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Macroeconomic drivers of Public Private Partnership (PPP) projects in low income and developing countries: A panel data analysis

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Abstract

Drawing on a comprehensive panel data of 137 low income and developing countries, this study queries the macro-economic drivers of Public Private Partnership (PPP) in these countries. PPP is mainly used as a method to address infrastructure needs of nation states which cannot allocate their financial resources towards infrastructure investments and/or cannot secure finance through other instruments. Previous studies in the field remain partial as they included a limited number of macro-economic factors and a smaller number of countries. Our findings suggest that general government balance, population size, money supply and the share of investments in GDP are significant determinants of PPP activity.

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Keywords: Public private partnership; Infrastructure investments; Low-income countries; Developing countries; Macroeconomic variables; Panel data analysis

1. Introduction

Budgetary constraints, high levels of national debt, and lack of sufficient funds are often identified as reasons why low-income and developing countries seek to find alternative methods to finance their infrastructure needs (Altug & Firat, 2018; Amos & Zanhou, 2019; Arezki et al., 2017; Yang, 2008). As such an alternative source of funding, Public Private Partnership (PPP) model has become increasingly popular in recent decades as a mechanism to support infrastructure-related investment activities of low-income and developing countries (Andrews & Entwistle, 2015; Boyer & Scheller, 2018; Maurya & Srivastava, 2019; Sharma, 2012; Yurdakul & Kamasak, 2021). In dynamic environments where economic and political risk perceptions of firms are high (Jermias

& Yigit, 2019; Kamasak, 2017), making a robust decision for public and private partners on whether to engage in a PPP project can be challenging. Macroeconomic stability is often cited as a significant factor for implementing PPP projects (Boyer & Scheller, 2018; Delmon, 2011; Ehrhardt & Irwin, 2004; Hammami et al., 2006; Thomsen, 2005). Yet, the full range of macro-economic antecedents of PPP remains underexplored.

This paper explicates the relationship between macroeconomic variables (i.e. GDP, per capita income, general government balance, total debt, inflation, money supply) and PPP activity by using World Development Indicators (WDI) and The Private Participation in Infrastructure (PPI) Project Databases for the period 1990 to 2016 (The World Bank, 2017a, 2017b). The number of PPP projects and investment in PPP as a percentage of GDP are considered as the proxies of PPP activity (Calderon, Moral-Benito and Serven, 2011; Canning & Bennathan, 2000). Our study contributes to the literature in two ways. First, the determinants of PPP are studied by an updated data set so that the effect of recent surge in the use of

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PPP in a wide spectrum of countries can be seen. While this extension may seem trivial at first sight, the period between 1990 and 2016 witnessed significant global political and financial events such as the collapse of the Berlin Wall in 1989, the global financial crisis of 2008–2009, the ongoing duality of expansion of liberalization in trade on the one hand and emergence of protectionism on the other, along with wars and political tensions between countries. This complex international settings has led to considerable repercussions on countries' macroeconomic policies. For example, the period after the global financial crisis in 2008 is characterized by increasing liquidity due to unorthodox policies of the central banks of the advanced countries and also increasing budget deficits and public debt in many parts of the world (Alessi et al., 2014; Han, 2016; Turky, 2017). Return seeking private funds might consider taking advantage of the stable cash-flow of infrastructure investment which they did not consider before the crisis or indebted governments might try to promote use of PPP to be able to continue to invest in their countries' infrastructure. Therefore, this event caused major economic changes might have considerable effect on countries' PPP activities thus investigation of this period deserves particular interest.

Second, this study considers additional variables compared to the standard indicators that were used by previous studies (i.e. Aschauer & Lachler, 1998; Erie et al., 2010; Hammami et al., 2006). More specifically, FDI inflow to the country or saving rate of the country are used to explore if these variables that are omitted by previous literature might be influential on the PPP activities of countries. It is suggested that the amount of FDI inflow and its share in GDP which can be considered as indications of the investment appetite for a country might be positively related with PPP activities (Arbatli, 2011; Denisia, 2010). Additionally, saving rate of a country and savings' share in GDP are likely to be negatively correlated with PPP activities (Arezki et al., 2017; Çelik & Isaksson, 2013). The main reason of this inverse relationship might be that the bulk of the savings are directed by financial institutions towards short-term fixed income assets (i.e. treasury bonds, derivative instruments and financial products) rather than PPP projects that offer long-term yielding (Reddy, 2019). But this relationship needs to be empirically tested. Thus, this paper aims to explore the unexplained variance in PPP activities by using additional variables which were not considered by previous studies in the PPP field.

