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PUBLIC-PRIVATE PARTNERSHIPS IN INFRASTRUCTURE: THE IMPACT OF CORRUPTION

Amanda Löfgren (22809)

Abstract. Public-Private Partnerships in infrastructure provision is gaining attention as an answer to the growing global infrastructure deficit, providing an effective model for sharing of risk and responsibility between the public and private sector. Such partnerships are also important channels of private investment, FDI and development assistance into an economy, but the extent to which these effects of Public-Private Partnerships are realized is likely to depend on the institutional setting. The aim of this paper is to determine the impact of corruption on these three central features of Public-Private Partnerships in infrastructure provision, thereby addressing a knowledge gap in extant literature. An empirical analysis of project-level data from 117 low- and middle-income countries suggests that corruption presents an obstacle to private sector participation in Public-Private Partnerships. The results further indicate that corruption is a significant predictor of the extent of foreign investor participation and development assistance only in certain sectors and regions. Finally, the results suggest an important role of multilateral development banks in attracting FDI into Public-Private Partnerships, as development assistance is found to significantly increase the probability that at least one of the private sector partners in a Public-Private Partnership is a foreign firm.

Keywords: Corruption, Public-Private Partnerships, Infrastructure, Foreign Direct Investment, Development Assistance

JEL: H54, G38, O18, O19

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1 INTRODUCTION

Infrastructure has long held a central role on the development agenda, as inadequate infrastructure is widely recognized as a constraint on growth and development. The World Bank estimates that inadequate infrastructure reduces growth in Africa by as much as 2 percentage points per year (World Bank Group 2010) and the United Nations identifies poor infrastructure as a major bottleneck for poverty reduction (United Nations Economic Commission for Africa 2014). Such estimates are supported by a considerable academic literature establishing the link between infrastructure and development outcomes on a macro and micro level. In a review of 141 econometric specifications in 64 papers, Straub (2008) concludes that two-thirds find a positive and significant link between infrastructure and some development outcome.

The recognition of poor infrastructure as a constraint on growth, in academic and policy debates alike, is paired with a growing infrastructure deficit in developing economies. The UN estimates the infrastructure deficit to amount to USD 93 billion per year from 2014 to 2020 in Africa alone (United Nations Economic Commission for Africa 2014). According to World Bank estimates, 1.2 billion people worldwide do not have access to electricity, 660 million people lack access to clean drinking water and 4 billion people - 60% of the world's population - do not have access to the Internet (World Bank Group 2016). Closing the infrastructure gap caused by growing demand for infrastructure and inadequacy of public provision will require investments amounting to trillions of dollars in the coming years (World Bank Group 2016).

Although economies of scale and demand externalities (World Bank Group 2002) make infrastructure a strong case for exclusive public provision, private participation in the delivery of infrastructure services has received increasing attention as an important alternative for enhancing access to basic infrastructure. The past 20 years have seen an enormous increase in private provision of infrastructure services in low- and middle-income countries (World Bank Group 2002; Burger et al. 2009). Private sector financial commitments to infrastructure provision was estimated to amount to an annual USD 181 billion in emerging and developing economies in 2014, up from about USD 20 billion in 1990 (Moszoro et al. 2014). Public-Private Partnerships (PPPs) in the financing, development, operation and maintenance of infrastructure facilities are of particular interest as a tool in overcoming the global infrastructure gap.

PPPs provide a model for sharing of risk and responsibility between the public sector and a private firm, while the public sector retains control over assets (Farlam 2005; Thomsen 2005). Typically, the private firm develops and operates the infrastructure facility and delivers services for which the public sector pays

an agreed price. However, public-private partnerships come in many different forms, with varying degrees of private involvement as well as allocation of risk and responsibility. The specific characteristics of the PPP have different implications for the impact of the partnership on wider economic factors, such as growth. According to the 2008 PwC report *Public–Private Partnerships: A New Catalyst for Economic Growth*, the type of partnership contracts employed has a higher impact on the growth of an economy than its number of PPPs or the total level of private investment. Similarly, Thomsen (2005); Zangoueinezhad and Azar (2015) and Dintilhac et al. (2015) find that the extent to which efficiency gains can be realized from PPPs depends on agreement type and the extent of private involvement. Contractual type and other features of PPPs - such as the involvement of multinational corporations and the assistance of donor agencies thus have considerable policy implications, and should be of interest to academics and practitioners alike.

