy provincial-level cities, 17 provincial capitals, and the rest are prefecture-level cities. The

⁷ The six cities are Zhoushan, Haikou, Sanya, Lasa, Urumchi, and Karamay.

above spatial weight calibrations facilitate to determine which neighbors matter when governments emulate others in the policy diffusion process.

Results

The spatial dynamics of PPP investment per capita in China is first examined. As shown in Figure 12, overall, per capita PPP investment amount increased from 2015 through 2017. Geographically, PPP projects and investments are concentrated in the Southeast and Southwest China. In the less economically advanced Western China, PPP investments are minimal. Moreover, per capita PPP investment amount in each year between 2015 and 2017 is presented to assess how spatial autocorrelation changed over time. There was a growing trend of spatial agglomerations of PPP investment during the three years, particularly in the central area. The concentration of PPPs over the three years in China suggests the spatial manifestations of diffusion and leads to the exploration of the diffusion mechanisms.

Regression results of PPP investment per capita are provided in Table 6, based on three different spatial weight matrices. In addition to the coefficients of explanatory variables, both direct and indirect effects are reported. The direct effects of changes in explanatory variables are different from the coefficient estimates. This is because direct effects include the feedback effects from the neighboring governments that originate from the government itself (Elhorst et al., 2017; LeSage & Pace, 2009). The indirect effects denote the impact of changes in explanatory variables on the neighboring governments. As shown in Table 6, the indirect effects of explanatory variables on PPP investments in the three models are insignificant, which suggests that those explanatory

variables in a given government do not significantly impact PPP investments of its neighboring governments.

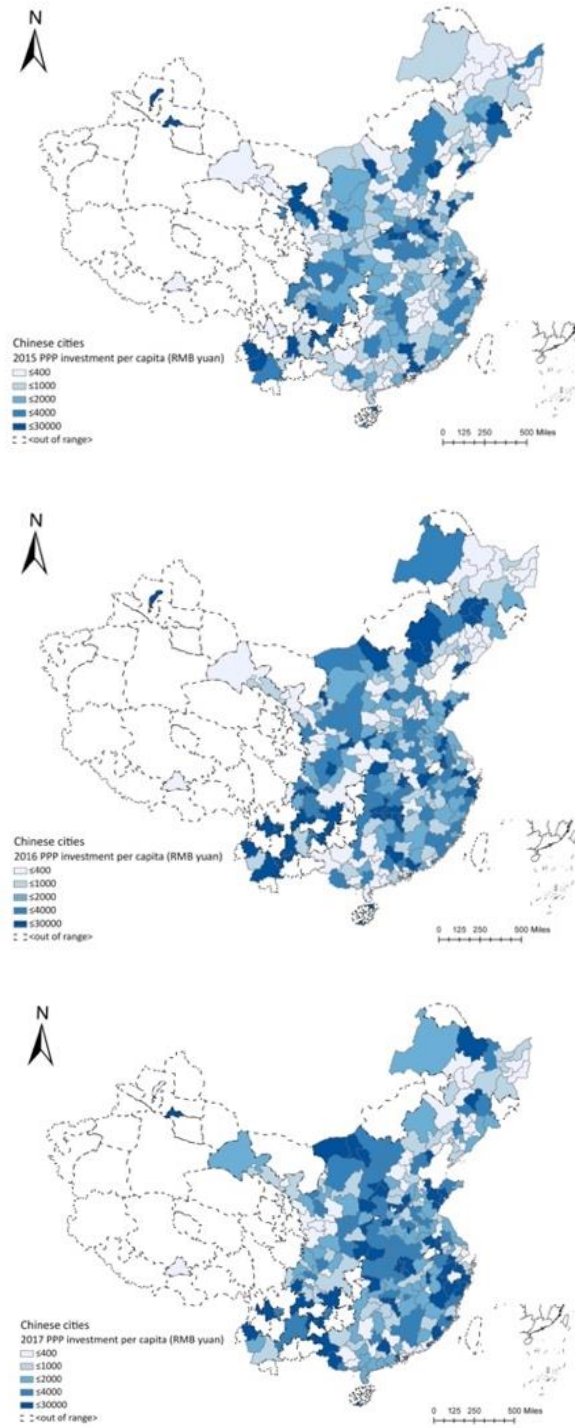


Figure 12. Spatial Distribution of Total PPP Investment Per Capita in China, 2015-2017

