

Diversification of Private Participation in Public Infrastructure in Developing Countries

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Abstract: *Public Private Partnership (PPP) is widely practiced in delivering public infrastructure. PPP utilizes private finance and management strengths. A number of countries worldwide have diverse demands. Political, institutional and macroeconomic conditions are involved in PPP in a wide range of public infrastructures and services. In diverse situations, countries worldwide are involved in a multiple number of PPP projects. With the proliferation of wide engagement in PPP, this paper examines how countries are attracting the private sector in the development of public infrastructure. The paper also determines what is engaged in PPP infrastructure using the multiple discrete-continuous extreme value (MDCEV) model. By examining the 4,423 projects from 86 developing countries, we found that countries are likely to be involved in telecommunication projects, followed by the energy and transportation and water projects. Water is one of the least preferred sectors among the four major infrastructure sectors provided by the PPI database of the World Bank.*

Keywords: *Private participation; public infrastructure; MDCEV model; Investment diversification; Sustainable economic growth.*

I. INTRODUCTION

The global demand for public infrastructure has been increasing with the advancement of the economy. After the 1980s, governments have been involved in the public-private partnership (PPP) mechanism because of the budget deficit to address the demand for infrastructure (Mota & Moreira, 2015; Silvestre, 2012; Yehoue, 2013). Technological advancement, concerns about health, environmental issues, and energy security are the prime government concerns that need to be addressed for the growing population and to sustain economic growth. The high urbanization rate in developing countries are the major issues to provide the adequate services to the citizen (Cohen, 2006) thereby high economic disparity among the population during the economic transition. In order to manage the economic transition by creating the livelihood of economic activities, developing countries need a huge amount of resources and remarkable resource management for successfully move forward. One possible way to manage the resources is to allow the private sector to facilitate public infrastructure by utilizing their capabilities for the simultaneous and proportionate development of public infrastructure along with sustained economic development.

The gap between the demand for public infrastructure and the caveats to address such demand has created an economic downturn in the developing countries (Castells-Quintana, 2017) leadingless economic activities. The availability of adequate infrastructure is the pillar of economic resilience. Thus, quality infrastructure can tackle the problems of socio-economic issues (Castells-Quintana, 2017) such as unemployment. However, without the active participation of the private sector in infrastructure development, there are fears of mismanagement in urban life and the creation of more urban poor because of the lack of proper urban infrastructure to address the demand. The fear of concentration of resources in urban areas creates inequality between rural and urban areas, which causes economic stagnation in developing countries (London & Smith, 1988). Thus, in order to vitalize the economic growth and sustainability, a long-term investment in infrastructure is necessary (Blundell-Wignall & Roulet, 2015).

When state-owned enterprises fail to address the market demand because of associated financial constraints, technical and managerial inefficiency of the partnership with the private sector is inevitable to address such caveat (Galilea and Medda, 2010; Yehoue, 2013). Developing countries with a low fiscal balance and resources cannot address the market demand for its own resources. Developing countries depend on foreign aid to improve the infrastructure and address market failure (Babb and Kentikelenis, 2017; Schwartz et al., 2014). The state-owned enterprise is often characterized as a scarce resource and having a less complementary asset in comparison with the private sector. The private sector has greater international exposure and can effectively handle the market demand by employing the acquired know-how such as the experience gained through international market exposure. By employing PPP arrangements, the government can leverage private sector resources to fill the gap of infrastructure demand. PPP arrangements with international partners have greater know-how in leading to the success of the projects. An effective transportation facility or energy availability decreases the cost to another sector. Similarly, the integration of information and communication technology (ICT) in managing the transportation infrastructure and energy resources may help to reduce the costs and to optimize the equal distribution of resources to the market. In order to fill the gap of the infrastructure deficit, proper mobilization of resources is necessary and is achieved only through proportionate development by diversifying investments in the infrastructure.

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Bilateral commitment and multilateral trade commitment, such as the World Trade Organization (WTO) agreement, have enforced governments to participate in market deregulation and to increase market (Cottier et al., 2011; Fredebeul-Krein & Freytag, 1997; McLarty, 1998; Z. Zhang & Assuncao, 2004). After the 1980s, governments have changed the policy to attract the private sector for the purpose of public infrastructure and are actively involved in PPP. The policies and approaches to attract the private sector for public infrastructure vary worldwide due to the nature of the infrastructures. The increasing number of engagements in private participation for public infrastructure is two-folded. First, need to address the increasing infrastructure demand and exploration, and the exploitation of new and fast-changing technology such as ICT. Second, need to benefit from the rise of regional industrial hubs and trade hubs and the growing number of bilateral and multilateral trade activities by the developing and emerging economies. The demand for public infrastructure are complementary and have a causal relationship with each other. For example, the advancement of ICT increases the energy demand (Collard, Feve, & Portier, 2005; Ishida, 2015). Other examples include the simultaneous attraction in a rapid and mass transportation system and the high rate of urbanization in developing country demand for public infrastructure. We need to address the trade commitment with an international community that meets the public demand and achieves sustained economic growth under associated constraints.