Virtually all low- and middle-income countries have experience with private provision of infrastructure services via PPPs, and partnerships frequent all infrastructure sectors (Thomsen 2005). Effective allocation of risk, access to funding and operation under efficiency incentives imply high potential in PPPs to provide cost-efficient, sustainable infrastructure services. Despite their prominence and potential in infrastructure provision worldwide, PPPs have received limited academic attention. In particular, research has paid little attention to the different characteristics and types of PPP contracts, and their determinants. A handful of papers have empirically assessed the determinants of PPPs, but these have focused on the number of PPP projects (see for example Jensen and Blanc-Brude 2005; Hammami et al. 2006) or total, country-level investment into PPPs (see for example D'Oehlo et al. 2015), rather than contractual types and other important characteristics. Notable exceptions are Basilio (2015), who studies the extent of donor agency participation in PPPs; Hammami et al. (2006), studying the extent of private participation in PPPs; and Galileia and Medda (2010), studying determinants of success in PPPs. These papers point to the relevance of analyzing the specific characteristics of PPPs, while recognizing that this is rarely done in extant research. In addition, most of extant research studies private participation in infrastructure in general, rather than PPPs in particular, thereby failing to disentangle the specifics of PPPs as policy tools (Dintilhac et al. 2015). In this paper, I therefore study the determinants of a selection of important features of infrastructure PPPs, with specific attention paid to the effects of corruption levels on these features.

There are four main reasons for why corruption is of particular interest in analyzing the determinants of PPP features. First, corruption is widely recognized as a constraint on investment in general, and empirical evidence suggests that Public-Private Partnerships in infrastructure provision are no exception. Among the papers that study the determinants of PPPs, many are

interested in the effect of corruption on country- or sector-level number of PPP projects and total investment into PPPs. Most find a negative relationship between corruption level and PPPs (see for example Hammami et al. 2006; D'Oelo et al. 2015; Jensen and Blanc-Brude 2005; Kirkpatrick et al. 2006). Despite this, very few studies consider corruption in examining the features of PPPs that determine their impact on the wider economy, such as contractual type and foreign ownership.

Second, the interaction between corruption and FDI is a topic of interest to economists and business scholars alike, resulting in a body of research supporting the view that corruption deters FDI (see Wei 2000; Campos et al. 1999). Although the private sector partner in a PPP might by all means be a domestic private firm, Thomsen (2005) points out that the market for PPPs in infrastructure is highly concentrated and dominated by large, multinational firms originating in OECD countries. To the best of my knowledge, no studies of the effect of corruption on FDI consider private participation in infrastructure specifically, despite its importance to infrastructure provision worldwide.

Third, it has been noted that despite the growth of PPPs since the 1990s, private participation in infrastructure provision is lower than what is deemed possible (World Bank Group, 2002). Part of the reason might be failed projects and disappointing returns (Thomsen 2005) - in which corruption may well play a significant role. Corruption is recognized as a major challenge to the physical infrastructure sector globally (Farlam 2005; Kenny 2006; Estache 2014). Understanding the obstacles to successful PPPs has important policy implications and it is therefore of interest to further the understanding of the role of corruption in PPPs.

Fourth, further understanding of the effects of corruption levels on private investment in low- and middle-income countries is interesting in its own right. Promoting private investment has been a priority on the development policy agenda for long, and corruption is widely recognized as a constraint on investment and ultimately also on growth.

1.1 Aim & Approach

The overall aim of this study is thus to further the understanding of specific features of Public-Private Partnerships in infrastructure provision in low- and middle-income countries. In particular, this study aims to investigate the effect of corruption levels on three key aspects of PPPs: degree of private-sector commitment; involvement of foreign investors; and assistance from donor agencies and multinational institutions.

In doing so, this paper uses project-level data from the World Bank Private Participation in Infrastructure Database. The dataset covers 15 500 projects across 4 sectors in 137 countries, over the period 1992 - 2016. The data is used in different specifications of an econometric model, where each specification has as its dependent variable a variable measuring of one of the three PPP aspects of interest. The specifications all have corruption level as the main independent variable of interest, and control for a set of confounding variables. In contrast to most extant research, this paper studies infrastructure PPPs in particular, as opposed to private participation in infrastructure in general.