Table 6. Regression Results of PPP Investment Per Capita, 2015-2017

Variables	W (Geo contiguity)			W (Inverse distance of total GDP)			W (Admin hierarchy)		
	Coeff.	Direct effects	Indirect effects	Coeff.	Direct effects	Indirect effects	Coeff.	Direct effects	Indirect effects
ln(Fiscal gap)	7.172 (5.905)	7.406 (6.077)	0.813 (0.801)	10.14* (5.637)	10.39* (5.809)	1.831 (1.682)	10.05* (5.597)	10.27* (5.755)	4.142 (3.096)
ln(Land REV per capita)	-1.153* (0.655)	-1.090* (0.633)	-0.117 (0.097)	-1.451** (0.661)	-1.389** (0.639)	-0.223 (0.186)	-1.337** (0.664)	-1.273** (0.642)	-0.511 (0.378)
ln(REV per capita)	6.483 (5.292)	6.594 (5.355)	0.732 (0.715)	9.346* (5.101)	9.464* (5.162)	1.700 (1.573)	9.280* (5.033)	9.382* (5.080)	3.809 (2.782)
GDP growth	0.310 (0.192)	0.309 (0.193)	0.031 (0.026)	0.229 (0.190)	0.227 (0.191)	0.039 (0.047)	0.246 (0.193)	0.245 (0.194)	0.105 (0.108)
ln(Capital inv per capita)	-3.636* (1.900)	-3.650** (1.763)	-0.383 (0.276)	-3.439* (1.959)	-3.442* (1.826)	-0.602 (0.539)	-3.813* (1.963)	-3.821** (1.828)	-1.648 (1.246)
Economic openness	249.3 (185.3)	261.4 (186.0)	25.92 (23.29)	267.5 (189.7)	279.1 (190.4)	47.58 (48.92)	302.6 (194.6)	314.8 (195.2)	135.4 (118.8)
ln(Passenger)	-2.378** (1.014)	-2.335** (1.050)	-0.240 (0.159)	-2.684*** (1.021)	-2.639** (1.061)	-0.449 (0.352)	-2.629** (1.027)	-2.586** (1.065)	-1.104 (0.765)
ln(Freight per capita)	0.766 (0.524)	0.749 (0.533)	0.077 (0.069)	1.016* (0.529)	1.001* (0.537)	0.171 (0.153)	1.004* (0.533)	0.990* (0.541)	0.412 (0.318)
Urban land rate	-0.020 (0.045)	-0.017 (0.044)	-0.002 (0.005)	-0.026 (0.046)	-0.024 (0.045)	-0.005 (0.010)	-6.854 (4.885)	-6.959 (4.893)	-2.856 (2.564)
Road density	0.369* (0.196)	0.365* (0.188)	0.038 (0.027)	0.374* (0.199)	0.369* (0.193)	0.063 (0.055)	0.004 (0.016)	0.004 (0.015)	0.002 (0.007)
ln(Govt size)	-3.361 (4.866)	-3.466 (4.882)	-0.392 (0.592)	-6.621 (4.918)	-6.733 (4.941)	-1.187 (1.308)	-0.024 (0.046)	-0.021 (0.045)	-0.008 (0.021)
Fiscal transparency	0.001 (0.016)	0.0004 (0.016)	-0.00004 (0.002)	0.004 (0.016)	0.004 (0.016)	0.0002 (0.003)	0.386* (0.200)	0.381** (0.194)	0.165 (0.130)
ln(Population)	-0.048 (5.194)	0.400 (5.232)	0.072 (0.559)	1.095 (5.470)	1.628 (5.515)	0.317 (1.029)	1.429 (5.399)	1.949 (5.433)	0.776 (2.321)
Spatial autoregressive (ρ)	0.091** (0.039)			0.134* (0.078)			0.275*** (0.101)		
Year and city fixed effects	Included			Included			Included		
Number of cities	283			289			289		
Number of observations	849			867			867		
R-squared	0.487			0.495			0.494		

Note: Robust standard errors in parentheses, *p < 0.1. **p < 0.05. ***p < 0.01.

In all model specifications, the spatial autoregressive coefficients are statistically significant and positive, suggesting an emulating mechanism among governments in the adoption of PPPs and the convergence of PPP investment amounts. The empirical evidence supports the hypotheses 1-3 that governments will have a greater propensity to adopt PPPs when governments with similar geographic, economic, and administrative characteristics have already adopted it. The spatial autoregressive coefficient in the model with the contiguity spatial weight matrix is the smallest (0.091), while that in the model with spatial weight matrix pertaining to the administrative hierarchy is the greatest (0.275). It suggests that the policy emulation not only occurs among governments in a close geographic distance, but also exists among the economy-based and administration-based peer governments. It also lends support to hypothesis 4 that the emulation among the governments with the same tier in the administrative hierarchy is of more importance.