However, government policies, that maximize the returns from an investment, are a key instrument to increase foreign direct investment (FDI) inflows and to utilize domestic private investment. Macroeconomic situations are the major problems in attracting private investment to a public infrastructure government policy and institutional arrangements. Moreover, regional economic pressures and market situations such as microeconomic conditions also affect private participation and the amount of private investment to public infrastructure (Balasubramanyam, Salisu, & Sapsford, 1996; Borensztein, De Gregorio, & Lee, 1998; Hammami, Ruhashyankiko, & Yehoue, 2006; Iossa & Martimort, 2015; Yehoue, 2013).

Theoretical Background

The economics behind the improvement of public services delivery can be explained through the public economic perspective (Engel, Fischer, & Galetovic, 2013; Iossa & Martimort, 2015). The public economy explains economic efficiency and the distribution of welfare. However, because of the lack of government effectiveness and governing policies, the risk of market failure in developing countries is higher. Thus, after the 1980s, governments have changed their policies that reduce active involvement in providing for public infrastructure and services to the regulator by collaborating with the private sector. This change in policy has a great impact on economic growth, which empowers the private sector in public infrastructure and subsequently increases the allocative efficiency by reducing the x-efficiency in the economy (OECD, 2008). This policy drift (Béland, Rocco, & Waddan, 2016) has contributed to maximizing social welfare and thus creating the Pareto-

efficient state by pulling available resources in the public and private sectors. In the traditional procurement approach, this point is hard to attain because of the less competitive environment. Because of the lack of competition and accounting for the appropriate value of money and inefficient behaviour of the public agencies, the demand for public infrastructure and services have not been appropriately addressed or the cost of addressing the demand is higher. This entails welfare loss not only because of the inefficiency of the public agency but also because of appropriate use and management of resources. In contrast, the private sector, who have better technology, financing capability, and management skills than public agencies, can address the prospective demand and strengthen themselves for better providing services of the underlying associated risks. This, in turn, provides public infrastructure services and increases welfare than that of traditionally procured services (X. Zhang & Chen, 2013). Private participation creates a competitive environment for providing deemed services by breaking the monopoly market in public services and increasing the allocative efficiency (Engel et al., 2013). However, private participation needs a remarkable amount of resources, conducive environment, and supporting policy. Private participation requires market reformation and the restructuring of the organization such as privatization or corporatization in order to create new ventures or partnerships with a specific proposal. This condition is better explained by the X-efficiency theory developed by Leibenstein (1966) in a sense that it can reduce the sources of X-efficiency through partnership (Hammami et al., 2006). Sustainability can be achieved through market liberalization where the market controls the sources of X-efficiency. In the X-efficiency theory, a public servant may not be able to derive an incentive as the private sector derives from the market, which obviously changes productivity.

Since the 1980s, governments are shifting their role from an infrastructure or service provider to a regulator in order to speed up economic development by utilizing private sector capabilities (OECD, 2008; X. Zhang & Chen, 2013). However, there is a need to support esteemed economic growth and dynamism in the economy under a budget deficit and various circumstances such as the inefficiency of government. Associated government policies and socioeconomic issues are also identified as main challenges in attracting the private sector (Hammami et al., 2006). In order to escape from these challenges, the PPP approach has evolved to utilize strengths of both parties in addressing the public demand to share the associated risk for a common goal. The private sector's focus on profit maximization and the public sector's focus in providing public services have placed social welfare as a central theme. In this situation, one can argue that these two different philosophical orientations could come to a common ground and could meet the demand for infrastructure. For the success of any PPP project, government plays a vital role. These determinants can be a true clue to invite the private sector, which will ensure a conducive environment for private participation and the success of PPP projects