Finally at the micro-level, the decisions in relation to the extent of government and private sector participation in PPP activities may depend on understanding the impact of different macroeconomic variables on PPP success (Casady et al., 2020). In particular, the decisions of local or international investors to commit their resources for PPP activities are a function of the economic parameters of a country (Opara et al., 2017; Sharma, 2012). In line, the future behavior of private partners (as well as governments) regarding the main incentive, performance criterion, risk sharing, and guarantee issues in PPP and their decisions about the shape of optimal PPP contracts may vary according to macroeconomic context.

Therefore, this study also aims to provide some managerial and policy implications for investors and governments regarding effective and efficient PPP implementations.

2. Literature review

Public and private partnership (PPP) is defined as “a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance” (The World Bank, 2019). The roots of PPP can be traced back to Leibenstein (1966) who introduced the concept of “X-efficiency”, explained the productivity differences between public and private firms with intangible “X-factors” such as labor management relations, organizational structures, incentive systems and selection of workers. In line with Leibenstein's (1966) suggestions, PPP can be necessary for governments and public firms to reduce the inefficiencies which occur in their organizational structures. Indeed, PPPs may both increase the amount of capital for infrastructure investments and efficiency of operation through transfer of private sector expertise, though these benefits would not always be automatically realized for every project (Ahwireng-Obeng & Mokgohlwa, 2002; Bajwa et al., 2018). While there are various potential benefits of PPP in several areas of the economic and social life, without a well-organized PPP system that also considers good timing, probability of failure might be higher than probability of success.

In the classic form of public investment, infrastructure projects are funded by governments' tax and public debt instruments and governments keep full ownership of the infrastructure asset (De Bettignies & Ross, 2004; Engel et al., 2014). The government does not only build the infrastructure asset but it also provides services to public either by itself or by using some contractors. Alternative methods can be used in the process of public investment, i.e. the construction of infrastructure project can be realized by a private contractor and the completed project can be operated by the government or by another third party contractor (Iossa & Martimort, 2015). While governments bear the full risk of projects from construction to operation in the classic form of public investment, profit seeking private sector agents take some of the risk in PPPs (Alfen et al., 2009; Ismail, 2013; Wang et al., 2013).

Yet, PPP could be viewed as a long term partnership between public and private actors with the aim of mutual benefits (Mu et al., 2011; Sheppard & Beck, 2018). PPP model is reported as beneficial for the whole economy as well as both public and private parties (Donaldson & Hornbeck, 2016). A number of studies (e.g. Chan et al., 2010; Estache, 2006) find that “PPPs provide several advantages and opportunities in terms of fiscal stabilization, fund flows and efficiency gain to the developing countries” (Sharma, 2012). However, as in any business model, satisfaction of both parties, in particular the private partner, and the effectiveness of project remain aspirational and may not be guaranteed unless a careful evaluation is conducted about the potential factors that may affect PPP

success. Thus, it is imperative that private firms and governments which target potential PPP projects should have a thorough understanding on the relationship between economic factors and PPP arrangements. This is not only important for the efficiency of PPPs but also for the mutual benefit of the partners.

The rapid rise of PPP activities across the world between 1990 and 2012 is evident, yet the trend starts to decline after 2012 (see Fig. 1). The most likely reasons for this trend might be the decreasing privatization activities and the lagged negative consequences of the global financial crisis of 2008–2009 which led to very tight government financial constraints in developing countries (Arezki et al., 2017; Boyer & Scheller, 2018).

The decision for governments and private firms to engage in a PPP project may be very challenging in developing countries (Kamasak, Yavuz and James, 2019). Zhang and Durango-Cohen (2012) suggest that a private firm's PPP preference should be based on a thorough evaluation of the economic and political conditions. The factors that might influence the decision of a PPP activity were explored before. In an earlier study, Banerjee, Oetzel and Ranganathand (2006) examined how different institutional factors affect private firms' investment decisions in infrastructure through a longitudinal dataset of 40 developing economies between 1990 and 2000. The authors found property rights and bureaucratic quality promoted private sector investment in infrastructure. Moreover, the effects of macroeconomic indicators such as inflation, GDP growth, exchange rate and market capitalization on firms' infrastructure investments were searched. While inflation rate was found to correlate negatively, GDP per capita was associated positively with investments. However, the study provided valuable insights only on the factors that played significant roles in private firms' infrastructure-related investment decisions rather than their PPP motivations.

