

Spatio-temporal dynamics of public private partnership projects in China

Zhe Cheng, Yongjian Ke, Jing Lin, Zhenshan Yang, Jianming Cai

Abstract: Public Private Partnership (PPP) has been widely applied in developing infrastructures around the world. In this research, a large database of PPP projects in China was firstly built to explore the spatio-temporal evolution in terms of regional differentiation, sectors, investors and contract types. It was found that China's PPP projects have undergone four stages with the characteristics of fluctuations along with time series, spatial differentiation and paradox of application. The mechanism behind these changes mainly include the momentum of economic development and impact of national policies, local settings, especially the local governments' motivation, preference, competency and reliability, as well as the feasibility and management of PPP projects. This paper tries to make its contribution in providing Chinese cases for international comparison, while helping Chinese national and local governments make customized policies, as well as laying foundation for further in-depth empirical and theoretical PPP research.

Keywords: Public private partnership (PPP); Spatio-temporal dynamics; PPP projects; China

1. Introduction

Public Private Partnership (PPP), an effective model for provision of infrastructure facilities and public services, has been increasingly developed in China over the past 30 years. PPP provides infrastructure products and services through establishing a long-term cooperation between public agencies and private sectors (Ke et al., 2010), which can help governments solve the problem of funding shortage, accelerate the construction of infrastructure, achieve better risk sharing, promote the governing effectiveness, and improve public service and output efficiency (Erridge and Greer, 2002; Shen et al., 2006; Yuan et al., 2012). Since its emergence in the 1980s, PPP has been rapidly applied in many fields such as healthcare, education, national defence, transportation, energy, and municipal administration, which can be seen in many other countries around the world (Akintoye et al., 2003).

PPP was introduced to China in the 1980s, then officially adopted and developed to a larger scale in the mid-1990s. Thereafter, the development of PPP has experienced different stages during which unstable factors occasionally occurred (Adams et al., 2006). Nowadays, PPP has become a very hot topic and received a heavy media coverage due to the promotion of central government. It is hence a right time to review the implementation of PPP in China. However, most of researches on PPP in China were either qualitative analyses or theoretical model analyses (Zhang, 2014). Limited research

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efforts have been made in investigating the PPP market in China with the support of a large database mainly due to the fact that there are no formal PPP project databases in China until 2014.

Therefore, this paper aims to present a systematic review and analysis on the implementation of PPP in China based on a large self-collected project-oriented database. More specifically, the objective of this research is to address the following questions: 1) how do PPP projects evolve over time, to better understand their general development process and approach, in order to evaluate the impact of policy change on PPP and feel the pulse of future trend; 2) what is their spatial distribution characteristics, to recognize the regional disparities and common features in China in terms of PPP development stages and levels under the local context, in order to identify the customized policies for different regions or cities; 3) what is the dynamic mechanism of their spatio-temporal pattern, to explore the theoretical framework through the interactive factor system analysis, in order to find the best pathway for PPP implementation in China and other countries as well; and 4) what is the implication for current PPP policies and its future development.

The significance of this research lies in the following aspects: 1) academically and theoretically, a PPP framework from China's model can be drawn based on the comprehensive analysis, which will provide a good basis for the international comparative research in the future, especially with other developing countries; 2) institutionally, this research may help national and local governments with their PPP policy and law making to better ensure the benefits of each stakeholder involved; 3) practically, or maybe more importantly, this research can also provide the solid macro context for PPP project managers for their micro planning and design, as well as the operation and management.

2. Background

Although more and more academic papers have discussed the application of PPP, there is still no consensus on the precise and comprehensive meaning of the concept due to the fact that PPP development in different countries are quite different (Khanom, 2010). Definitions put forward by the UK HM Treasury, World Bank, Canada's National Committee of PPP and Asian Development Bank (ADB) are more widely recognized with a powerful influence. Regardless of various definitions, PPP generally refers to a contracted cooperative arrangement between the public and private sectors to provide public goods or services (Ke et al., 2011). The official definition of PPP has not come into formation until 2014 in China. The possible reason might be the State-owned Enterprises (SOEs) is the dominant player in China's PPP market, which is difficult to be categorized into public or private sectors (Ke et al., 2014). The term of PPP used in Chinese can be literally translated as the cooperation between governments and social capitals in the field of infrastructure and public services, where government agencies are mainly responsible for overseeing the price and quality of the delivery of products, while social investors are responsible for undertaking the design, construction, operation, and maintenance of infrastructures, thereby obtaining a reasonable investment return.

Since the first PPP project Shenzhen Shajiao B power plant was implemented through the model of Built-Operate-Transfer (BOT) in 1984, more PPP projects have been widely introduced to China for the last 30 years. However, there were no national agencies specialized in PPP in China to provide guidance, statistical, counselling and supervision services for PPP projects until 2014. On 26th May 2014, a PPP working group was established under the Ministry of Finance (MOF), which was then transformed into a PPP Centre in early December 2014. The role and responsibility of this centre is not yet validated as a national PPP unit, mainly because the members of this centre are all affiliated to MOF.

Besides, there were no official PPP project databases until May 2015 when the National Development and Reform Commission (NDRC) published its PPP project database. The NDRC database include PPP projects existed in the market and potential PPP projects on the way, but does not include any past PPP projects. The information transparency is insufficient for statistical analysis. The exact number of PPP projects in China hence remains unclear. The World Bank Private Participation in Infrastructure (WBPII) Project Database, the only publicly available database, has collected data on 1226 PPP projects in China (as of 6th July 2015). The WBPII database classifies PPP projects into four categories including concessions, management and lease contracts, greenfield projects and divestiture. It is not convenient for research use because this classification is too general and also lacks locational reflection. More importantly, WBPII database excludes those PPP projects invested by SOEs. As mentioned above, SOEs can be the player and in fact they are the major players in PPP projects in China. The actual number of PPP projects is believed to be much greater than the World Bank has recorded. Some of China's PPP consulting firms claimed that the number was about 7000–8000 (Dayue consulting, 2014).