In addition to the emulation among local governments, results of the effects of local government own fiscal capacity on per capita PPP investments are examined. The greater the need for additional financial resources and the stronger the self-financing capacity, the greater the PPP investments. Except the model with the contiguity spatial weight matrix, fiscal gap is statistically significant and positively associated with per capita PPP investments. All other things being equal, a 1% increase in fiscal gap (i.e., the ratio of a local government's expenditure to revenue) is on average associated with a 10.9% [$1.01^{(10.39)} - 1 = 0.109$] increase in PPP investment per capita in the model with the inverse economic distance spatial weight matrix, and a 10.8% [$1.01^{(10.27)} - 1 = 0.108$] increase in PPP investment per capita in the model with the administrative hierarchy spatial weight matrix. By contrast, the land transfer revenue per capita exerts a

statistically significant and adverse effect. All other things being equal, a 1% increase in the land transfer revenue per capita would lead to 1.08% to 1.26% reduction in PPP investment per capita across all the model specifications. It suggests that governments with more alternative financial resources would reduce their investments in PPP projects.

Additionally, the public revenue per capita has a statistically significant and positive effect. Models with the inverse economic distance and administrative hierarchy spatial weight matrix show that a 1% increase in local government revenue per capita would bring an increase by 9.87% and 9.79% of PPP investment per capita respectively. It suggests the importance of self-financing capacity of governments in the formation of PPPs, accounting for the private sector's risk aversion toward the potential fiscal risks.

Table 6 exhibits the effects of all control variables on PPP investments. The capital investment per capita and the total passenger traffic are statistically significant and adversely associated with per capita PPP investments. Both the variables imply a strong economy and thus more alternative resources the governments can gather for public service delivery, which leads to a reduction of PPP investments. The total freight traffic per capita has a statistically significant and positive effect. It may suggest a greater demand for PPPs to facilitate the economic development in the city. Regarding the environment that may attract private sector's participation in PPPs, it found that a higher level of road density and fiscal transparency would improve PPP investments.

Conclusions

Although policy diffusion studies have broadly discussed the learning and competition mechanisms among similar governments, knowledge on the measurements of similarities and the comparison of diverse similarities is limited. In this research, we

utilize the geographic proximity as a baseline to identify similar governments, and further extend the geographic similarity to non-geographic ones. The economic resemblance among governments is included to capture the role of economic development in the policy adoption and diffusion. In addition to the single factor, we employ the administrative hierarchy as a composite index to specify governments with multiple similar characteristics. Governments with the same tier in the administrative hierarchy are considered neighbors having the same level of social and economic development, and thus the benchmarking governments to learn from their success and compete with them. Furthermore, as the factors associated with policy adoption are normally multifaceted, a composite proxy for the similarity among governments would better match with the policy diffusion mechanisms. The impact of the administrative similarity among governments on policy emulation, therefore, is assumed to be more accurate.

Built upon the perspective of policy diffusion, this research uses the SAR panel data analysis to examine the emulation mechanisms based on diverse similarities among local governments. It illustrates the applicability of policy diffusion of PPPs in the context of China for its unprecedented rapid growth across prefecture-level cities between 2015 and 2017. This research suggests that the convergence of PPP investments in China is a result of local government policy emulation among the geographic, economic, and administrative neighbors.

The horizontal emulation mechanisms regarding PPP adoption between governments are captured by the statistically significant and positive spatial autoregressive coefficients in the models using multiple spatial weight matrix specifications. The empirical evidence suggests that local governments tend to emulate

others if they are spatially adjacent, have comparable levels of economic development, or occupy the same tier in the administrative hierarchy. The effects of non-geographic similarities are much greater than the geographic one. With today's lower barriers to and costs of communication and travel, the interactions between governments that are geographically distant have been much more frequent. Governments can identify and emulate benchmarking peers based on the economic development level or a more comprehensive measurement, such as the administrative hierarchy, when considering the adoption of a policy innovation.

Additionally, this research controls for the internal characteristics for policy adoption. Empirical results show that local government fiscal capacity may influence the adoption of PPPs. Specifically, the larger the fiscal gap is, the more likely for governments to attract private investments. This is also supported by the evidence that the land transfer revenue, which is an important financial source for governments, is adversely associated with PPP investments. Moreover, the formation of PPPs requires that governments have a strong self-financing capacity. This is because fiscally constrained governments may carry high fiscal risks, which would trigger private sector's risk aversion and ultimately prevent them participating in the partnerships.