To the best of our knowledge Hammami et al., 2006 conducted the first ever study on the cross-country determinants of infrastructure-based PPP arrangements by using PPI panel dataset. The comprehensive research of Hammami et al., 2006 examined a number of indicators that were effective on governments' and firms' PPP activities. According to the study, countries with large budget deficits were more likely to use PPP whereas countries with natural resource endowments

were less likely to use PPP since their budget constraint was not binding. While Hammami et al., 2006 used budget balance and debt statistics as proxies for budget deficits, the researchers used aid per capita and fuel exports as proxies for natural resources. The impact of population and GDP per capita were used to capture the effect of the size of the market on the intensity of the use of PPP. The relationship between macroeconomic stability in a country, which was measured by the level of inflation, money supply, international reserves and stability of the exchange rate, and the use of PPP was also investigated. Hammami et al., 2006's research revealed that debt level and country size were the most important determinants of PPP activities.

In a more recent study, Mengistu (2013) investigated the impact of several macroeconomic variables along with public finance figures and market size on PPP based infrastructure investments for Sub-Saharan African (SSA) countries through a dataset that comprise the period of 1995–2008. The findings indicated that market size was an important driver of PPP. Additionally, heavy tax burden and inflation showed negative correlations with the PPP activity. To date, only a few studies (i.e. Hammami et al., 2006) analyzed what determines PPP choice comprehensively. Yet, the economic motivations behind the PPP push are significant (Boyer & Scheller, 2018; Engel et al., 2014; Yurdakul & Kamasak, 2020). Considering the volatile economic and political environments at both national and global scale, governments and private firms need contemporary and up-to-date forecasts to make rational and sensible decisions in relation to PPP investments in infrastructure. Therefore, this paper provides empirical evidence regarding factors which may affect the PPP activities by utilizing a comprehensive macroeconomic dataset.

3. Dataset and method

The World Bank's Private Participation in Infrastructure (PPI) database comprises the panel data of 137 low- and middle-income countries' infrastructure based PPP activities (measured by the number of PPPs and investment in PPPs) for the period 1990 to 2016. The developed countries are not in the scope of this study and PPI is the largest panel dataset with standardized information for developing countries.

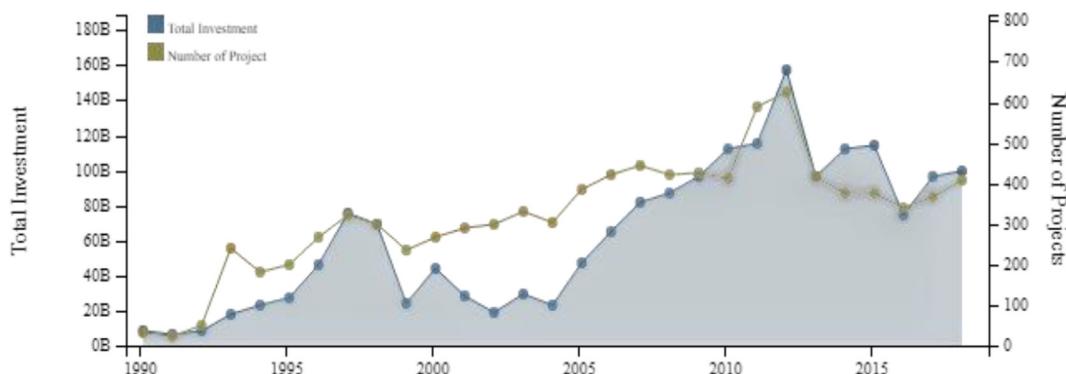


Fig. 1. PPP activities across the world between 1990 and 2016 (The World Bank Private Participation Infrastructure Database).

Table 1

Potential determinants of PPP and their data sources.