The topics of international PPP research mainly focused on risk management, critical factors for success, financing, investment environment, procurement, economic viability, concession agreements, concession periods and etc. (Ke et al., 2009; Tang et al., 2010), while the research interests of PPP in China on strategies and framework in choosing the right type of PPP, financing structure optimization, legal issues, concession period design and pricing mechanism (Shan and Ye, 2012). Regarding some of the topics, there are several review publications to summarize the PPP application in China in order to draw lessons for future references. For instances, Ke et al. (2014) summarized the application of PPP in China in terms of opportunities, environment and usage; Wang et al. (2014) analysed the overall application of PPP by examining the characteristics and classical projects in different sectors; Adams et al. (2006) examined the PPP system and major models in China and identified the key constraints; Mu et al. (2011) analysed and explained the institutional transition process of PPP in China's transportation based on the Path Dependence Theory; reviewed and assessed the development of PPP in China's urban water sector based on a self-collected project database on 152 water supply projects and 200 waste water treatment projects.

The limitation of these previous review publications is that they are based on either literature review or case studies, thereby lacking convincing evidence and support from statistical data. One of the important reasons lies in the lack of information disclosure system. It is hence nearly impossible to obtain official data on completed PPP projects nationwide.

3. Research methodology

Due to the lack of an official and reliable PPP project database in China, this research built a project-oriented database by using search engines such as Baidu and Google to collect publically available information of PPP projects in China. A three-stage data collection framework was adopted as shown in Fig. 1: in stage 1, a comprehensive search was conducted by using all possible keyword combinations from two different lists of search phrases, i.e. names of province and PPP related keywords; in stage 2, a manual validation with a multi-channel cross validation was applied to eliminate those unqualified or incomplete projects such as projects with poor-quality information in order to enhance the reliability. For example, by using the investment project information which was published on the website of some famous investors (such as Veolia Water, China Communications Construction Company Limited), the more reliable data was then well matched and validated; and in stage 3, the PPP project database was categorized as per time (i.e. financial closure year), location, sector, investor and contract type.

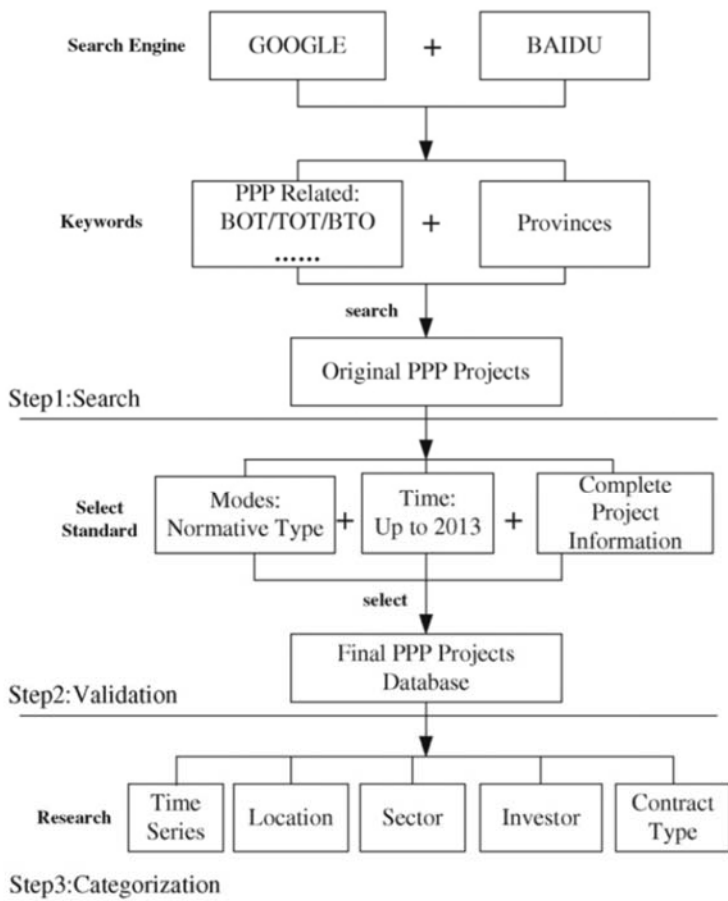


Fig. 1. Data collection framework.

According to the introduction of PPP implementation in China, the selection criteria of PPP projects are as follows: 1) Build-Transfer (BT) projects were not considered, because the implementation of BT aggravated the huge debts suffered by local governments and did not enhance service efficiency and quality despite of their wide usage in China; 2) the project must be officially approved and initiated, i.e., only those projects with awarded contract can be included in the database; 3) the inclusive deadline was set by the end of 2013, as in 2014 PPP projects witnessed a massive increase due to the strong promotion by NDRC and MOF, yet most of which are still upon approval; and 4) this research covers only the PPP projects in Mainland China without including Hong Kong, Macau and Taiwan.

Based on the self-collected PPP project database, this paper firstly presents the statistical results of distributions by year, region, sector, investor and contract type. Then, based on the analysis of the statistical results and the macro environment, the PPP development stages and their spatio-temporal pattern in China are provided. At last, the influencing factors and mechanism behind the spatio-temporal pattern of PPP projects in China are explored.

4. Results

By using the above-mentioned method, 1221 qualified PPP cases were collected and analysed with the total investment worth more than 1000 billion RMB (158.7 billion USD²). Considering China's huge infrastructure investment demand, which was over 70 trillion RMB (11.1 trillion USD) in 30 years, the role of PPP infilling the funding gap is very limited. Given the fact that the concession

period of PPP projects is usually no longer than 30 years, it's commonly seen that most of projects take the longest period as the norm. One reason is the related rules and regulations. The Municipal Public Utility Concession Management Approach, issued in 2004 by the Ministry of Construction (MOC), now known as the Ministry of Housing and Urban–Rural Development (MOHURD), clearly states that the concession period should be determined based on industry characteristics, scale, business pattern and other factors, and shall not exceed 30 years. Another reason is that the connection between research and practice is weak and slim. Although there are already plenty of quantitative methods and models to determine the concession period, such as Monte Carlo simulation (Carbonara et al., 2014), real option (Wang et al., 2014), and web-based analysis (Zhang, 2011), yet they are rarely applied into practice. Instead, the decision makers in most cases simply take 30 years as the period.