The rest of the paper is organized as follows: section two provides some background on the definition and rationale of Public-Private Partnerships, section three reviews relevant extant literature and formulates the hypotheses tested. Section four introduces the data and variables and section five presents the empirical methodology of the paper. Section six presents the results and section seven discusses. Section eight concludes.

2 BACKGROUND

2.1 PUBLIC-PRIVATE PARTNERSHIPS: DEFINITIONS & RATIONALE

There is no one generally accepted definition of Public-Private Partnerships, and as mentioned above, many studies do not distinguish between PPPs and 'private participation in infrastructure'. This inevitably limits the ability to disentangle the specifics of Public-Private Partnerships, as pointed out in Dintilhac et al. (2015), where the authors call for more narrow analyses of PPPs. Therefore, this study makes a distinction between PPPs and Non-PPPs within the various types of private participation in infrastructure (PPIs) analyzed. This paper adopts the definition of PPPs used by the World Bank: *"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"* (WB, ADB and IDB 2014, pp 17-18). It is worth to emphasize, however, that PPPs come in different variants and that the partnership may involve several private entities. For clarity, this paper uses 'PPI' to refer to private participation in infrastructure in general, and distinguishes among PPIs between 'PPPs' and 'Non-PPPs'. The definitions of the respective types follow below (see sections 2.2 for definitions of different PPP types, and section 4.2 for classification into PPPs and Non-PPPs).

The use of the term *infrastructure* in this paper refers to all facilities used to deliver energy; Information and Communication Technology (ICT); water and sewerage; and transport. This is in line with the infrastructure sectors included in the World Bank PPI Database.

Private participation in infrastructure provision is often considered the answer to the growing needs for infrastructure in low- and middle-income countries. As pointed out in numerous studies (see for example Thomsen 2005; Hammami et al. 2006; Moszoro et al. 2014; D'Oelo et al. 2015), domestic public expenditure in these countries is not nearly enough to cover the needs for physical infrastructure. The systematic under-investment in infrastructure, causing the so-called infrastructure deficit across developing countries, has been attributed to a combination of the sustained upward trend in market sizes and trade flows in low- and middle-income countries, demographic pressures mainly in the form of urbanization, climate-related pressures, recurrent fiscal crises and the policy responses to these (Hammami et al. 2006; Moszoro et al. 2014).

Encouraged by multilateral organizations, governments in low- and middle-income countries have actively pursued policies to facilitate private financing and delivery of infrastructure since the 1980s (Kirkpatrick et al. 2006). Public-private partnerships have experienced relatively steady growth over the past two decades, both in terms of the number of projects completed and the dollar-value of investments into PPPs (World Bank PPI database, figure 1).

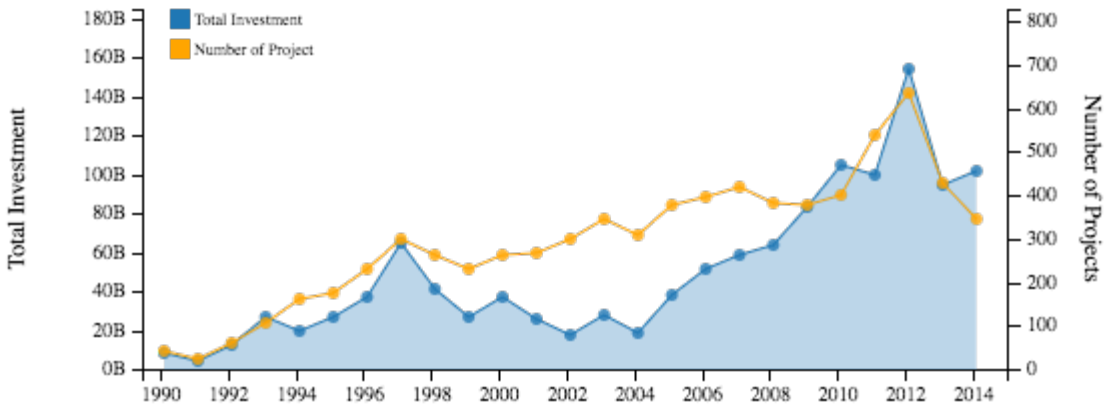

FIGURE 1. NUMBER OF PROJECTS AND TOTAL PPP INVESTMENT IN INFRASTRUCTURE, 1996-2015, LOW- AND MIDDLE-INCOME COUNTRIES (SOURCE: WORLD BANK PPI DATABASE)