Evidence extracted from this research may shed light on the role of pilot cities in the spread of policy innovations. The diverse policy emulation pathways may offer various policy options to facilitate and promote policy innovations across geographic, economic, and administrative divides and to reduce the regional disparity in public service delivery. It may be necessary for policymakers to adjust the selection of pilot

cities and promote the policy diffusion with a holistic view aligned with the varying attributes of policies, the regional economic development, and the specific strategic plans.

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CONCLUSION

This dissertation focuses primarily on the formation of PPPs from mutual screening and selection of collaborating partners to geographic expansion of PPPs over time. Built upon the resource-based theory, this dissertation uses three essays to explore the driving forces of PPP formation both at a micro organizational level and at a macro national level. Three different perspectives and three corresponding methodologies provide a comprehensive and holistic understandings of PPP formation. The first essay examines government preferences for potential private partners, while the second essay, in turn, explores the private sector's screening and selection of candidate public partners. In addition to the respective perspective of government entities and private parties, the third essay focuses on the proliferation and spread of PPPs across geographic space from a perspective of policy diffusion.

Theoretical Contributions

Theoretically, this dissertation contributes to the extant literature in the following three ways. First, essay one builds on the previous studies on government motivations of participating in PPPs and extends to the explorations of government preferences in the partnerships. Instead of answering the question why governments adopt PPP projects, this research focuses on with whom governments prefer to collaborate. In light of the resource-based theory, both public and private sectors participate in PPPs by forming strategic alliances to gain access to each other's unique resources. Organizations that have greater access to and stronger control over strategic resources are more likely to be sought after as partners. Also, the essay one is among the first to rely on a social network perspective to understand the interdependence and interconnection among the PPP

participants. Previous research on PPPs generally focuses on individual and isolated PPP transactions to identify the important participants or describe the characteristics of PPP development. The perspective of social network incorporates both public and private organizations into a holistic network based on their connections and takes their interactions into account, which will advance our understandings of PPP participant roles and development patterns.

Second, essay two stands through a lens of private entities in PPPs when governments are assessed by the private sector as potential partners. The perspective of private entities will complement and advance the existing research that predominately focuses on the government demands for PPPs. The major driving force of government pursuit of PPPs is to overcome the financial constraints in public service delivery. However, the fiscal gaps, at the same time, may signal the fiscal risks in PPP projects. As a result, the risk-averse private entities would be more cautious and conservative when making investment decisions. Through the lens of the private sector, their preferences can be better addressed.

Third, essay three captures and tests various policy emulation mechanisms based on diverse similarities between governments, and compares relative magnitudes of such mechanisms in a policy diffusion process. It contributes to the policy diffusion literature that focuses largely on geographic proximity or political/ideological similarity between governments, by incorporating the administrative hierarchy and comparable tiers in the hierarchical system. The inclusion of the administrative hierarchy provides a comprehensive benchmarking index, will greatly enrich our understandings of policy

diffusion among alike governments not only based on geography or a single indicator but from a holistic likeness index.

Methodological Contributions

Methodologically, the significance of this dissertation is threefold. First, guided by networked connections among PPP participants, this dissertation innovatively uses the social network analysis in the study on PPPs. It establishes PPP networks by incorporating governments and private organizations as two categories of actors. Each PPP transaction is viewed as a linkage between a local government and multiple private firms. Then this research uses eigenvector centrality and betweenness centrality to measure the influence and control power of participants in PPP networks. It enables the comparison between different types of private participants and identification of government preferences for influential private partners.

Second, essay two uses a causal mediation analysis to separately examine the effects of government fiscal gaps on PPP formation, through the lens of governments and private entities respectively. Those two pathways are often lumped together in the existing literature. The regression result shows that the direct effect of fiscal gaps is significantly negative, suggesting risk aversion of the private sector toward fiscally constrained governments. Also, the result supports a mediating role of government debt between fiscal gaps and PPP adoption. The significantly positive effect of fiscal gaps advances scholar understandings that usually focus on the effects of either fiscal gaps or government debts. Furthermore, when comparing the magnitude of the direct effect to that of the indirect effect, the adverse effect turns out to be much greater than the positive

effect. It suggests that the deterrence effects of fiscal gaps are therefore much greater than its resource acquisition impacts.

Third and last, essay three contributes to the methodologies used in policy diffusion studies by incorporating the spatial econometric models. It improves the identification of diffusion mechanisms based on a multiple specification of neighboring and peer governments. Using the geographic proximity as a baseline to examine the policy emulation among governments, this research expands the proximity with regard to the level of economic development and administrative hierarchy. The empirical evidence suggests that local governments tend to have comparable PPP investments if they are spatially adjacent, have comparable levels of economic development, or have parallel positions in the administrative hierarchy. The same tier in the hierarchical system, which rests on a holistic comparison of cities, would impose a greater influence on the convergence of PPP investments than spatial closeness or economic resemblance.