(World Bank, 2005). When state-owned enterprises fail to address the market demand because of associated financial constraints, the technical and managerial inefficiency of the partnership with the private sector is inevitable to address such caveat (Galilea & Medda, 2010; Yehoue, 2013). Developing countries with a low fiscal balance and resources cannot address the market demand for its own resources. Developing countries depend on foreign aid to improve the infrastructure and address market failure (Babb & Kentikelenis, 2017; Schwartz, Ruiz-Núñez, & Chelsky, 2014). The state-owned enterprise is often characterized as a scarce resource and having a less complementary asset in comparison with the private sector. The private sector has greater international exposure and can effectively handle the market demand by employing the acquired know-how such as the experience gained through international market exposure. By employing PPP arrangements, the government can leverage private sector resources to fill the gap of infrastructure demand. PPP arrangements with international partners have greater know-how in leading to the success of the projects. The need of infrastructural demand with heavy economic constraints can be fulfilled by the restructuring of enterprises and tax reforms. Such behaviour depends upon the political beliefs of the government. With high corporate taxes, the return on investment is less likely from an assumed payback period. In such cases, the investor is less likely to invest. The government structure also affects the mobilization of private funds. In a decentralized government system, local or state government has higher decision power in meeting public demand than a central government system (Hammami et al., 2006). A decentralized government is more likely to involve PPP projects for infrastructural demand by mobilizing private funds (Roland, 2000). In an unstable political environment, a frequent change of government may happen and a political party(ies) may not serve a full term, which may lead to a change in the policy based on the political agenda and beliefs. In such a situation, investors may fear the change in policy and the accountability of the government. The contracted projects by an earlier government may not be supported by the successor, which may lead to the failure of the PPP (Hammami et al., 2006). The PPP mechanism is a risk sharing mechanism in which the public sector transfers some of the risks to the private sector. In a strong legal and institutional background, the investor feels secure by the return investment. However, under a weak legal environment and rule of law, the investor is less likely to invest (Galilea & Medda, 2010). Again, with a dedicated institutional mechanism such as a regulator and a strong anti-corruption agency, the investor is more likely to invest. In such environment, the success of PPP is also high.

The government's creditworthiness and reputation also play a positive role in PPP projects. Countries with prior PPP experience attract more PPP projects. The success is more likely compared to the countries without experience. Many studies have been carried out to find the relationship between PPP experience and private participation (Galilea & Medda, 2010; Hammami et al., 2006). In addition, the private sector who already has experience in PPP and an exposure in another market or neighbouring country is able to deal with the certain risk associated with the market

environment. The market size, high gross domestic product (GDP) per capita and untapped market are an opportunity for the private sector. These factors influence the private sector to participate in a PPP contract. However, prior PPP experience may strengthen the risk management capability. Market saturation needs to consider the extent of private sector participation. To our knowledge, there is no study carried out that accounts for the government concerns regarding over-investment and/or underinvestment through PPP mechanism from utility perspective which intuitively can be stated as marginal diminishing utility by involving the PPP mechanism for the same sector. The utility concept is widely used in the consumer behaviour. However, the utility concept can also be applied when government makes decision to build the public infrastructure as government has two choices for the procurement, one as using traditional approach of procurement and another as going through the public private partnership approach. Limiting to the context of this study, government can invite private sector where government's performance is weak or government has number of constraints to develop such sector for instance if government's performance to operate certain infrastructure then government may incorporate private sector to make efficient; if energy demand is very high and government cannot afford building new infrastructure then government has two options either running energy deficient condition or incorporating private sector to build energy infrastructure. In such a situation, government may approach to the private sector to overcome the issues of overinvestment and underdevelopment of particular sector by discouraging/encouraging private sector to participate in particular sector. This instance can be explained through the utility framework which can be collectively called as the social utility {Soliño, 2016 #60}. A similar study has been conducted by {Ferris, 1994 #58} to study the government choices for providing health services. Government across the world have been promoting private participation in public infrastructure, however, government makes decision only if the PPP approach of procurement justifies the value for money {Grimsey, 2005 #59}. The value for money approach is widely adopted to identify whether PPP mechanism is suitable, however, government may decide and approach to the private sector for the development of public infrastructure if government perceives that particular sector needs to be strengthened with the help of private sector. Similarly, government may interfere on the provision of incorporating private sector to maintain the market competition and over-investment in particular sector for instance government hesitates to issue telecom operator license in competitive market. In such situation, marginal diminishing utility approach can be applied to explain why government has high level of unwillingness to issue telecom operator license. The ability to attract private sector investment and the number of private sector participants depend on the country's risk-sharing capability, the willingness to address the public demand in cooperation with the private sector, and the extent of strategic economic development. Thus, the government employs a different strategy to attract the private sector and to mobilize private capital (Delmon, 2009).

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The notion of involvement in the public-private partnership mechanism by the government is to maximize the available resources and pool private sector capabilities by having social welfare as the central point. However, the decision on whether to go for the PPP mechanism or through the traditional procurement approach for public infrastructure is based on the utility maximization theory. The theory of consumer demand (Lancaster, 1966) and utility theory (Cochran, 1974) can also be well suited to identify the dilemma on PPP or traditional procurement options (Stephenson Jr, 1991). Hence, this study aims to address the proper identification of sectors among the multiple alternative sectors and their level of satiation. From the utility theoretical perspective, the proportionate development of public infrastructure gives higher utility than crowding out the private sector on a particular public infrastructure category. For instance, a country may not be involved in the crowding out of the private sector in the energy sector when excess energy is available or duplicate in the transportation infrastructure. Instead, a country may diversify their available resources to another sector. Similarly, the private sector is concerned about the market demand and return on investment. Thus, this paper tries to identify how countries perceive the satiation of private investment in public infrastructure.