The basic rationale of PPPs lies in risk sharing between the public and private parties. Although risk allocation varies between different types of PPPs, a typical risk allocation is illustrated in Figure 2. Importantly, financial risk and risk related to design and construction is typically borne by the private sector entity, while legal and political risks are assumed by the public sector. This risk sharing enables the combination of private sector finance, know-how and incentives with public sector facilitation of investment and control over public goods. Exclusive

public provision of infrastructure services is often not possible due to public budgetary constraints, while exclusive private provision is often not financially viable due to low or uncertain private returns (Thomsen 2005), or inappropriate due to the nature of the public good, with economies of scale and natural monopolies.

Type of Risk	Public	Private
Demand and Revenue Risks	x	x
Design and Construction Risks		x
Operation and Maintenance Risks		x
Financial Risks		x
Legal Risks	x	
Political Risks	x	
Environmental Risks	x	
Force Majeure	x	x

FIGURE 2. TYPICAL ALLOCATION OF RISK IN A PPP (SOURCE: PWC, 2008)

In theory, there are a number of potential benefits in the partnering of the public sector with private actors in infrastructure, and these vary with the type of partnership employed. Some benefits that are often cited are improved quality of or access to infrastructure services without straining the government budget, efficiency gains achieved due to incentives faced by the private actor, knowledge transfer, access to finance, project selection and allocation of resources, increased revenues to the government and improved asset maintenance (Thomsen 2005; PwC 2008; Dintilhac et al. 2015). The empirical evidence of the economic impact of PPPs is very limited, and many conclusions about the effects of PPPs are anecdotal or based on case studies. Overall, there seems to be consensus that PPPs can provide considerable benefits in accordance with the theoretical benefits listed above.

2.2 PPP TYPES

The different types of PPPs considered in this analysis are those defined by the World Bank in the PPI database. They vary primarily along the dimensions of risk allocation, function responsibility and ownership. These dimensions are

often thought of collectively as the degree of private participation in the PPP project (see for example Hammami et al. 2006).

The following list presents all types of PPI contracts included in the database; a classification of contract types into PPPs and Non-PPPs follows in section 5.1. The list is based on descriptions in the World Bank PPI database and in PwC (2008).

Management and lease contracts

- *Management contract.* Responsibility for managing the utility is transferred to a private operator. The government pays the operator, and the payment is typically divided in two parts: one fixed sum and one that is contingent on achieving some specified results. Ownership, investment decisions and operational risk remain with the public actor.
- *Lease contract.* The government leases the utility to a private operator, transferring responsibility for operating the utility and managing the business. Ownership and investment decisions remain with the public authority. The private actor bears the operational risk.

Brownfield projects, also known as Concessions

In this type of project, a private entity typically takes responsibility for existing facilities, and rehabilitates or expands them. After a set period of time, responsibility transfers back to the public authority. The private actor bears much of the operational and financial risk, and tries to recoup its investment over the contract period. The PPI database classifies Brownfields in three sub-types:

- *Rehabilitate, Operate, Transfer (ROT).* A private entity rehabilitates an existing utility and takes operational responsibility for a set period of time. The private actor maintains, operates and manages the utility at its own risk and then transfers it back to the public sector,.
- *Rehabilitate, Lease or Rent, and Transfer (RLT).* A private entity rehabilitates at its own risk an existing utility and leases or rents it from the public owner over a set period of time, during which it is responsible for operating it. The private actor bears risk related to the development and operation or the asset.
- *Build, Rehabilitate, Operate and Transfer (BROT).* A private entity extends or completes a partially built utility, and rehabilitates the assets at its own risk. Then it operates the utility at its own risk for a set period of time, after which the project transfers back to the public authority.