Variables	Notation	Data source
<i>Number of PPP Projects (between 1990 and 2016)</i>	NumPPP(1990–2016)	PPI
<i>Total amount of investment in PPP Projects (between 1990 and 2016)</i>	GDP(to)PPP(1990–2016)	PPI
<i>General Government Balance - Net Lending/Borrowing (% of GDP)</i> : This balance may be viewed as an indicator of the financial impact of general government activity on the rest of the economy and non-residents.	GenGovBal	WDI
<i>Central Government Debt (% of GDP)</i> : Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. Debt is a stock rather than a flow, thus it is measured as of a given date, usually the last day of the fiscal year.	TotalDebt	WDI
<i>Aid per capita - Net official development assistance (ODA) received per capita (current US\$)</i> : The disbursements of loans to promote economic development and welfare in countries and territories in the Development Assistance Committee (DAC) list of ODA recipients which is calculated by dividing net ODA received by the midyear population estimate.	AidPerCap	WDI
<i>Fuel Exports (% of merchandise exports)</i> : Fuels comprise the commodities in Standard International Trade Classification (SITC) section 3.	FuelExport	WDI
<i>Population (Log)</i> : Total population of the country. The values shown are mid-year estimates.	Population(log)	WDI
<i>Real GDP per capita (Lagged) - (constant 2010 US\$)</i> : The gross domestic product divided by mid-year population.	RGDPpercapita(lag)	WDI
<i>Inflation (annual %)</i> : Measured according to GDP implicit deflator which is the ratio of GDP in current local currency to GDP in constant local currency.	Inflation	WDI
<i>Money Supply - Broad money (% of GDP)</i> : The sum of money supply.	MoneySupply	WDI
<i>International Reserves (current US\$)</i> : Total reserves in months of imports of the country.	IntReserves	WDI
<i>Gross Saving Rate (% of GDP)</i> : Gross savings are calculated as gross national income less total consumption, plus net transfers.	GrossSav(to)GDP	WDI
<i>Foreign Direct Investment (FDI) (% of GDP)</i> : The net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.	FDI(to)GDP	WDI
<i>Total Investment (% GDP)</i> : Expressed as a ratio of total investment in current local currency and GDP in current local currency.	TotalInv(to)GDP	WDI

The governance indicators are not included in this study, yet the effect of governance-related factors on PPP activities are already shown in the literature.¹ The focal concern of this paper is the macroeconomic variables which are gathered from World Development Indicators (WDI) provided by the World Bank (The World Bank, 2017a, 2017b). Details of these variables and their data source are discussed in Table 1.

Table 2 presents the mean and standard deviation values of the variables used in the estimation during the sample period 1990–2016.

The empirical link between the twelve prospective macroeconomic determinants and PPP activities is analyzed by regression analysis. PPP activity which is the dependent variable is measured in two ways. First, the number of PPP projects irrespective of their financial value is used. Then, the Dollar value of PPPs expressed as a percentage of GDP is considered. R software is used for the statistical analyses and regression coefficients are estimated by Ordinary Least Squares (OLS) method.

Based on the above variables and available data, the two below empirical models are tested statistically:

$$\text{NumPPP (1990–2016)} = f [\text{GenGovBal}; \text{TotalDebt}; \text{AidPerCap}; \text{FuelExport}; \text{Population(log)}; \text{RGDPpercapita(lag)}];$$

Inflation; MoneySupply; IntReserves; GrossSav(to)GDP; FDI(to)GDP; TotalInv(to)GDP]

$$\text{GDP(to)PPP (1990–2016)} = f [\text{GenGovBal}; \text{TotalDebt}; \text{AidPerCap}; \text{FuelExport}; \text{Population(log)}; \text{RGDPpercapita(lag)}; \text{Inflation}; \text{MoneySupply}; \text{IntReserves}; \text{GrossSav(to)GDP}; \text{FDI(to)GDP}; \text{TotalInv(to)GDP}]$$

The time dimension of the panel data is taken into account as well. Thus, the equation where Y_{it} denotes outcome variable, X vector includes control variables and u_t presents year fixed effects, is used in the estimations:

$$Y_{it} = \alpha + \beta X_{it} + u_t + \varepsilon_{it}$$

Table 2
Descriptive statistics.

Variables	Mean	S.D.
Number of PPP projects	7.36	7.93
PPP investment-to-GDP ratio	0.08	0.14
General government balance-to-GDP ratio	-2.56	-4.84
Central government debt-to-GDP ratio	61.48	82.06
Aid per capita (US\$)	14.45	13.18
Fuel exports-to-merchandise exports ratio	19.43	28.73
Log of population	16.07	0.65
GDP per capita (US\$-Constant 2010)	3201	2895
Inflation (consumer prices annual %)	34.66	42.39
Money supply-to-GDP ratio	44.93	32.29
International reserves in months of imports	5.17	4.26
Gross saving rate-to-GDP ratio	21.78	5.93
FDI-to-GDP ratio	0.29	4.18
Total investment-to-GDP ratio	23.36	9.34

¹ Estimation results in the articles of Kasri and Wibowo (2015), Kaufmann et al. (2010) and Hammami et al. (2006, pp. 1–37) show that there is a positive relationship between the number of PPP and institutional factors. If the government effectiveness and regulation quality increases, the number of PPP projects increase according to the data source Worldwide Governance Indicators.