Study design

The objective of the study is to identify the satiation on private participation and extent of private investment in public infrastructure when engaging in multiple sectors. Either the country may engage in a number of PPP projects in a particular sector or multiple sectors specified above. The data structure for all projects is multiple discreteness with an investment amount for each project as a continuous variable. Analysing a particular sector cannot capture the effect of private participation in another sector when using the dummy variable. In addition, the ordinary least squares method with only a positive observation may produce a biased and inconsistent result (Greene, 1981) in the settings of zero investment or no participation observation. The possible biases when using a linear model such as the ordinary least squares model (OLS) can be avoided by allowing a corner solution, which is a zero consumption that can be effectively dealt by the Tobit model (Amemiya, 1984; Fraser & Wind, 1986; McDonald & Moffitt, 1980; Tobin, 1958). Previous studies such as Hammami et al. (2006) used the Tobit model to study the amount of investment attracted by a country through PPP in public infrastructure. However, they did not incorporate the effect of other sectors because of the restrictive in nature and assumes that the same set of variables with the same coefficients, determine both probability of engagement in the PPP project and the amount of investment made to the infrastructure category. Tobit model can correct the issues of conventional regression model by incorporating the latent variables and allowing corner solutions. The ability to incorporate a corner solution in the model helps to identify the effect of involvement in PPP projects in multiple sectors. Nevertheless, the use of the Tobit model accounts for the extent of investment amount but does not take into account the specific choices out of the available alternatives in which the government can diversify private participation. In addition, the Tobit model does not provide the diminishing marginal utility of particular choice alternatives for strategic allocation of resources and mobilization of the private sector

for the development of public infrastructure. Therefore, other than the esteemed sector, this paper contributes to incorporate the effect of private participation in other sectors. As explained earlier, the government may engage in a number of PPP projects to fulfil the market demand and boost the economy. The involvement in PPP projects in the public infrastructure depends on the country-specific situations that are widely discussed by (Hammami et al., 2006; Iossa & Martimort, 2015; Yehoue, 2013). The decision to engage in the development of projects through PPP are not perfectly substitutable in inviting the private sector and for leveraging private finance in public infrastructure. This entails that the government may engage with multiple numbers of PPP projects, which depends upon the development strategy, demand for infrastructure and the ability to attract the private sector with different incentives and risk sharing schemes that utilize the potential of the private sector. Thus, because of the demand and need of individual countries and their socio-economic characteristics, the multiple discrete-continuous extreme value (MDCEV) model has the advantage to explain PPP engagement behaviour and the ability to capture the marginal utility of the traditional models discussed above for analysing the countries' involvement in the development of public infrastructures through the PPP mechanism.

The MDCEV model was developed by Bhat (2005,2008) and is suitable to analyse the multiple discreteness problems for capturing the additional utility from available alternatives in contrast with the single discrete choice situation (Shin, Bhat, You, Garikapati, & Pendyala, 2015) The MDCEV model uses the variant of translated constant elasticity of substitution (CES) utility functions by accommodating first-order condition of the Kuhn-Tucker approach to relax the associated constraints for the utility maximization (Bhat, 2005, 2008). Here, we have utilized the MDCEV model to deal with the PPP engagement behaviour perceived by the developing countries, which are constrained in the available budget to the government. This means that in exchange for sharing financial contribution to the project during the investment time, the government may bear other associated risk through negotiation before reaching the financial closure.

Let K be the alternative sectors in which the country may potentially be involved through the public private partnership schemes. The utility functional form of the country can be expressed as

$$U(x) = \sum_{k=1}^K \frac{\gamma_k}{\alpha_k} \psi_k \{ (x_k / \gamma_k + 1)^{\alpha_k} - 1 \}$$

where ψ_k , γ_k and α_k are parameters associated with alternative sector k and $\psi_k = \exp(\beta_k'x + \varepsilon_k)$ is the baseline utility perceived by the country on engaging PPP to develop public infrastructure. The role of the γ_k parameter is to allow the possibility of zero investment on alternative sector k . In addition, parameter α_k represents the satiation or marginal diminishing utility while engaging on particular infrastructures.