4.1. Number of PPP projects by year

As shown in Fig. 2, the PPP application in China has witnessed a fast growth, with an accelerating trend when stepping into the 21st century. However, the tendency is not smooth but fluctuated in periods of 2003 to 2004 and 2007 to 2008 probably due to the SARS epidemic and financial crisis respectively.

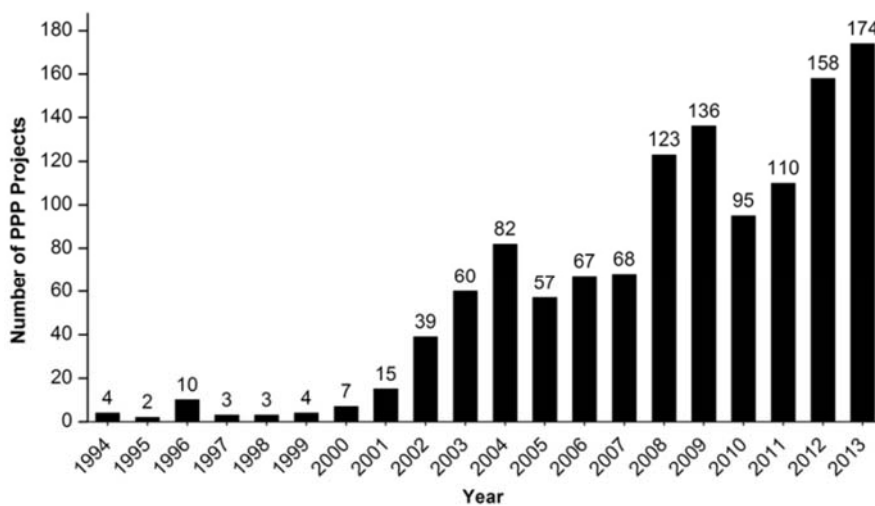


Fig. 2. Number of PPP projects by year in china (1994–2013).

4.2. PPP projects share by region

China could be geographically divided into four regions: eastern, central, western and northeast. The eastern region covers Beijing, Tianjin, Shanghai, Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong and Hainan. The central region includes Shanxi, Henan, Hubei, Anhui, Hunan and Jiangxi. The western region contains Inner Mongolia, Xinjiang, Ningxia, Shaanxi, Gansu, Qinghai, Chongqing, Sichuan, Tibet, Guangxi, Guizhou and Yunnan. The northeast region consists of Liaoning, Jilin and Heilongjiang. As shown in Table 1, nearly half of the projects are committed in the eastern region, followed by the central and western regions, while the northeast region far lag behind. In terms of distribution by province presented in Fig. 3, Fujian, Guangdong and Jiangsu are the most widely PPP users, while the least applied ones are Tibet, Qinghai and Hainan.

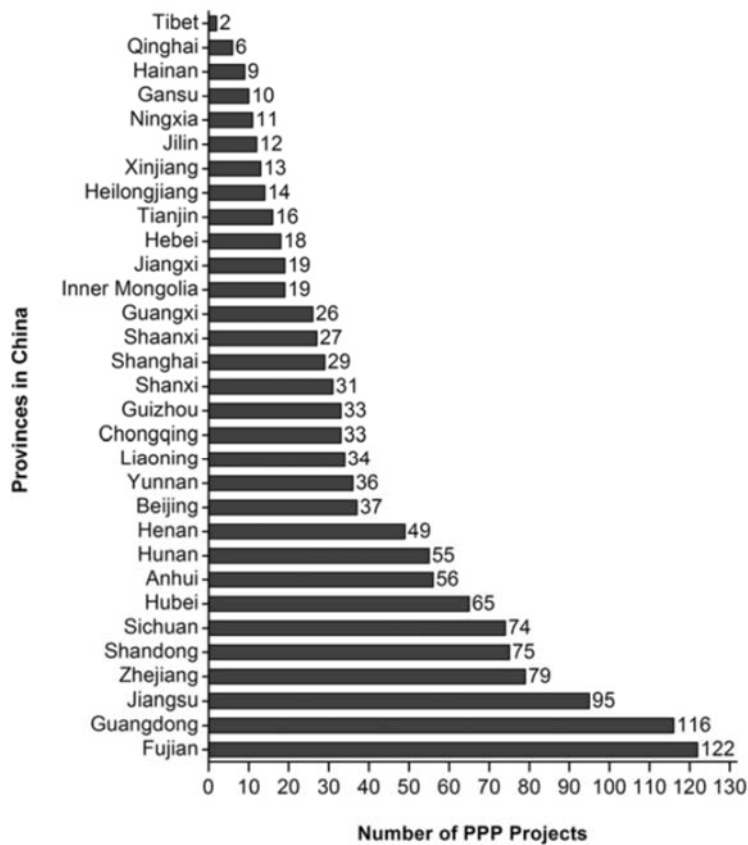


Fig. 3. PPP projects distribution by province in China.

4.3. Distribution by sectors

Table 1 also shows the PPP projects distribution by sectors. It can be seen that as one of the most marketized components of urban infrastructure, water sector including water supply and sewage treatment, has the largest share of PPP projects, accounting for 54.6% of all project cases in the database, followed by municipal facilities (such as waste management and heat supply) and transportation (including toll roads, bridges, urban rails, and tunnels). The main reasons are as follows: 1) these industries are more attractive to private investors as projects usually have a sound financial self-liquidating ratio; 2) the total investment of each project is relatively small; 3) the path dependence and lock-in effect, given the fact that the first few pilot projects in China mainly focused on water supply, transportation, municipal facilities; and 4) some of the sectors such as national defence, jail system, healthcare and compulsory education, are not as open in China as in developed countries due to the national conditions, market barriers and policy restrictions.

Table 1
PPP projects distribution by classification in China.

