Determinants of Public–Private Partnership in Infrastructure: Empirical Evidences from India

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Abstract This study explores important determinants of Public–Private Partnership (PPP) in Indian Infrastructure. This study used secondary data for a period of eleven years (2005–2016) to observe the important determinants in PPP in Infrastructure in India. This study also examines the infrastructure scenario in India and its global comparison and tries to evaluate the impact of PPP on Infrastructure development. This study uses secondary data from various sources like, World Bank, Global Competitiveness Report, Department of Economic Affairs, PPP Cell, and Infrastructure Division to identify various factors to attract more PPP in Indian Infrastructure Sector. The findings from determinants of PPP analysis yield several insights about attracting PPP in Infrastructure sector and indicate that market size measured by Real GDP, Macroeconomic stability, Exchange Rate, Governance has a significant impact on determinants of PPP in Infrastructure sector.

Keywords PPP · Infrastructure · Policy · India

1 Introduction

Infrastructure development plays a vital role in Economic growth and development of a country and it has been widely accepted in the academic literature [2, 7, 9, 10, 19, 22, 28]. Better infrastructure increases productivity and reduces the overall production cost [25]. It is commonly apparent that infrastructure development in a country increases competitiveness and reduces the cost of business and increases the rate of return from the investment. Therefore, quality of infrastructure is important determinant of Foreign Direct Investment made by Multinational Companies [3, 8]. Similarly, social infrastructure viewed in terms of education and health-related facilities con-

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tribute significantly to human capital formation and hence affect investment through several mechanisms. On the one hand, healthy and educated workforce enhances the productivity of the workers. On the other hand, lack of health and education infrastructure facilities can raise health-related costs when the investors need to develop or significantly subsidize health care and education system for their employees. Such increasing costs of education and health are likely to affect investors' return adversely. Infrastructure is an important element in judging a country's regional development. Being a rapidly growing nation and various regions, the Indian government is giving considerable importance to the infrastructure sector by allocating substantial fund under different five-year plans on development of airports, ports, roads, and railway infrastructure.

The key challenge and constraint for the infrastructure development in India is access to financing (World Economic Forum, 2015–16). As per, Economic survey by the year 2040, India will face a $ 526 billion of investment gap for the infrastructure development. Therefore, Indian government currently raising finance through private sector investment and now government is encouraging various infrastructure projects via Public–Private Partnerships (PPPs) mode. Public–Private Partnership is defined as a legal agreement between public and private sector entity that offers the delivery of physical infrastructure and services to the society in specific time duration. PPPs can play important role in infrastructure development of India as it will bring non-debt creating capital flows, better management practices, and technology for efficient delivery of projects. Therefore, the government of India should focus on various factors and improve various policies that can attract more PPPs in Infrastructure. PPPs can one of the sources of investment which can accelerate the process of infrastructure development by bringing more capital flows, in India. PPP in Infrastructure sector in India will develop overall quality of Infrastructure in India which can lead to more economic growth and development for the economy.

2 Infrastructure Scenario in India: Cross-Country Comparison

As Per, Global Competitiveness Index 2016–17, infrastructure is one of the important pillars of competitiveness of any country. Improvement in quality of infrastructure is crucial for ensuring the comprehensive growth and development of the business activities in the economy. Enhancement in transport infrastructure reduces the distance between counties and integrate the various regions. This also facilitates movement of workers, goods and services in a timely manner. Therefore, well-developed infrastructure improves international trade and investments by shifting production in low-cost location. In addition, improvement in communication infrastructure is important factors for improvement in flow of information and it connects emerging and underdeveloped economies with developed economies. Improvement and devel-

opment of business activities also depend on electricity connectivity and availability which free from interruptions and shortages.

According to Global Competitiveness Index (GCI), 2016–17, the most problematic factors for doing business in India depicted that inadequate supply of infrastructure is eight important factors that influence overall attraction in doing business in India. Thus, infrastructure development is very crucial for attracting foreign as well as domestic companies in increasing business activities in India. According to GCI, India ranks 39 on the GCI out of 138 countries. With respect to Infrastructure, India is ranking 68 out of 138 countries which indicate that overall quality of infrastructure is not good in India. Overall score of infrastructure in India is 4.0 out of total 7 score means infrastructure development in India is stagnant in Median. According to different indicators of Infrastructure, India is ranking far below with 138 countries in the work compiled by global competitiveness index 2016–17 (Table 1). India ranks 51 out of 138 in the quality of overall infrastructure with the value of 4.5. Overall quality of roads, railroad port, and air transport Infrastructure India is ranking 51, 23, 48, and 63, respectively. Railway infrastructure is comparatively advance in India compare to road port and air infrastructure. Available airline seat km per week is 4324.2 million and India is ranking 8 out 138 countries. With respect to quality of electric supply India is ranking 88 which is far behind than other emerging economies like Brazil, China, and Russia. Availability of communication infrastructure is also not adequate in India as it ranks 123 and 114 with respect to mobile telephone subscription and fixed telephone line per 100 populations.