The parameter representing marginal diminishing utility or the satiation gives an important implication to economic theory as it provides information about the simultaneous development of public infrastructure without risking the problem of overinvestment in a particular sector. It also helps to understand strategic development of the infrastructure by avoiding the externalities associated with it. As suggested by Bhat (2005, 2008), estimation without restricting the satiation parameters have serious identification problems because of the similar role of the γ_k and α_k parameter. However, their impacts on the utility function is different as γ_k controls the satiation by translating the consumption and α_k controls by exponentiation the consumption quantity (Bhat, 2005, 2008). In order to avoid the identification problem, we limit the parameter to a constant. If we restrict $\alpha_k = 1$ and assume that the country engages in a particular sector, it is unlikely for diversification of infrastructure development as it gives the highest baseline utility to a particular sector (Lim & Kim, 2015). However, allowing the α_k parameter ranging from 0 to 1 gives information on how the country is involved in the development of the possible alternative infrastructure type. Thus, we use the α -profile restricting $\gamma_k = 1$. Then, the model in simple form is expressed as

$$U(x) = \sum_{k=1}^K (\psi_k \{(m_k + 1)^{\alpha_k} - 1\})$$

Subjected to constraints $\sum_{k=1}^K m_k = M$, where M is the total investment made for infrastructure development for a particular country in a particular year.

Data

The data used for this study is from the Private Participation in Infrastructure (PPI) database of the World Bank. The PPI database is an extensive public repository of private sector participation in the public infrastructure of low- and middle-income countries (see appendix for list of country, number of projects used for this study) and covers four infrastructure sectors: transportation, energy, telecommunication, and water and sewerage. This database includes projects with more than one million US dollars as a financial commitment during the financial closure and covers variants of management or lease contracts, concessions, and greenfield and divestiture projects¹. The 4,423 PPI projects are from 86 developing economies during 1996 to 2014. The other variables for this study are adapted from different sources as shown in Table 1.

[Table 1 goes here]

Estimation Results and Discussion

Use of latent variable can capture the determinant of private investment in the individual alternative sector. However, our intention is to estimate how private investment is used through the PPP mechanism for the development of public infrastructure and do not specifically focus on a particular sector. All α –satiation parameters are estimated. Here, the satiation parameters for telecommunication is the largest, which signifies that the demand for telecommunication projects are highest among the other

sectors. This is due to high market opportunity in a developing country where ICT has contributed the highest growth rate (Chavula, 2013). The early maturity of telecommunication or highly competitive telecommunication industry induces more innovation, which further stimulates private investment not only in the network infrastructure but also in ICT applications. The satiation parameters for the energy infrastructure is the second highest, which signifies the growing demand of energy because of rapid industrialization and the high rate of urbanization. A number of studies empirically proved that there is the causal relationship between energy consumption and GDP growth in the developing countries (Asafu-Adjaye, 2000; C.-C. Lee, 2005). Moreover, as the country's GDP per capita increases, the energy consumption per capita also increases (Narayan & Smyth, 2008). In order to address the energy demand, the higher investment in the energy infrastructure is needed and the result is comparable with previous studies (Hammami et al., 2006; Panayides, Parola, & Lam, 2015; Yehoue, 2013). However, this paper included the extent of private participation in a particular sector in order to measure the effect of private participation in respective and alternative sectors. The result shows that private participation in one sector induces an increase in investment in the same sector and other alternative sectors. This result signifies that the maturity, extent of private participation, and use of product or services from the infrastructure demands more energy, which increases the possibility of a new PPP mechanism and investment. Similarly, there is high demand of the transportation infrastructure in the developing countries to maintain an international trade link and expand market power worldwide. Estimation results using the MDCEV Model are shown in Table 2.

[Table 2 goes Here]

Developing countries have the largest untapped telecommunication market and opportunity. The International Telecommunication Industry (ITU) estimates that almost half of the world's population has internet connectivity and has a higher demand for mobile broadband in developing countries.² Similarly, energy demand in the developing countries is growing higher than before³ because of the high urbanization rate and increasing economic activity of new industrial sectors. In order to support the growing demand and escape from economic growth stagnation, a country uses the PPP mechanism to address the energy demand. Private participation in the transportation sector has a lower satiation parameter than the telecommunication sector and energy sector, which signifies that the transportation sector is highly risky for the private sector followed by the water and sewerage management sector. The satiation parameter for these alternative sectors gives a clear understanding that the developing countries welcome more PPP projects to strengthen their economy. Moreover, the satiation parameter gives a decision and the investment absorption capability of the developing countries

¹More overview of the data source and information about the data can be found at <http://ppi.worldbank.org/data>

²ITU factors and figures <http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2016.pdf>