Classification	Category	Number of PPP Projects	Ratio	Sum
Distribution by region	Eastern China	596	48.8%	1221
	Central China	271	22.2%	
	Western China	294	24.1%	
	Northeast China	60	4.9%	
Distribution by sectors	Water	667	54.6%	1221
	Municipal facilities	324	26.5%	
	Transportation	187	15.3%	
	Power plant	4	0.3%	
	Culture & sports	4	0.3%	
	Education	13	1.1%	
	Tourism	2	0.2%	
	Healthcare	4	0.3%	
	City building	7	0.6%	
	ICT	3	0.2%	
	Environment	6	0.5%	
	Distribution by investors	State-owned enterprises (SOE)	533	
Foreign enterprises		145	11.9%	
Private enterprises		521	42.7%	
Joint ventures		22	1.8%	
Distribution by contract type	PPJV	76	6.1%	1241 ^a
	BOT	1024	82.5%	
	TOT	126	10.2%	
	BOO	13	1.0%	
	BTO	2	0.2%	

Note: PPJV = public private joint venture; BOT = build operate transfer; TOT = transfer operate transfer; BOO = build own operate; BTO = build transfer operate.

^a Including 20 BOT + TOT projects.

4.4. Distribution by investors

SOEs in China have taken the leading role in PPP investment. Among 1221 projects, 533 projects are invested by SOEs, accounting for 43.7% of all projects as shown in Table 1. Private enterprises also play an important role with a 42.7% of market share. Foreign investment is relatively limited by many legal conditions, such as foreign investors are not allowed to hold more than 50% of share. The reason of SOEs having the largest market share is due to their generally stronger capacity in terms of capital, technology and organizational size compared to private enterprises. More importantly, with the monopolistic advantages and governmental background, SOEs have an inherited higher status in dealing with government-related business and negotiation. The local governments naturally have a strong tendency to choose state-owned investors.

Distribution by investors has changed significantly over time as shown in Fig. 4. Before 2000, only 9 out of 30 projects were invested by SOEs, while 17 were invested by foreign investors, accounting for 56.6% during that period. After entering the 21st century, the share of SOEs and private enterprises surged accompanied with a significant fall by foreign companies. For example, in 2013, among 174 cases, 78 were invested by SOEs and 93 by private enterprises, accounting for 44.8% and 53.4% respectively, while only 3 were invested by foreign companies. The possible reason is that in one hand, SOEs and private enterprises in China are constantly becoming more experienced and

sophisticated in applying PPP by accumulative learning from the past practices and international best cases; in the other hand, foreign companies are gradually losing their first-comer advantage and competitiveness.

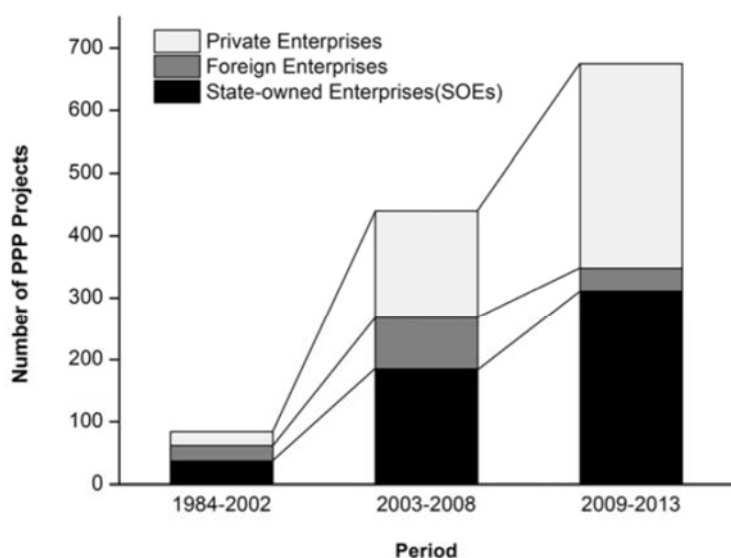


Fig. 4. PPP projects distribution by investors in different periods.

4.5. Distribution by contract type

With the number of 1024, BOT model occupies an absolute dominant share, accounting for about 82.5% of the total 1221 cases. One reason is that BOT was the specific form of contract type promoted by government in the 1990s (Ke et al., 2014). Another reason is that the paramount driving force for most local governments in China to adopt PPP is economic return (Chan et al., 2009). With the handover of responsibilities of finance and build to the private, BOT is hence preferred by local governments. Table 1 presents all the PPP projects by contract types in China.

5. Discussions

5.1. PPP development process by phases

There are different views on division of PPP development phases in China, such as five-phase division by Jin (Jin, 2014), who divided development process into the following phases, i.e., exploration (1980–1993), pilot (1994–2202), upscale (2003–2008), fluctuation (2009–2012) and popularization (2013–); and three-phase division by Su and Luo (Su and Luo, 2015), who divided the process into pioneer (1990–2003), modern (2003–2013) and new-wave (2013–) phases. However, this paper makes a four-phase division based on the national macroeconomic environment and relevant milestone policies, as well as the statistical analysis of the self-collected database. The new division can be illustrated in Fig. 5.

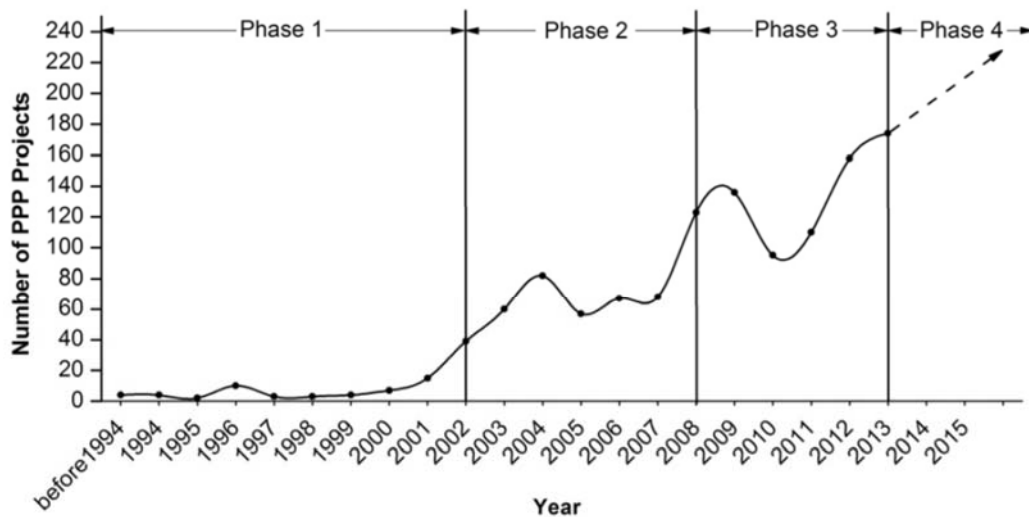


Fig. 5. New division of PPP development phases in China.