Greenfield projects

These are similar to brownfield projects, but here the private entity or a public-private joint venture builds the facility instead of only rehabilitating it. The private entity typically bears operational and financial risk and tries to recoup its investment over the contract period. The PPI database classifies Greenfields in five subtypes:

- *Merchant.* A private entity builds a new facility and operates it. With no revenue or payment guarantees from the government, the private actor assumes construction, operation and market risk for the whole project.
- *Build, Operate, and Transfer (BOT).* A private entity builds a new facility and owns and operates it, all at its own risk. At the end of the contract period, ownership of the project is transferred to the government.
- *Build, Lease, and Transfer (BLT).* A private entity builds a new facility largely at its own risk, transfers ownership to the government and then leases the facility from the government and operates it at its own risk.
- *Build, Own, and Operate (BOO).* A private entity builds a new facility, then owns and operates it, all at its own risk.
- *Rental.* A private entity places a new facility at its own risk, owns and operates the project.

3 Literature Review

3.1 Corruption, Infrastructure & Investment Levels

Corruption is often defined in terms of the abuse of public power or resources for private gain. For the purposes of this paper, further precision in the conceptual definition of corruption is not necessary, other than to note that corruption is prevalent in the private sector as well as in the public sector, as Rose-Ackerman (1975) was early in emphasizing. In this paper, it is useful to view corruption as occurring in the intersection between the private and public spheres of an economy, with important implications for infrastructure and Public-Private Partnerships.

Anecdotal and empirical evidence suggest that the physical infrastructure sector is highly affected by corruption globally. Kenny (2006) and Estache (2014) offer two thorough overviews of the extent of corruption in infrastructure. One low-end estimate suggests that the cost of corruption amounts to roughly five percent of investment and maintenance costs in physical infrastructure across developing countries (Kenny 2006). What is referred to as ‘petty corruption’ frequents in the delivery of infrastructure services, or infrastructure connection. An example of

this kind of corruption in infrastructure is the bribe that needs to be paid by the household to have their house connected to an electricity grid. So-called 'grand corruption' is also widespread in the sector, especially in activities related to licensing and construction contract awarding, sometimes to the extent of changing policy practices and regulations (Kenny 2006). Estache (2014) lists five stages in the life cycle of an infrastructure project in which corruption potentially affects governance decisions, from the perspective of the government. These are sector supervision; financing; fulfillment of capital, operational and maintenance needs; construction; and finally the delivery of the infrastructure services. From this we can conclude that corruption is expected to affect all the essential decisions of Public-Private Partnerships in Infrastructure.

The recognition of the impact of corruption on investment justifies a wealth of research on the interaction between corruption and investment, although not specific to infrastructure. While the popular view among policy makers and governments is that corruption is an obstacle to investment and growth, several scholars have argued that corruption can serve as a "grease" in the market system and contribute to economic efficiency. According to this hypothesis, firms can cut through bureaucratic red tape by bribing officials, thereby overcoming inefficiencies in the market. Braguinsky (1996), for instance, argues that in a capitalist market economy with perfect competition, limited corruption is conducive to growth because it helps productive agents circumvent such regulation that would otherwise limit access to resources, thereby ending monopolies or promoting innovation. Rashid (1981) argues that when productive agents find it worthwhile to bribe for access to resources, and as long as public officials see the bribe income as windfall gains, corruption improves economic efficiency.

In contrast to this hypothesis, there is a body of research supporting the view of corruption as an obstacle to investment. In an influential paper, Mauro (1995), uses data from 1980-83 to empirically assess the consequences of corruption, and finds that corruption is associated with lower levels of private investment, thereby negatively affecting growth. Relatedly, Kaufmann and Wei (2000) argue that even if, in theory, corruption can work as "grease in the wheels of commerce", the prevalence of corruption does not exclude bureaucratic inefficiency in a given market. Instead, firms often face both, which makes corruption very costly to investment.

3.1.1 Theoretical perspectives

A number of theoretical perspectives have been used to study this interaction between corruption and investment. Economists often place corruption in the broader debate about the role of institutions. The argument that poor government institutions comprise an obstacle to private investment is decades old. In seminal work from 1990, North stresses the role of institutions in fostering investment and economic performance. Malfunctioning judicial systems that fail in

enforcing contracts; and inefficient and dishonest bureaucracies that delay documentation and licensing are two frequently cited channels through which institutions of poor quality hinder investment. Poor protection of property rights, which lowers incentives to invest, innovate and import new technologies, is a third (Mauro 1995).