3 Trend in Public–Private Partnership in India: Where Infrastructure Stand?

The Government of India recognized PPP model as a mode for developing the country's infrastructure development. After liberalization of the Indian economy in 1991, there were various attempts to promote PPPs by Indian Government. However, most of the sectors, it failed to attract PPP. India was observed as too uncertain and there was substantial resistance to private sector involvement. It is only in the middle of the 2000s that the first PPPs were signed and implemented (Table 2).

The above data indicates that there is fluctuating trend in PPP involvement in Indian Infrastructure in the selected time. The total value of the PPP was highest (57854.97 Rs. Cr) in the year 2009–10 which dropped in 2010–11. After 2013–14, there is significant decline in the PPP in Indian Infrastructure (Table 3).

Projects recommended by the Public Private Partnership Appraisal Committee (PPPAC) indicates that Road sector is attracting most of the PPP in India followed by Ports, Railways, Housing, and Tourism. Road sector attracted around 287275.09 Cr. Rs. of PPP from 20th December, 2005–28th October, 2016. Whereas port sector attracted around 48677.96 Cr. Rs Airports and sports sector are not able to attract significant investment under PPP model.

Table 1 Quality of infrastructure in India: a global comparison

S. no.	Indicator of infrastructure	Value (1–7) 2016–17	Rank (out of 144) 2016–17	Value (1–7) 2015–16	Rank (out of 144) 2015–16
1	Quality of overall infrastructure	4.5	51	4.0	74
2	Quality of roads	4.4	51	4.1	61
3	Quality of railroad infrastructure	4.5	23	4.1	29
4	Quality of Port infrastructure	4.5	48	4.2	60
5	Quality of air transport infrastructure	4.5	63	4.3	71
6	Available airline seat km/week, millions*/week	4324.2	8	3726.6	11
7	Quality of electric supply	4.3	88	3.7	98
8	Mobile telephone subscriptions/100 pop*	78.8	123	74.5	121
9	Fixed telephone lines/100 pop*	2.0	114	2.1	116

Source Global Competitiveness Index, 2016–17, World Economic Forum
*The best possible outcome

PPP in Infrastructure in India is mostly attracted by road sector and ports but sectors like Railways, housing, and airports are not able to attract more PPP hence government needs to undertake policy reforms to attract more PPP in these sectors (Table 4).

State-Wise Summary of Projects recommended by the Public Private Partnership Appraisal Committee (PPPAC) reveals that there is again uneven distribution of PPP projects in India. Only selected states in India attracted most of the PPP projects like Maharashtra, Uttar Pradesh, Odisha, and Tamil Nadu.

Table 2 Projects recommended by the Public Private Partnership Appraisal Committee: Year Wise Summary

S. no.	Financial year	Number of projects approved	Total project cost (in Rs. Crore)
1	2016–2017	5	5140.15
2	2015–2016	17	28465.76
3	2014–2015	18	29070.77
4	2013–2014	25	55326.29
5	2012–2013	25	25641.53
6	2011–2012	52	53248.6
7	2010–2011	33	26010.24
8	2009–2010	53	57854.97
9	2008–2009	48	53381.78
10	2007–2008	13	11227.46
	Total	**304**	**351901.09**

Source Department of Economic Affairs, PPP Cell, Infrastructure Division (From 20th December, 2007–28th October, 2016)

Table 3 Projects recommended by the Public Private Partnership Appraisal Committee: Sector wise Summary

S. no.	Sector	No of projects approved	Total project cost (In Rs. Crore)
1	Airports	4	0
2	Housing	8	7299.17
3	Ports	36	48677.96
4	Railways	1	8500
5	Roads	249	287275.09
6	Sports	5	0
7	Tourism	1	148.87
	Total	**304**	**351901.09**

Source Department of Economic Affairs, PPP Cell, Infrastructure Division (From 20th December, 2005–28th October, 2016)