5.1.1. Phase one: exploration (1984–2002)

China faced a serious capital shortage in the 1980s when it began its reform and opening-up policies. As a result, the effective way out was to attract and utilize the foreign direct investment (FDI). In this phase, the newly emerged BOT model was introduced to China. The first BOT project was Shajiao B power plant in Shenzhen, invested by a Hong Kong based company in 1984, which was successfully transferred to local government in 2000 after a concession period of 15 years. However, Shajiao B power plant was frequently criticized for its rough procedure, imprecise contract documents and limited influencing power (Ye and Tiong, 2000). In 1994, the central government nominated five BOT pilot projects including Laibin B Power Plant, Chengdu No. 6 Water Plan and Beijing No. 10 Water Plan. Among them, Laibin B Power Plant was the first successful national-level BOT project, from which the central government formed a basis to issue a number of policies to promote and guide the BOT development in China.

91 projects are collected in the database for this phase. Their characteristics are as follows: 1) PPP was mainly applied in transportation, energy, water and waste treatment sectors; 2) the main player was foreign investors with mature technologies and management skills; 3) BOT was the most common contract type; 4) several limitations in the implementations restrained a larger scale of PPP application, such as risks were not equitably allocated and procurement was costly and time-consuming.

5.1.2. Phase two: stable expansion (2003–2008)

The 16th National Congress of the Communist Party of China (NCCPC) in 2002 promoted market mechanism as a key measure for the infrastructure development. As a response, the MOC issued a number of official documents for the application of PPP as the legal basis. With strong support by the central government and the rapid demand for infrastructure development due to the successful bidding of Olympic Games to be held in Beijing, a fever of PPP application was broken out nationwide. Typical cases in this phase included Beijing National Stadium (Liang et al., 2011) and Beijing Metro Line 4 Project (Chang, 2013).

This phase bore the following features: 1) PPP was applied mainly in municipal utilities, such as water supply, sewage treatment, garbage disposal and heat supply; 2) SOEs and private investors

took the leading role while foreign investment declined its share significantly; 3) public bidding process was widely taken in selecting investors, which effectively reduced costs, improved efficiency, ensured compliance with regulations, and granted local governments more initiatives to avoid black box operation and maintain public interest; 4) relatively more mature process, contract templates and working patterns were summarized based on the ongoing projects. Other improvements include significant reduction of pre-transaction cost and preparation duration.

5.1.3. Phase three: development with fluctuations (2009–2013)

The financial crisis in 2008 affected both the global financial market and the development of PPP in China. In response to the crisis, Chinese central government launched a stimulate package worth 4 trillion RMB (0.63 trillion USD), resulting in a huge amount of public funding flooded into infrastructure sector. One of the direct consequences was the attitude change of local governments towards PPP implementation, who lost the enthusiasm and passion on PPP model application and turned to traditional procurement methods in many potential PPP projects, which to some extent squeezed out plenty of private capitals.

The characteristics of this phase include: 1) SOEs absolutely dominated the PPP market given the fact that they possessed more government resources, by being highly affinitive with local governments and more favoured by state-owned commercial banks. It hence became a China-specific PPP model where local governments and SOEs cooperated with each other to deliver public facilities and services; 2) financing channels were further broadened for PPP projects. In the previous phases, debt financing in a PPP project was mainly made up of loans from banks. With development of financial market, PPP players had increased their use of diversified financing channels such as IPO, corporate bonds and trust.

5.1.4. Phase four: new boom (end of 2013–)

The new generation of Chinese leadership, which came into power in March 2013, brought with a substantial and positive change in government attitude towards private investment in infrastructure development. This is reflected by the fact that the 12th National People's Congress (NPC) decided to propose a national PPP concession law led by NDRC, which experienced many rounds of discussion and now in final drafting. Given the wide gap of PPP development based on the global comprehensive evaluation between China and other countries, the missionary goal of the law is to serve as the first national-level law to resolve the conflicts in PPP project operation with the existing national by-laws and local regulations, as well as to ensure the benefits of various stakeholders involved, including the State-owned Enterprises (SOEs), provincial Chinese banks and private sectors. In 2014, the State Council and various ministries issued a series of rules and regulations in forms of notices, opinions, provisions, and measures (more than 40 official documents) to promote the application of PPP model. One of the highlights in these rules and regulations was that the central government paid more attention to the standardization of PPP implementation, evident from the vital guidelines by the MOF such as PPP implementation guidelines, value for money evaluation and public fiscal capacity evaluation. With government strong promotion, the PPP topic was heavily covered in the public media. A new boom of PPP projects emerged.

Different from the past, in this round of PPP boom, MOF took the leading role rather than MOHURD and NDRC. By the end of 2014, the first batch of 30 PPP pilot projects was announced by MOF, followed by many provinces and cities to designate a large number of local PPP pilot projects. A PPP centre was also established by MOF in December 2014. Echoed by proactive involvement of many other ministries and local governments, NDRC released a database which had

1043 projects up to May 2015 with a total investment 1.97 trillion RMB (0.31 trillion USD). While there still existed some major risks in the application of PPP especially at the local government level, the effects of policies and programs in strongly promoting PPP have not yet emerged.

5.2. Spatio-temporal pattern

The following section will discuss the spatio-temporal pattern of PPP application in China based on the self-collected PPP project database in terms of temporal fluctuations, spatial differentiation and paradox of application.