In regression analyses where panel data are used, the omitted variable problem which might influence the explanatory power of the model should be considered. This situation is called unobserved heterogeneity (Kennedy, 2008). Even when all relevant variables are included in the regression, there might still be some determinants left outside the model. Fixed-effect estimation of panel data which “examines individual differences in intercepts, assuming the same slopes and constant variance across individual group and entity” (Park, 2011) can help to deal with this problem. Therefore, in our empirical applications fixed-effect method is employed. Four fixed-effect types were used: Fixed-type 1 is the most general form where all variables are included in the model, yet Fixed-type 2, Fixed-type 3 and Fixed-type 4 are different in terms of the usage of savings, investment and FDI as a percentage of GDP. While Fixed-type 2 uses gross saving rate-to-GDP ratio, Fixed-type 3 uses FDI-to-GDP ratio, and finally Fixed-type 4 uses only total investment-to-GDP ratio. The effect of observed heterogeneity to the specification is presented by the equation above. Part of the error term that is related to the unobserved heterogeneity is shown with i . The notation implies that this effect may differ from individual to individual but is constant over time.

Using this framework, a couple of regression analyses in which PPP activity (as the dependent variable) is measured by number of PPP projects and the amount of investments for PPP projects (percentage to GDP) are conducted. In order to control the regional effects, the dummies that represent six regions; South Asia (SouthAsia), Europe and Central Asia (EUandCentAsia), East Asia and Pacific (EastAsiaandPac), Latin America and the Caribbean (LatAmCarib), Middle East

and North Africa (MidEastandNorAf) and Sub Saharan Africa (SubSaharanAf) are used (PPI, The World Bank, 2017a, 2017b).

As a robustness exercise, separate specifications with “GrossSav(to)GDP(lag), FDI(to)GDP(lag) and TotalInv(to)GDP” were estimated due to the fact that these variables might be correlated because of the existent relationship between saving and investment. Indeed, when these variables were used separately it was seen that investment to GDP ratio was the only surviving explanatory variable. Therefore, in the first and second fixed effect types (Fixed-type 1 and Fixed-type 2), while the independent variables are lagged by t-1 year, the effects of all independent variables for the selected countries on the number of Public Private Partnership projects which is between 2000 and 2016 are indicated. This approach can also deal with potential endogeneity problems arising from two-way causality (Vergara, 2010; Buch et al., 2013; Pan et al., 2020).

One of the difficulties encountered in econometric models is the endogeneity problem. This occurs when relevant variables are omitted from the model (omitted variable bias) and when an explanatory variable is correlated with the regression error term (simultaneity bias). Endogeneity problem can lead to the OLS estimator to be inconsistent and biased. To deal with endogeneity problem, the independent variables are lagged by one period in the first and second fixed effect types (Fixed-type 1 and Fixed-type 2). The argument is that although current values of the independent variables might be endogenous, it is unlikely that past values of the independent variables are subject to the problem.

The results of regression analyses are presented in Table 3. The findings revealed that while general government balance

Table 3
The results of regression analyses.

Variables	NumPPP (1990–2016)	GDP(to)PPP (1990–2016)	Fixed- type 1	Fixed- type 2	Fixed- type 3	Fixed- type 4
GenGovBal	0.184* (0.011)	0.033** (0.001)	0.158* (0.021)	0.143* (0.032)	0.134* (0.031)	0.148* (0.018)
TotalDebt	0.042 (0.140)	-0.002 (0.533)	0.019 (0.516)	0.014 (0.621)	0.010 (0.718)	0.015 (0.564)
AidPerCap	0.001 (0.892)	0.001 (0.459)	0.005 (0.396)	0.004 (0.305)	0.003 (0.418)	0.004 (0.469)
FuelExports	-0.036 (0.207)	-0.008* (0.048)	0.011 (0.783)	0.015 (0.688)	0.023 (0.533)	0.015 (0.675)
Population(log)	7.474* (0.013)	3.218*** (0.001)	4.740 (0.181)	5.965 (0.050)	5.223 (0.113)	5.160 (0.082)
RGDPpercapita(lag)	-0.003*** (0.001)	0.002 (0.916)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.002*** (0.001)
Inflation	0.001 (0.304)	0.001 (0.514)	-0.001 (0.986)	0.004 (0.905)	0.011 (0.745)	0.007 (0.839)
MoneySupply	0.217*** (0.002)	0.010** (0.006)	0.065* (0.017)	0.071** (0.007)	0.069** (0.007)	0.060* (0.022)
IntReserves	0.521*** (0.001)	-0.027 (0.190)	-0.145 (0.332)	-0.166 (0.251)	-0.119 (0.379)	-0.106 (0.434)
GrossSav(to)GDP(lag)	-0.003 (0.948)	-0.003 (0.635)	0.048 (0.339)	0.068 (0.143)		
FDI(to)GDP(lag)	-4.093** (0.009)	-0.134 (0.575)	-0.077 (0.962)		0.155 (0.916)	
TotalInv(to)GDP	0.201*** (0.001)	0.034** (0.001)	0.109* (0.021)			0.118** (0.006)
Number of regions	6	6				
SouthAsia	-2.861 (0.110)	-0.229 (0.142)				
EUandCentAsia	0.274 (0.932)	0.067 (0.593)				
EastAsiaandPac	3.363* (0.046)	0.435** (0.004)				
LatAmCarib	5.295 (0.148)	-0.036 (0.741)				
MidEastandNorAf	-21.259*** (0.001)	-20.684*** (0.001)				
SubSaharanAf	-29.374*** (0.001)	-26.251*** (0.001)				
Observations	1299	1299	1299	1299	1299	1299
R^2	0.184	0.163	0.126	0.115	0.108	0.128
Adj. R^2	0.116	0.088	0.067	0.059	0.056	0.069