³<https://www.eia.gov/todayinenergy/detail.php?id=14011>

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to these infrastructure alternatives by showing that the water and sewerage management sector is one of the least prioritized sectors than the other sectors. The independent variable of international reserves has a negative effect on attracting the number of projects and associated investment in the telecommunication sector than in the energy sector. This signifies that the country focuses on the attraction of more private investment in energy-mix projects through private participation than investing on renewal by the government. Moreover, after the wave of energy sector reform in developing countries, the opportunity has extended to the transmission and distribution, and energy mix (e.g., power sector reform in BRICS (Brazil, Russia, India and China) (Barroso, Rosenblatt, Guimaraes, Bezerra, & Pereira, 2006; Karekezi & Kimani, 2002; Xu & Chen, 2006). A country with a higher GDP per capita focuses more on energy investment because of the increasing energy consumption per capita (Narayan & Smyth, 2008).

The regional dummy variables are most significant and have a positive effect on the utility structure. This shows that regional culture and development pressures are also enforcing factors that are involved in the PPP mechanism for infrastructure development. To account for this phenomenon, we removed the North America data because there are no observations. Thus, Eastern Europe and Central Asia are taken as the base. The experience variable is statistically insignificant. However, this can be interpreted as a sign that as the number of private participation in the telecommunication sector increases, the government is more reluctant to engage in the PPP mechanism in the telecommunication sector, but not in other sectors. After deregulation of the telecommunication industry, a number of private sectors are interested to operate, however, the regulatory body that is heavily involved in managing spectrum and monitoring the quality of services rather than allowing a new operator (Huigen & Cave, 2008). Nevertheless, a country faces challenges in providing universal obligatory services across the demography (Pentland, Fletcher, & Hasson, 2004). In previous studies, they found that the telecommunication sector contributed positively to the amount of investment and the number of private participation (Hammami et al., 2006; Yehoue, 2013). According to the previous research, the countries who are already experienced in PPP, are involved more in PPP projects. However, because of the constraint on the methodology, the diminishing marginal utility was not accounted. For instance, it is true that developing and emerging countries need more infrastructure. However, this is determined by the demand and developing country not involved in PPP projects that produce an excess of energy. Instead, they use the available resources for developing other public infrastructures. Similarly, investors do not want to invest in a highly competitive market unless the government is willing to provide a high incentive or guaranteed revenue, which is unlikely. However, experience in the transportation sector and the energy sector induces more investment in the transportation sector as there is the causal relationship between the transportation sector and the energy sector (Achour & Belloumi, 2016; Azlina, Law, & Mustapha, 2014). The population variable used to account the proxy for the market size has a negative effect in

involving multiple projects in the transportation sector and the water and sewerage management sector in comparison to the energy and telecommunication sectors. The result is as expected and inline with the previous study because of the growing energy demand and high concern for environment-friendly energy technologies. The effectiveness of the government is the mobilization of private funds. Bureaucratic constraints and inefficient hierarchy are the major constraints for executing development projects. A responsible and accountable government is more likely involved in strategically addressing public demand. Those characteristics of the government with an efficient or effective government has the possibility to have an impact on PPP projects. In an unstable political environment, a frequent change of government may happen and the political parties may not serve a full term in the government. Change of policy based on political agenda and belief may also happen. In such a situation, the investor may fear change in the policy and the accountability of the government. The contracted projects by an earlier government may also not be supported, which may not lead to effectively reaching financial closure by the government. Similarly, to account for the income level, we used the World Bank income category as the income dummy by using the low-income country as the base. The high-income dummy variable does not have a statistical contribution to the utility. The lower middle-income countries attract more PPP projects and investment in the energy sector than in the transportation sector and the water and sewerage management sector in comparison with the low-income countries. The income effect result can be interpreted as to how a country diversifies their private participation in developing the public infrastructure according to the underlying demand for public infrastructure.

Conclusion

The public Private Partnership (PPP) mechanism has been widely accepted in a variety of public infrastructure projects and services. PPP is an important tool for economic development that leverages private capital and expertise for the development of public services. For sustainable economic development, investment diversification and utilization of the private sector are important. However, based on the government development strategy government can prioritize incorporating private sector for the development of public infrastructure, nevertheless, while incorporating private sector proper value for money and the possible contribution to the economic growth should be properly analysed.

Most of the developing countries are facing problems in delivering infrastructure that supports sustainable growth (Blundell-Wignall & Roulet, 2015). The investment concentration and/or overinvestment (underinvestment) in a particular sector may not be an effective way because of the possible low utilization of resources. The diversification in infrastructure development supports growth and may help to accelerate growth paths of the economy in developing country, which could be instrumental to escape from the development trap such as the low or middle-income trap.