5.2.1. Temporal fluctuations

As discussed in the four-phase development process of PPP shown in Fig. 5, the application of PPP in China is not a plain sailing. This unstable development process is primarily attributed to the macro investment environment and PPP-related rules and regulations. For instances, the fadeout of foreign investment in the infrastructure development in the end of 1990s was mainly due to the financial stimulus package for 1997 Asia Financial Crisis and the action of cleaning up unqualified BOT projects by central government. The 4 trillion RMB (0.63 trillion USD) stimulus package for tackling 2008 international financial crisis also led to an attitude change of local governments towards PPP implementation as argued in the above section. The current fever of PPP application since late 2013 was also another typical example, which was caused by the strong promotion of central government and other ministries, especially the MOF.

5.2.2. Spatial differentiation

Spatial differentiation of PPP implementation in China is huge, which ranges from 2 in Tibet to 122 in Fujian with a mean value of 39 and a median value of 31. More importantly, it can be seen from Fig. 6 that the spatial distribution of China's PPP projects is ladder-like, which nearly coincides with the regional economic development pattern in China, leading us to assume that economic development and PPP application shall have a strong correlation waiting for further test. Local government attitude towards PPP application is also a very important reason for the spatial disparity. Take Fujian province as an example, it has already issued many local regulations and easy-to-follow templates for concession contracts in fields of sewage, garbage disposal and gas supply since 2007. As a result, Fujian province successfully carried out 66 projects from 2008 to 2010. The high demand of infrastructure and public services in coastal China due to its high density of population is also another reason for their active implementation of PPP besides their high fiscal revenue and payment credit. Both conditions are favourable for reducing risks for private investors.

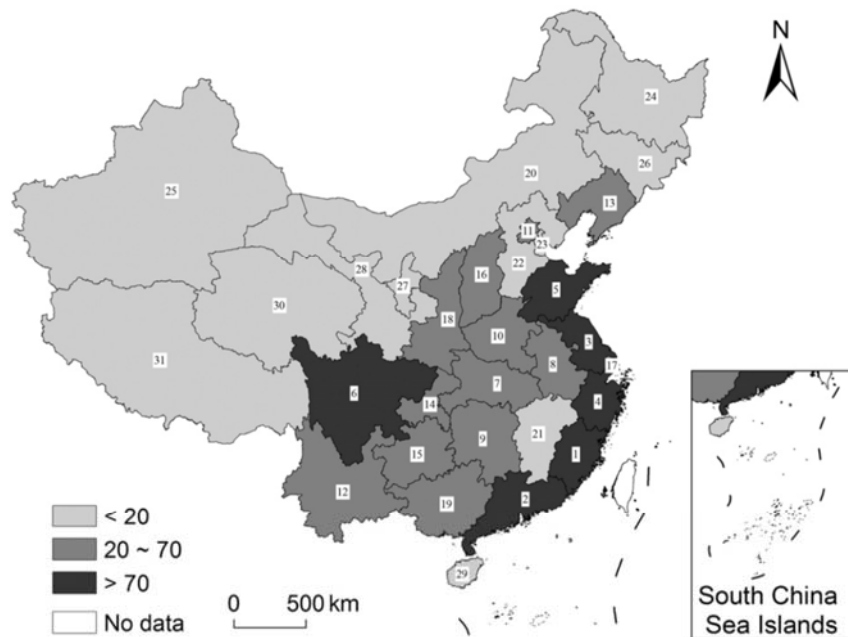


Fig. 6. Number of PPP projects implemented in China by province Note: 1 Fujian; 2 Guangdong; 3 Jiangsu; 4 Zhejiang; 5 Shandong; 6 Sichuan; 7 Hubei; 8 Anhui; 9 Hunan; 10 Henan; 11 Beijing; 12 Yunnan; 13 Liaoning; 14 Chongqing; 15 Guizhou; 16 Shanxi; 17 Shanghai; 18 Shaanxi; 19 Guangxi; 20 Inner Mongolia; 21 Jiangxi; 22 Hebei; 23 Tianjin; 24 Heilongjiang; 25 Xinjiang; 26 Jilin; 27 Ningxia; 28 Gansu; 29 Hainan; 30 Qinghai; 31 Tibet. *The number sequence of provinces in this figure is consistent with the bottom-up sequence of provinces in Fig. 3.

5.2.3. Paradox of PPP application

Theoretically, PPP may shed a ray of light to mobilize more financial resources for less developed provinces in China in their infrastructure development and public services. However, possibly due to the Matthew Effect, PPP application to some extent falls into the paradox featured somehow by “winner take-all”. The PPP most-needed region is supposed to be those lagging behind or during struggling periods in economic development. However, the reality in China is that the majority of PPP projects are found in the economically more developed regions and rapid economic development periods. For example, the top five provinces with the highest number of PPP projects, i.e. Fujian, Guangdong, Jiangsu, Zhejiang and Shandong, are all located in the coastal China, which is the most developed region in the country. As shown in Fig. 7, fiscal revenue and PPP projects implementation are correlated, reflected by the fact that local governments tended to choose PPP more frequently than traditional procurement during the good years of fiscal revenue.