4 Literature on Determinants of PPP in Infrastructure

There is abundant empirical literature on factors that potentially influencing private investment and Foreign Direct Investment (FDI) but there is very limited literature with respect to determinants of PPPs. The determining factors include stable macroeconomic conditions, openness of the government, government budget constraints, market size and institutional factors like effective rule of law, political stability, corruption, etc. [5, 11, 13, 24]. Most of the studies find that effective macroeconomic conditions and better institutional quality are positively related to PPP in Infras-

Table 4 Projects recommended by the Public Private Partnership Appraisal Committee: State Wise Summary

S. no.	State	Number of projects approved	Total project cost (in Rs. Crore)
1	Andhra Pradesh	20	17541.84
2	Bihar	13	12262.44
3	Delhi	8	9492.58
4	Goa	5	4727.96
5	Gujarat	14	18524.8
6	Haryana	12	16046.2
7	Jammu and Kashmir	8	20927.55
8	Karnataka	20	14846.48
9	Kerala	11	10056.44
10	Madhya Pradesh	20	20758.9
11	Maharashtra	29	51176.94
12	Odisha	20	22411.82
13	Punjab	12	10981.37
14	Rajasthan	20	17001.77
15	Tamil Nadu	26	21879.95
16	Uttar Pradesh	22	27506.23
17	West Bengal	13	14072.41
	Total	**304**	**351901.09**

Source Department of Economic Affairs, PPP Cell, Infrastructure Division (From 20th December, 2005–28th October, 2016)

tructure. However, factors such as budget restraints of government and government efficiency might have negative influences on the PPP in Infrastructure [13].

According to empirical studies lower and stable inflation rate, interest rate and exchange rate may decrease the cost of production. Macroeconomic stability in country is very important for the private sector because most of the PPPs project usually have long duration and high initial cost in the starting of the project and often require more time to generate revenue [11]. Some of the studies have revealed that the openness of the country is positively related with increased private investments as openness of the country means there are fewer restrictions for private investment [3, 18]. Market size is another important factor which attracts more PPP in the infrastructure sector. If the size of the market is higher then, there will be more demand for transport, electricity, ports, airport, and telecommunication-related infrastructure. The demand for public infrastructure will be even more when the GDP per capita is higher and people have more purchasing power [12, 13].

Business decisions by private sector player may largely be influenced by the institutional factors like governance, business environment, political structure, etc. Several papers have shown that inefficient institutions as measured by corruption,

political instability, and weak enforcement of contracts deter PPPs [4, 5, 16, 21, 27, 17, 15]. Some of the studies have taken institutional factors like political stability, effective rule of Law and regulatory quality, Government Effectiveness, Control of Corruption, and empirically proved that effective institutions quality attract more private investments [1, 14, 23]. In contrast, if the quality of institutions is weak then it decreases private investment and PPPs as it increases the cost of project and decreases profit of private investor [6, 20, 26, 27].

5 Model Specification and Estimation

To find out the relationship between different determinants of PPP in Infrastructure, the following panel data model is specified:

$$Y_{it} = \alpha_{it} + \sum_{k=1}^{k} \beta_{kit} X_{kit} + u_{it}$$

where

i 1, 2…N (refers to cross-sectional units)
t 1, 2…T (refers to a given time period)
k 1, 2…K (refers to number of explanatory variables)

Thus, Y_{it} represent the PPP in the sector i at time t and X kit is the values of such determinants as market size, trade openness, for the individual i at time t. The analysis begins by estimating pooled regression model assuming that there is no significant country or temporal effects then this study estimate fixed effects model (FEM) and the random effects model (REM) to control country-specific and temporal effects, if any. This study performs F test, LM test, and Hausman test for Selection of Appropriate Model.

Accordingly, the equation is estimated as:

$$FDI_{i,t} = \alpha + \beta 1ms_{i,t} + \beta 2to_{i,t} + \beta 3mas + \beta 4tax_{i,t} + \beta 5reer_{i,t} + \beta 6be_{i,t} + \beta 7GI_{i,t} + \varepsilon_{i,t}$$

5.1 Data

The data used for analysis are annual PPP data with observations from 2005 to 2016 for 5 important sectors of Infrastructure, but most results focus on the last 11 years due to limits on data availability for Sectoral PPP and institutional/qualitative variables. The analysis focuses on five important sectors of Infrastructure accounting for most of PPPs in Infrastructure. Data on PPP is taken for Housing, Ports, Railways, Roads, and

Table 5 Explanatory variables

Explanatory variables	Indicators	Sign	Data sources
Economic variables	Market size: real GDP	+	RBI
	Trade openness: trade/GDP ratio	±	World Bank
	Macroeconomic stability: Inflation rate	–	RBI
	Tax rate: total tax rate (% of commercial profits)	–	World Bank
	Exchange rate: real effective exchange rate	±	RBI
Policy variables (0 = worst, 100 = freest business environment)	Business environment: overall indicator of the efficiency of government regulation of business	+	Index of Economic Freedom, Heritage Foundation
Governance index [Institutional quality (0 = low level of governance, 100 = better governance)]	Control on corruption, rule of law, political stability and no violence, government effectiveness, regulatory quality	+	World Governance Indicators, World Bank

Source Authors calculations

Airports are collected from Department of Economic Affairs, PPP Cell, Infrastructure Division (From 20th December, 2005–28th October, 2016). The dependent variable in the specifications below is the inflow of PPP broken down into five different sectors of infrastructure.