The mature infrastructure, inter-industry interaction and the inter-industry innovation spill-over, inter-industry demand-driven innovation, and welfare sharing between the industries enhance the productivity of the economy (Azagra-Caro & Consoli, 2016; Snieska & Simkunaite, 2009). Systematic and strategic investment in public infrastructure increases opportunities in the economy, which ultimately induces investment that solve the problems of underinvestment (Epstein, 2014). Thus, simultaneous advancement of the infrastructure helps to explore the economic opportunities, which creates positive externality and the cross-industry spill-over effect that induces more investment from the private sector (Woo, 2009). However, knowing the fact of active engagement of the private sector to the public infrastructure helps to build production capabilities by reducing costs and innovative activities (Kharas & Kohli, 2011), which plays a positive role in tracing an escape route from the low- or middle-income trap through the government intervention to utilize the private sector in the infrastructure development (J. D. Lee & Baek, 2012). Nevertheless, the lower middle income country are lacking behind attracting private sector than other counterpart which fears on attaining the sustained growth and income trap. This paper shows how diversification of private engagement and private capital is happening through the PPP mechanism for public infrastructure and how their marginal utility is changed while engaging in a particular infrastructure sector. Using the multiple discrete-continuous extreme value (MDCEV) model, it is easier to see how socioeconomic conditions, experience, regional pressure and the income level of the country affect the decision and involvement of the country to the PPP infrastructure. This study reveals the mobilization of private capital to the infrastructure for sustainable economic growth. Nevertheless, this paper does not account for the interaction between private capital, infrastructure alternatives, and the risk sharing mechanism commonly employed. This interaction can reveal a better picture of the PPP mechanism practiced worldwide.

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58. ble 1 Variables used in this study and data sources.

Variables	Data source
Investment in PPP projects	World Bank PPI Database
Number of PPP projects	
Experience*	
Regional dummies**	
Income dummies**	

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GDP per capita	World Bank Indicator database ⁴
Population	
Official development assistance (ODA) per capita	
Government effectiveness	World Bank Governance Indicator ⁵

*The experience in each sector is the cumulative number of projects. The experience is 0 when there are no projects that reach financial closure prior to the date.

** Dummies are created based on the World Bank's regional and income categories **Table 2 Estimation Results Using The MDCEV Model.**

Variables	Baseline utility	Standard errors	t-value	p-value	
Constants	Telecommunication	1.9570	1.7370	1.1260	0.2600
	Transportation	-4.1930	1.5980	-2.6230	0.0090
	Water and sewerage management	-11.5600	2.7400	-4.2200	0.0000
Total Reserve (log)	Telecommunication	-0.7770	0.2568	-3.0250	0.0020
	Transportation	0.2093	0.2209	0.9475	0.3430
	Water and sewerage management	-0.0065	0.3649	-0.0179	0.9860
GDP per capita	Telecommunication	-0.0003	0.0001	-3.8630	0.0000
	Transportation	-0.0001	0.0000	-2.9790	0.0030
	Water and sewerage management	-0.0002	0.0001	-2.8950	0.0040
Population (log)	Telecommunication	1.9570	1.7370	1.1260	0.2600
	Transportation	-4.1930	1.5980	-2.6230	0.0090
	Water and sewerage management	-11.560	2.7400	-4.2200	0.0000
ODA per capita	Telecommunication	-0.0032	0.0020	-1.5950	0.1110
	Transportation	-0.0044	0.0026	-1.7120	0.0870
	Water and sewerage management	-0.0027	0.0038	-0.6995	0.4840
Experience	Telecommunication	-0.0035	0.0022	-1.6110	0.1070
	Transportation	0.0006	0.0014	0.4162	0.6770
	Water and sewerage management	0.0014	0.0016	0.8849	0.3760
Government Effectiveness	Telecommunication	-0.5815	0.2059	-2.8240	0.0050
	Transportation	0.1673	0.1873	0.8933	0.3720
	Water and sewerage management	0.1809	0.3109	0.5819	0.5610

⁴ Development indicators are accessed from the public data repository of the World Bank and can be found at <http://data.worldbank.org>

⁵ Government effectiveness captures the perception of the government. The indicator is developed by Daniel Kaufmann. The World Bank aggregated the indicator from various sources. The values range from -2.5 (worse) to 2.5 (best). More information can be found at <http://info.worldbank.org/governance/wgi/#doc-sources>