Policy Implications

The evidence derived from this dissertation may shed light on the policy implications of government involvement in PPP participation. Derived insights from the resource-based theory, essay one finds that private organizations that have greater access to and stronger control over strategic resources are more likely to be sought after as partners. Moreover, as their strength of resources may vary across industrial sectors, private organizations will play various roles in different sectors. Taking PPP experiences in the China's context for example, CSOEs play a dominant role in PPP projects, since CSOEs leverage ample resources and possess extensive political and financial access compared to their private counterparts. Furthermore, the dominance of CSOEs is much

more significant in the transport sector than in the environmental protection sector. This is because private firms are likely to have more opportunities and play a significant role in the environmental protection sector that involves more high-tech activities. Private firms usually possess technical know-how though they may lack credentials, experience, and financial capital for infrastructure construction. Therefore, policymakers should pay attention to the specific sectors when choosing the private partners in PPP projects. Additionally, policymakers may need to take actions to reduce resource gaps between the large-sized enterprises and small and mid-size enterprises. Only in so doing, it is likely that a variety of enterprises can participate in PPP projects and exert their strengths in public service delivery.

In addition to the attention paid to government preferences for private partners, policymakers should attach great importance to reducing the risk aversion of the private sector and attract their participation in PPPs. Essay two reveals that the private sector may be more cautious and conservative when collaborating with fiscally constrained governments due to their risk aversion in investment decisions. Thus, governments should be cautious about the PPP rush that may create double jeopardies, including depleted own-source revenues on the one hand and unattainable PPP involvement on the other. For local governments with a significant fiscal gap and fewer options to provide public goods and services through private investment, the first and foremost solution is to improve the self-financing capacity based on economic growth and development to close the fiscal gaps between spending needs and available revenues. Furthermore, following the pecking order of government financing approaches, governments can issue revenue

bonds in addition to general obligation bonds to finance public projects, within the debt limit.

Also, it calls for an independent risk assessment, monitoring, and reporting system, analogous to the credit rating system of the municipal bond market, to facilitate private investors' screening and selection of governmental partners, mitigate their risk aversion, and improve their confidence in collaborating with local governments, including those that are fiscally stressed. The PPP risk rating system, ideally offered by third-party intermediaries, should not only consider local governments' fiscal conditions as included in the municipal bond rating system, but also cover the past successes and failures in PPP participation, management capacities, political endorsement, legal institutions, and so forth. In addition, analogous to a bond insurance for governments with unfavorable creditworthiness, PPP default insurance may mitigate government financial risks and encourage more participation.

In a broader sense, PPPs as a policy tool can be transferred from one government to the others. Essay three identifies the policy emulation process of PPPs between geographically, economically, and administratively similar governments. The findings carry implications on the role of pilot cities in the spread of PPPs. The diverse policy emulation pathways may offer various policy options to facilitate and promote policy innovations and to reduce the regional disparity in public service delivery. Policymakers should take various attributes of policies, and governments' varying levels of economic development, as well as different positions in the administrative hierarchy into account when selecting the candidate pilot cities for promoting the policy innovations.

Future Research

Built upon the three essays, this dissertation sets an agenda for future research from the following aspects. Essay one empirically identifies the important participants in PPP networks by focusing on the specific organizations in the networks. From a whole network perspective, future research can further explore the characteristics of PPP networks and summarize variant types of partnerships between governments and private entities. Additionally, the extant research on PPP formation mainly treats PPP transactions as individual observations, while overlooking the interdependence and interconnection among PPP participants from a network perspective. Therefore, the exponential random graph models can be used in the future research to explore the drivers of PPP formation based on the pair-wise transactions. The drivers may include the attributes of PPP participants, the dyadic properties of PPP transactions, and the structural properties of PPP networks. Essay two in this dissertation explores the government demands for PPPs by examining the relationships between government fiscal gaps, debt burden, and PPP adoption. It focuses on the general obligation bonds and PPP projects in all industrial sectors. Future research can move a step further by examining the specific revenue bonds and PPP projects in the correlated sectors. For example, to address the relationships between the transportation revenue bonds that are issued to finance transportation projects and PPP projects in the transport sector. The specific explorations of the drivers of PPP formation in different sectors will grant us a more detailed knowledge of PPP utilization. Last but not least, essay three primarily explores the horizontal diffusion mechanisms of the spread of PPPs across municipalities. In addition,

future research can illustrate the vertical mechanisms among different levels of government, such as the top-down coercion and bottom-up promotion of PPPs.

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