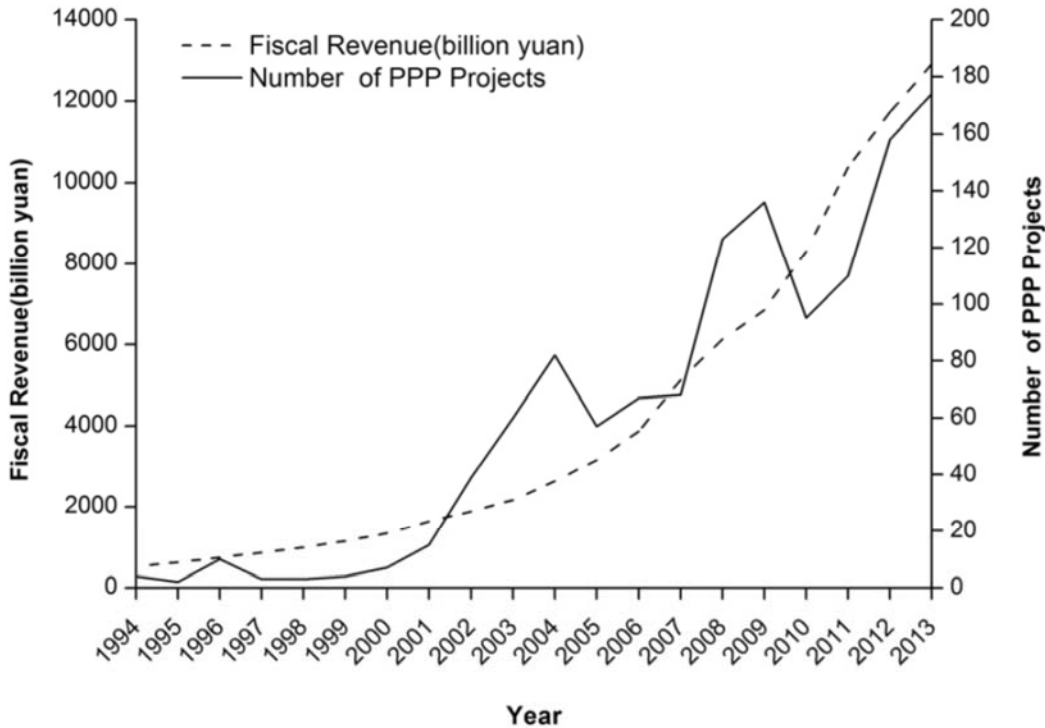


Fig. 7. Fiscal revenue and PPP projects (1994–2013).

5.3. Mechanism analysis

The driving forces of the above-mentioned spatio-temporal pattern of PPP projects in China are as follows:

(1) National economy and policies

This is one of the key factors for the PPP development of China. The first boom of PPP applications (primarily in the form of BOT) in China occurred in 1980s, when China put forward the reform objective of establishing a socialist market economic system. The second boom of PPP application started from 2002, when Chinese government issued several regulations for the purpose of encouraging, guiding and supporting private investment into the infrastructure development. The introduction of the 4 trillion RMB (0.63 trillion USD) stimulus package by Chinese government during the 2008 financial crisis weakened the role of private investment in PPP application, resulting in a fluctuation of PPP development. The current new boom of PPP projects reappeared in 2013, when the new government has a strong political will to diversify the investment composition, including the promotion of PPP application.

(2) Local government motivation and preference

Local governments in China have strong preferences to adopt PPP approach and select investors. In the first phase, local governments endeavoured to attract foreign investment in the infrastructure development due to the weak domestic economy and insufficient capitals. FDI hence took the leading role in PPP projects. However, in the second and third phases, aligned with the fast development of Chinese economy and the increasing improvement of management skills and the financing capabilities of Chinese companies, SOEs took over the leading role instead due to their strong connection with local governments and being familiar with the national conditions and financing institutions.

(3) Local government reliability

The reliability of local governments is critical to the success of PPP projects. Given the long concession period, high risk exposure and uncertainties of local governments, private investors have to carefully evaluate and assess the competency of local governments in their PPP projects bidding. Local governments who are more reliable and competent and have a higher operational maturity and degree of information disclosure are preferred by private investors. As the first-comer and pioneer in applying open policies, coastal China has accumulated abundant experiences in attracting FDI. With richer experience and competency, local governments there have attached more importance on equality of long-term cooperation and mutual credit, thus being more trustworthy.

(4) Path dependence

The Chinese PPP development can be seen as a result of path dependence based on the regime, politics, culture, economy and accidental factors (Mu et al., 2011). For instance, the first successful PPP project of Chengdu 6th water plant set a good example for Sichuan province. By following this model, Sichuan has become the only province in the middle-west part of China able to par with those provinces in the eastern part of China. In the early phases, the front-end transaction cost in PPP projects in China required longer time and more money compared to the traditional procurement model, forcing local governments to abandon some complex method, such as the VFM (Value For Money) and take the simplified mode of PPP which more suits to Chinese situation and market requirement in that time. However, with the development of PPP maturity, the lock-in effect of the simple mode began to hinder the normalization and development of PPP in China.

5.4. Future development of PPP

In avoiding large amount of local government debts, partly due to the overuse of Local Government Funding Vehicle (LGFV) mainly through selling land, the Chinese government has issued a series of policies, encouraging the adoption of PPP approach to attract private capital since 2014. Accordingly, a large number of PPP projects has been announced by all levels of governments in China, with a total investment of roughly 3.4 billion RMB (0.54 billion USD) (Tan, 2015). Although the whole effect of the current policies remains to be tested and reviewed, some problems have already been detected recently, such as the inadequacy of feasibility study, non-normative operation and less transparency. It seems that local governments show more passion in obtaining investment through PPP financing rather than gaining better public services and facilities, which lead to contract signing of PPP projects at a lower rate on the one hand, and many pseudo-PPP projects on the other hand.

Given China has built a relatively complete infrastructure system after 30 years of development, the most pressing task facing the country to date is to improve the quality and efficiency of infrastructure and public services, in which PPP can play a significant role in that it not only can generate the needed funds, but more importantly enhance efficiency and promote governance. In respect to the present situation and future development of PPP in China, some key measures can be taken as follows: 1) establish a professional and highly capable PPP authority to enhance government capability along with a well-informed public institution serving as an advocator and initiator for PPP; 2) choose the suitable private sectors through a transparent and competitive bidding process, especially with the focus on the experiences and financial capacity of candidates; 3) prevent VFM from becoming a mere formality, although it proves to be a powerful and effective tool for achieving the best value; 4) set up an open official information platform to make public better known the situation including the project data and the best practice; 5) stress the multi-stakeholder participatory process in PPP development. For PPP project managers, this paper can be useful in micro perspective that whenever they want to operate or run the project, they can carefully look into the

typologies and spatial distribution of similar PPP projects in China as a whole, and design their own specific strategies accordingly.