Europe and Central Asia	Telecommunication	1.4360	0.4021	3.5710	0.0000
	Transportation	0.0750	0.3136	0.2391	0.8110
	Water and sewerage management	0.1341	0.4542	0.2952	0.7680
Latin America and Caribbean	Telecommunication	0.8532	0.3890	2.1930	0.0280
	Transportation	0.8089	0.2945	2.7460	0.0060
	Water and sewerage management	1.3340	0.4071	3.2770	0.0010
Middle East and North Africa	Telecommunication	1.9920	0.4406	4.5210	0.0000
	Transportation	0.6645	0.3477	1.9110	0.0560
	Water and sewerage management	1.3110	0.5304	2.4720	0.0130
South Asia	Telecommunication	0.2656	0.4597	0.5778	0.5630
	Transportation	-0.0491	0.3985	-0.1232	0.9020
	Water and sewerage management	-2.2050	0.6594	-3.3450	0.0010
Sub-Saharan Africa	Telecommunication	1.4390	0.3866	3.7230	0.0000
	Transportation	0.5974	0.3241	1.8430	0.0650
	Water and sewerage management	-0.4209	0.5663	-0.7431	0.4570
High Income	Telecommunication	1.8080	0.9010	2.0070	0.0450
	Transportation	0.5541	0.6189	0.8953	0.3710
	Water and sewerage management	0.9173	1.0250	0.8951	0.3710
Lower Middle Income	Telecommunication	-0.3084	0.3315	-0.9303	0.3520
	Transportation	-0.7584	0.3329	-2.2790	0.0230
	Water and sewerage management	-1.1740	0.7117	-1.6490	0.0990
Upper Middle Income	Telecommunication	0.7327	0.3987	1.8380	0.0660
	Transportation	0.1558	0.3814	0.4084	0.6830
	Water and sewerage management	-0.0864	0.7711	-0.1120	0.9110
α_1	α_{Energy}	0.8240	0.0146	56.3600	0.0000
α_2	$\alpha_{\text{Telecommunication}}$	0.9783	0.0081	121.3000	0.0000
α_3	$\alpha_{\text{Transportation}}$	0.8107	0.0168	48.3300	0.0000
α_4	$\alpha_{\text{Water and sewerage management}}$	0.7223	0.0316	22.8600	0.0000
Log-Likelihood	-4987.225				

Appendix

List of countries, number of projects and amount of investment (in million USD)

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Country	No. of projects	Total Investment	Country	No. of projects	Total Investment	Country	No. of projects	Total Investment
Albania	21	3079.6	Guatemala	33	7723.1	Pakistan	57	18664.4
Algeria	21	13428.84	Guinea	5	1197.1	Panama	26	7968.5
Angola	6	2456.5	Guinea-Bissau	2	153	Papua New Guinea	3	286
Argentina	89	27575.58	Guyana	2	87	Paraguay	4	851.8
Armenia	8	2142.12	Haiti	8	547.02	Peru	102	29461.8
Azerbaijan	6	2195.56	Honduras	23	4880.36	Philippines	84	33368.76
Bangladesh	52	9529.62	India	642	273628.01	Romania	46	26217.3
Belarus	6	9521.09	Indonesia	78	47090.4	Russia	91	64557.48
Bolivia	19	4689.1	Iraq	9	10913.84	Senegal	16	4938.41
Botswana	3	630.06	Jamaica	7	2606.8	Serbia	8	6425.09
Brazil	603	497486.39	Jordan	21	8463.1	Sierra Leone	6	409.93
Bulgaria	51	12067.73	Kazakhstan	17	11933.81	S. Africa	55	29446.05
Burkina Faso	4	1231.75	Kenya	24	9807.9	Sri Lanka	73	4356.64
Cameroon	6	3399.6	Lebanon	2	153	Sudan	6	3902.4
Chile	148	41000.6	Liberia	6	659.03	Suriname	1	60
China	808	124705.67	Lithuania	6	2278.5	Syrian AR	4	1360.1
Colombia	102	31294.87	Madagascar	8	898.35	Tanzania	18	3950.45
Congo, DR	5	2653.7	Malawi	5	832.1	Thailand	96	23385.401
Congo, R.	7	1826.5	Malaysia	56	29550.76	Togo	6	1527.4
Costa Rica	28	3043.5	Mali	4	1811.6	Tunisia	8	6424.94
Cote d'Ivoire	13	4246.9	Mexico	189	80725.6	Turkey	149	106715.94
Dominican Republic	28	5212.4	Moldova	6	1027.53	Uganda	22	4074.73
Ecuador	22	3317.3	Mongolia	2	137.8	Ukraine	39	10735.338
Egypt, El-Salvador	22	26166.47	Morocco	16	28043.48	Uruguay	25	5468.3
Ethiopia	15	4132.1	Myanmar	7	2601.1	Venezuela	12	1769.07
Gabon	3	124	Namibia	3	13.5	Vietnam	81	13050.48
Gambia	10	1411.27	Nicaragua	16	2499.54	Zambia	9	3924.77
Ghana	2	41.6	Niger	5	686.7	Zimbabwe	5	2183.7
	16	7383.57	Nigeria	45	38551.13			