Note 1: First entry in each cell shows the coefficient and the second entry given below the first entry shows the p-value. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Note 2: Fixed-type 1 uses all variables; Fixed-type 2 uses GrossSav(to)GDP; Fixed-type 3 uses FDI(to)GDP; Fixed-type 4 uses TotalInv(to)GDP.

Note 3: Independent variables are lagged by t-1 year in Fixed-type 1 and Fixed-type 2.

($\beta = 0.184, p < 0.05$), population ($\beta = 7.474, p < 0.05$), money supply ($\beta = 0.217, p < 0.001$), international reserves ($\beta = 0.521, p < 0.001$), and share of total investment in GDP ($\beta = 0.201, p < 0.001$) were positively associated with the number of PPP activities, real GDP per capita ($\beta = -0.003, p < 0.001$) and share of FDI in GDP ($\beta = -4.093, p < 0.01$) were found to have negative associations with PPP.

In terms of the amount of investments for PPP projects, the analysis yielded similar results which indicated general government balance ($\beta = 0.033, p < 0.01$), population ($\beta = 3.218, p < 0.001$), fuel exports ($\beta = -0.008, p < 0.05$), money supply ($\beta = 0.010, p < 0.01$) and share of total investment in GDP ($\beta = 0.034, p < 0.01$) as the determinants of PPP activities. Against the shared findings, real GDP per capita, international reserves and share of FDI in GDP were not found to associate with PPP activities measured by money terms.

In the regression analysis shown in the [Table 3](#), different time periods, dependent variables and independent variables are used in four fixed effect types. The differences between the fixed effects were stated in the explanation of [Table 3](#). It is completely coincidence that they have sequential decline.

In order to deal with the issue of left-censoring in the dependent variable, Feasible Generalized Least Squares (FGLS) and Poisson regression methods were used as robustness checks with alternative specifications compared to the OLS model. Both methods yielded quite similar findings with the OLS method. For example, the analyses that were conducted by FGLS found a significant negative relation for FDI to GDP ratio which was consistent with the OLS findings. Similarly, for the case of using PPP to GDP as the dependent variable, a negative but insignificant relation with FDI to GDP ratio was obtained. As an explanatory variable, investment to GDP ratio showed a positive association with PPP to GDP ratio but the coefficient was very small. A positive and significant coefficient for population was found, thus the larger the country, the higher is the PPP to GDP ratio (see [Appendix 1](#)). In a similar line, the results of Poisson regression showed that, while not statistically significant, coefficient of FDI to GDP was negative and investment to GDP was positive. For the case of using number of PPP as the dependent variable, we got positive and significant effect from investment to GDP and FDI to GDP ratio (see [Appendix 1](#)). In the context of left-censoring issue, this finding presents that FDI and investment are positively associated with PPP activity.

4. Discussion

Using the PPI database provided by the World Bank, this study sought to analyze the factors that drive PPP activities in infrastructure among 137 low income and developing countries for the period between 1990 and 2016. The findings particularly highlight the significance of general government balance which is found to be a determinant in both number of PPP and investments in PPP activities. Indeed, this result corroborates with the existing literature (i.e. [Hammami et al., 2006](#); [Sharma, 2012](#)). General government balance can usually be sustained by prudent fiscal policies ([Cerutti et al., 2015](#)). Yet, the fiscal

discipline may not always exist in low income and developing countries ([Karolyi, 2015](#); [Kenc et al., 2016](#)). Therefore, the spending or borrowing requirements of low income and developing countries which are generally high, can reflect general government balance figures. The deterioration in general government balance and fiscal constraints in low income and developing countries where lack of funds for financing large scale infrastructure projects is a problem, might push countries to engage in more PPP activities. This finding may predict that “the more macroeconomic instability, the more PPP activities”, which may not present an attractive argument for private investors who look for safer and less risky business environments. Yet, general government balance is not the only indicator of macroeconomic stability (or instability), thus it may merely show the need of a country for PPP investment in our case.