The independent variables in our estimation include (Table 5) Real GDP for market size, Trade to GDP ratio for trade openness, Inflation rate for Macroeconomic stability, Total tax rate as a percentage of commercial profits for tax rate, Real Effective exchange rate for Exchange rate, and Business Environment. This study also crated Governance index including six variables of Governance, i.e., Voice and Accountability, Political Stability and Lack of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption to evaluate the impact of good governance on PPP in Infrastructure.

5.2 Results

This study firstly checks suitable model comparing FEM and REM and pooled regression. F test, LM test, and Hausman test indicate that fixed effect model is appropriate

Table 6 Macro level panel data analysis: fixed effect model

Variable	Fixed effect model
Market size	0.35 (0.00)***
Trade openness	−0.563 (0.5)
Macroeconomic stability	−2.106 (0.06)*
Tax rate	0.02 (0.5)
Exchange rate	−0.120 (0.01)***
Governance	−0.58 (0.06)*
Business environment	−0.28 (0.12)
Constant	131636.8 (0.00)***
F = 5.75(0.00) Nobs, Nvar (55,7)	R^2 = 0.68

Note Against each variable, coefficient followed by P value in the parenthesis
*Significant at 10%; **Significant at 5%; ***Significant at 1%

in this model. The empirical results (Table 6) obtained from Fixed Effect model specify that R2 of the model is 68% which indicates that variables of the model explain around 68 percent of the variation in PPP in Infrastructure in India. Overall the model is statistically significant indicated by F-statistic which is 5.75 and the probability of the F-statistic is 0.0000.

The result further indicates that at macro level Market size, Macroeconomic stability, Exchange Rate, and Governance have significant impact on PPP. Market Size measured by Real GDP indicates that it is positively related to PPP in Infrastructure. The main reason for this is higher Real GDP leads to more production within economy which requires more infrastructure facilities. Higher inflation rate negatively influences on PPP in infrastructure. The main reason for this, higher inflation increase cost of raw material and overall project cost. Real effective exchange rate is negatively associated with PPP in infrastructure; it indicates that when local currency devaluate it increases the PPP inflow as devaluation of currency make infrastructure projects profitable.

Governance/Institutional quality is measured by effective Rule of Law, Political Stability and No Violence, Government Effectiveness and Regulatory Quality negatively associated with PPP; it indicates that governance quality is not a relatively important variable in India for attracting more PPP in infrastructure.

6 Conclusion

Adequate level of Infrastructure is essential for the economic development of a country. Therefore, every governments create appropriate policies to attract more investment in the sectors such as transport, power, telecommunications, water supply, sanitation and sewerage, education and training, health and empowerment to increase

to quality of infrastructure. The overall results indicate that infrastructure quality is not adequate in India as India ranking 87 out of 144 countries in infrastructure quality. Thus, the government needs to undertake proactive policy reforms to developed infrastructure quality in India. Overall score of infrastructure in India is 3.8 out of total 7 score means infrastructure development in India is stagnant in Median.

PPP in Infrastructure in India is mostly attracted by road sector and ports but sectors like Railways, housing, and airports are not able to attract more PPP hence government needs to undertake policy reforms to attract more PPP in these sectors. The findings from PPP determinants analysis yield several insights about attracting PPP in Infrastructure sector. Market size measured by Real GDP, Macroeconomic stability, Exchange Rate, and Governance has significant impact on determinants of PPP. Macroeconomic stability and exchange rate have significant impact on determinants of PPP This result provides a hint of the significance of monetary policies to attract more PPP keeping lower inflation rate and exchange rate to attract more PPP in Infrastructure.

Although overall institutional and governance factor do not impact on PPP in Infrastructure significantly in the long-run these markets need to improve institutional and governance quality to attract additional inflow of PPP into Infrastructure. Thus, India needs to address various policies in the path of institutional and governance reforms to attract additional PPP in infrastructure in the long run.

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