6. Conclusions

Currently there has emerged a PPP fever in China since late 2013 because of the strong promotion by central government. However, PPP is not a panacea for all infrastructure projects (Ke, 2014). A systematic study of PPP history in China will assist the country to achieve a healthier development of PPP. The study of 1221 PPP projects in the self-collected database shows that China has a wealth of experience in the application of PPP. It is found that in China BOT is the predominant contract type; water supply and sewerage treatment are the most marketized sectors; and SOEs have been playing a leading role in PPP application since 2002. With the fluctuation of PPP development from 1984 up to now, China has witnessed an obvious disparity among regions and provinces, which to some extent complies with Matthew Effect of “winner-take-all”. This possibly implies that PPP implementation may have a positive correlation with regional socio-economic development. However, it needs to be further tested and proved. Fortunately, the existing large database can be exploited in depth to serve the purpose, particularly for careful examination and exploration in specific case study in one typology or one area in terms of dynamic mechanism, process evolution and development model.

While this paper makes its contribution in macro policy making, for example, for the finalization of Chinese Concession Law yet to come, it still has some limitations in the following aspects: 1) more international comparative studies should be conducted to make the implications broader, which we are now preparing by collecting more available data; 2) database itself should be consistently updated with the release of more open and transparent data to make it more powerful in academic analysis and practical application; 3) lack of a micro systematic analysis in PPP best practices in terms of benchmark, standard criteria, parameters and etc., which limited its application for involved stakeholders, particularly for project managers. All the limitations call for a series of following-up research in future. Given the current dynamic momentum of PPP development in China, a more thorough international comparative study in terms of policy making, laws and regulations, institutional environment as well as PPP best practices is badly needed and should be done immediately in the near future.

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References

- Adams, J., Young, A., et al., 2006. Public private partnerships in China: system, constraints and future prospects. *Int. J. Pub. Sect. Manag.* 19, 384–396.
- Akintoye, A., Hardcastle, C., et al., 2003. Achieving best value in private finance initiative project procurement. *Constr. Manag. Econ.* 21 (5), 461–470.
- Carbonara, N., Costantino, N., et al., 2014. Concession period for PPPs: a win-win model for a fair risk sharing. *Int. J. Proj. Manag.* 32 (7), 1223–1232.

- Chan, A.P.C., Lam, P.T.I., et al., 2009. Drivers for adopting public private partnerships—empirical comparison between China and Hong Kong special administrative region. *J. Constr. Eng. Manag.* 135 (11), 1115–1124.
- Chang, Z., 2013. Public–private partnerships in China: a case of the Beijing no. 4 metro line. *Transp. Policy* 30, 153–160.
- Dayue Consulting, 2014. The world bank PPP unit visit Dayue. Retrieved 8–20, 2015, from http://www.dayue.com/templates/T_Second/index.aspx?contentid=2302&nodeid=50&page=ContentPage.
- Erridge, A., Greer, J., 2002. Partnerships and public procurement: building social capital through supply relations. *Public Adm.* 80 (3), 503–522.
- Jin, Y., 2014. Look forward to the future from the development history of PPP in China. Retrieved 8–23, 2015, from http://opinion.caixin.com/2014-08-01/100712038_all.html#page2.
- Ke, Y., 2014. Is public–private partnership a panacea for infrastructure development the case of Beijing National Stadium. *Int. J. Constr. Manag.* 14 (2), 90–100.
- Ke, Y., Wang, S., et al., 2009. Research trend of public–private partnership in construction journals. *J. Constr. Eng. Manag.* 135 (10), 1076–1086.
- Ke, Y., Wang, S.Q., et al., 2010. Risk allocation in public–private partnership infrastructure projects: comparative study. *J. Infrastruct. Syst.* 16 (4), 343–351.
- Ke, Y., Wang, S.Q., et al., 2011. Understanding the risks in China's PPP projects: ranking of their probability and consequence. *Eng. Constr. Archit. Manag.* 18 (5), 481–496.
- Ke, Y., Jefferies, M., Shrestha, A., Jin, X.-H., 2014. Public private partnership in China: where to from here. *Organ. Technol. Manag. Constr.* 6 (3), 1156–1162.
- Khanom, N.A., 2010. Conceptual issues in defining public private partnerships (PPPs). *Int. Rev. Bus. Res. Pap.* 6 (2), 150–163.
- Liang, W., Song, X.Y., et al., 2011. Case study of the Bird's Nest: risks and opportunities in China's PPP implementations in major sports facilities. *Adv. Mater. Res.* 243–249, 6332–6338.
- Mu, R., de Jong, M., et al., 2011. The rise and fall of public–private partnerships in China: a path-dependent approach. *J. Transp. Geogr.* 19 (4), 794–806.
- Shan, X., Ye, X., 2012. Research on Public–Private Financing Mode of Public Rental Housing and its Selection. 2012 International Conference on Management Science & Engineering, pp. 1787–1793.
- Shen, L., Platten, A., et al., 2006. Role of public private partnerships to manage risks in public sector projects in Hong Kong. *Int. J. Proj. Manag.* 24 (7), 587–594.
- Su, L., Luo, J., 2015, 2015-05-25. Development History of PPP in China. *Securities Times*.
- Tan, B., 2015. Is the Spring of PPP Coming? *South Reviews*. 22, pp. 21–25 (Guangzhou)
- Tang, L., Shen, Q., et al., 2010. A review of studies on public–private partnership projects in the construction industry. *Int. J. Proj. Manag.* 28 (7), 683–694.
- Wang, C., Liang, W., et al., 2014. Real option in urban rapid rail transit PPP project. *Appl. Mech. Mater.* 505-506, 437–442
- Ye, S., Tiong, R., 2000. Government support and risk–return trade-off in China's BOT power projects. *Eng. Constr. Archit. Manag.* 7 (4), 412–422.
- Yuan, J., Wang, C., et al., 2012. Developing key performance indicators for public–private partnership projects: questionnaire survey and analysis. *J. Manag. Eng.* 28 (3), 252–264.
- Zhang, X., 2011. Web-based concession period analysis system. *Expert Syst. Appl.*
- Zhang, Y., 2014. From state to market: private participation in China's urban infrastructure sectors, 1992–2008. *World Dev.* 64, 473–486.