Other variables such as inflation and total debt that are inherently and theoretically significant predictors of macroeconomic stability (or instability) are not found to be determinants of PPP activities. Normally, inflation rate is predicted to have a negative impact on the number of PPPs in a sense that lack of price stability may decrease the risk appetite of private investors, thus limiting their engagements with PPP activities. One potential explanation for the lack of a positive relationship between inflation and PPP, in our study, is that many private partnering firms may have already obtained price or revenue guarantees from governments to protect themselves from the negative effects of high inflation and may have given their PPP decisions irrespective of inflation. Thus, each macroeconomic variable that may influence macroeconomic environment of a country may not manifest in the same way on the choice of PPP.

Population size, which reflects the size of the market, was found to be a significant determinant of PPP activities. In line, this study finds some evidence which suggests that PPPs tend to be higher in larger markets. There was no clear evidence for the relationship between aid per capita and PPP activity and only a minor negative association between PPP investments and fuel exports was observed. One possible explanation for this finding is that fuel exporting countries might have already completed their energy infrastructure before the 1990s ([Hammami et al., 2006](#)). Alternatively, this minor correlation might imply that countries which could obtain large funds from their natural resources or from fuel exports might not resort to PPP activities compared to other developing countries where financial means were used for energy or for other imports ([Glasser, 2001](#)). A similar finding which can be evaluated in the same way is found regarding real GDP per capita. According to the results, countries with higher GDP per capita (which can be assessed as an indication of wealth) tend to engage in less PPP practices. But on the other hand, as an indicator of purchasing power, real GDP per capita is expected to have a positive correlation with PPP. Therefore, the result related to real GDP and PPP is found to be inconclusive.

The study yields a noteworthy result which presents a strong association between money supply and PPP activity both in number of projects and amount of investments for PPP. The rationale behind this finding might be that quantitative

easing could make financing cheaper, thus investment on PPP might become easier. Yet, this suggestion necessitates more evidence since no relationship between inflation (that may rapidly increase in times of quantitative easing) and PPP is observed. In parallel with expectations, a significant relationship between international reserves and the number of PPP is evident in this study. This finding corroborates with the results of similar studies (i.e. Hammami et al., 2006, Sharma, 2012) suggesting that higher international reserves promote macroeconomic stability, thus leading to more PPPs. This makes sense as macroeconomic stability reduces the risk of PPP projects, and attract more private investment. The estimation results regarding the share of savings in GDP and PPP finds no significant relationship. This may be due to the fact that financial institutions which manage pension and hedge funds may have directed savings towards more short term financial instruments rather than PPP projects that are likely to offer yields in the longer term. When this finding is evaluated from the supplier side, the necessity for governments to adopt sound economic policies that increase the share of savings in GDP can be seen. Therefore, when the savings rate is high enough, governments might need less reliance on the PPP projects.

The result relating to the share of FDI in GDP and PPP points to a significant but negative relationship. This result can be evaluated that FDI might inflow to low income and developing countries in different FDI configurations such as M&A or greenfield start-ups or takeovers which seek to secure relatively medium to short-term profit rather than in the form of longer term PPP investment. The nature of FDI inwards may vary according to the level of development across countries. Because of their unstable economic conditions and problematic institutional structures, low-income and developing countries may not be the long-term investment targets of foreign investors. Therefore as a policy implication, under these conditions, M&A might be the preference of foreign investors since M&A can provide the advantage of accessing directly to the market and previously established vertical linkages of the local firms. Rapid entrance and diffusion to the local market through FDI in the form of M&A might be more attractive to foreign investors. Finally, the findings indicate a positive relationship between the share of total investments and the number PPP projects. This might emerge from the shortage in infrastructure in low income and developing

countries which requires infrastructure investment. The higher the total investment the higher the number of PPP projects.

PPPs are short- or long-term projects which include decisions that are made under substantial economic risks and uncertainty. In particular, macroeconomic environments in low and middle income countries may be too dynamic and unstable. Under these harsh economic conditions, smart design of risk sharing between public and private partners becomes very important. Sometimes the rules of the game can be attempted to change by PPP actors. For example, decisions regarding taxation, user fees or government guarantees can change at the mid or final stages of the PPP project (Oliveira et al., 2016; Shirke et al., 2019). As a managerial implication, PPP actors should establish strong contracts which can force (when required) all actors continue their commitments as they promised before the implementation started. Moreover, money supply affects expected cost and benefit figures of PPP projects through changing interest rates and availability of money, thus using sophisticated probabilistic risk and return models and scenario plans can help private investors to make more thorough decisions.

5. Limitations

This study focused on the macro-economic drivers of PPP activity in the low income and developing countries. There are other factors that might be influential on PPP activities, thus understanding global dynamics, looking at country specific examples will be necessary. The study does not cover macro-political factors which are also major sources of volatility for investors. Regulatory environment, politics and corruption index could be integrated for a more comprehensive understanding. Our study is based on an extensive panel data. Further study could be in the forms of a qualitative investigation from top managers and government officials and bureaucrats to clarify mixed and inconclusive findings.

Declaration of competing interest

There is no conflict of interest.

Appendix 1. Estimation results with FGLS and Poisson regression

Estimation Results with FGLS Regression
(Dependent Variable: Number of PPP)

Variable	Coefficient	p-value
GenGovBal	0.132	0.072
TotalDebt	0.001	0.914
AidPerCap	0.002	0.775
FuelExports	-0.034	0.162

Estimation Results with FGLS Regression
(Dependent Variable: PPP to GDP)

Variable	Coefficient	p-value
GenGovBal	0.002	0.327
TotalDebt	0.001	0.985
AidPerCap	0.001	0.911
FuelExports	0.001	0.486

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Estimation Results with FGLS Regression (Dependent Variable: Number of PPP)			Estimation Results with FGLS Regression (Dependent Variable: PPP to GDP)		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
Population(log)	4.331	0.001	Population(log)	-0.002	0.001
RGDPpercapita(lag)	0.004	0.073	RGDPpercapita(lag)	0.003	0.073
Inflation	-0.003	0.328	Inflation	0.001	0.692
MoneySupply	0.199	0.001	MoneySupply	0.002	0.388
IntReserves	0.476	0.002	IntReserves	-0.004	0.803
GrossSav(to)GDP(lag)	-0.006	0.215	GrossSav(to)GDP(lag)	-0.005	0.337
FDI(to)GDP(lag)	-3.484	0.002	FDI(to)GDP(lag)	-0.001	0.479
TotalInv(to)GDP	0.201	0.001	TotalInv(to)GDP	0.002	0.001
SouthAsia	-4.226	0.337	SouthAsia	0.014	0.014
EUandCentAsia	0.229	0.952	EUandCentAsia	-0.001	0.789
EastAsiaandPac	-6.494	0.077	EastAsiaandPac	-0.001	0.925
LatAmCarib	4.106	0.138	LatAmCarib	-0.003	0.886
MidEastandNorAf	-15.673	0.001	MidEastandNorAf	0.002	0.684
SubSaharanAf	-76.326	0.001	SubSaharanAf	0.047	0.001
Estimation Results with Poisson Regression (Dependent Variable: Number of PPP)			Estimation Results with Poisson Regression (Dependent Variable: PPP to GDP)		
Variable	Coefficient	p-value	Variable	Coefficient	p-value
GenGovBal	0.016	0.068	GenGovBal	0.014	0.879
TotalDebt	0.002	0.017	TotalDebt	0.006	0.821
AidPerCap	0.001	0.093	AidPerCap	0.000	0.962
FuelExports	-0.002	0.134	FuelExports	0.233	0.999
Population(log)	0.573	0.001	Population(log)	-0.222	0.424
RGDPpercapita(lag)	-0.001	0.001	RGDPpercapita(lag)	-0.000	0.531
Inflation	-0.005	0.001	Inflation	-0.002	0.965
MoneySupply	0.013	0.001	MoneySupply	0.005	0.766
IntReserves	-0.011	0.028	IntReserves	-0.025	0.816
GrossSav(to)GDP(lag)	0.004	0.079	GrossSav(to)GDP(lag)	-0.002	0.906
FDI(to)GDP(lag)	0.294	0.002	FDI(to)GDP(lag)	-0.152	0.926
TotalInv(to)GDP	0.025	0.001	TotalInv(to)GDP	0.025	0.645
SouthAsia	-0.580	0.037	SouthAsia	-0.357	0.847
EUandCentAsia	0.442	0.029	EUandCentAsia	-0.146	0.908
EastAsiaandPac	-0.410	0.066	EastAsiaandPac	-0.433	0.784
LatAmCarib	0.832	0.004	LatAmCarib	-0.072	0.945
MidEastandNorAf	-0.843	0.003	MidEastandNorAf	0.292	0.859
SubSaharanAf	-8.914	0.019	SubSaharanAf	-1.584	0.738

A robustness check with alternative specifications compared to the OLS model.

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