Another, related, theoretical perspective on corruption and investment is concerned with the behavior and decisions of the investor. There is, for example, a considerable literature on corruption and the composition of FDI, which directly reflects the ownership decisions and entry strategies of international investors. The role of corruption in such decisions and strategies is often studied through the lens of transaction cost theory, modeling the benefits and costs that the investor faces in different possible investment strategies. This perspective seems highly relevant to Public-Private Partnerships, in which all parties are concerned with decisions regarding ownership, capital investment, function responsibility and risk allocation. Mozsoro et al. (2014) construct a simple investment model that captures institutional as well as financial variables specifically in PPI. In this model, corruption level is captured by political risk, given by the ratio of the private discount rate to the social discount rate of a PPI project. The private discount rate that the investor faces equals the social discount rate plus a risk premium for variance in the terminal value of the project, that is, its uncertain discounted cash flows. The preference for private participation in infrastructure, as opposed to traditional public procurement of infrastructure services, decreases in political risk. The model predicts that a decrease in corruption level is associated with lower political risk, and thus higher PPI. As such, it formalizes the rather reasonable notion that corruption adds to the risk faced by private investors, thereby making private investment more costly and less common.

Both of the two theoretical perspectives briefly accounted for here predict that corruption deters private participation in infrastructure. The first because corruption represents poor quality of institutions, thereby hindering private investment. The second because corruption raises the risk faced by private investors, discouraging the decision to invest in a PPI or PPP project. Relatedly, Estache's literature review on corruption in infrastructure (2014) concludes that the literature, on average, expects *and* finds that corruption limits entry to the market by potential investors. Below follows a summary of the most important empirical findings on the role of corruption in private participation in infrastructure.

3.2 Corruption & Private Participation in Infrastructure

The literature on private participation in infrastructure often considers corruption as one of many possible determinants of private investment or analyzes the role

of corruption implicitly, as part of some index of governance or risk. The empirical research on the determinants of PPI typically employs a cross-country regression approach to establish which factors affect the total number of PPIs and total investment received by a country. Mozsoro et al. (2014) test their model (above) using the World Bank PPI Database for the period 1990 – 2010. They find that country corruption level, as measured by The Quality of Governance Standard Database, is a significant determinant of PPI investment. In terms of direction and magnitude, the authors find that a decrease in corruption score by ten points corresponds to an increase in private investment by 6.7%, supporting the prediction of their model.

D'Oelo et al. (2015) study transport infrastructure in developing countries. Using the World Bank PPI database and World Governance indicators, the authors find that corruption negatively impacts private investment in transport infrastructure. In particular, they find that for countries that improve their Control of Corruption score over time, the level of private investment increases. In a similar study of the water sector, Jensen and Blanc-Brude (2005) find that Control of Corruption significantly increases the number of PPI-contracts signed in a sample of 60 countries. Comparing to other indicators of governance, they find that corruption is the most important in explaining number of PPIs.

Hammami et al. (2006) was among the first papers to study the determinants of PPI using the World Bank PPI Database. The authors test the effect of a number of factors, ranging from macroeconomic stability to sector-specific factors, on three dependent variables: the number of PPI projects in a given country; the value of PPI investment as a share of GDP in a given country; and the degree of private participation in a given project. Corruption is captured by the ICGR 'Control of Corruption Index', and data used covers the years 1990 to 2003. The findings suggest that corruption is a significant determinant of the number of PPI projects across the whole sample, such that lower corruption is associated with more PPI projects. When studying the different sectors separately, however, corruption is only a significant determinant of number of projects in the energy sector. The authors fail to establish a significant effect of corruption on the total investment value, but find it to be a highly significant determinant of the extent of private participation. The extent of private participation in a given project is captured by an index, assigning a value to each type of contract included in the PPI Database. The index ranges from 1 to 12, where a higher value indicates higher extent of private participation. Higher corruption is found to be associated with lower private participation. Hammami et al. (2006) is frequently cited in later studies of the determinants of PPI or PPPs. A limitation of the paper, however, is that while the authors claim to study the determinants of PPPs, not PPIs, they make no distinction between the two in their use of the data. The results thus apply to the whole range of private participation in infrastructure, and not necessarily to Public-Private Partnerships in particular. As mentioned

above, the literature on PPPs often fails to distinguish between PPPs and PPI, a limitation that the current paper seeks to address.

So far, the literature summarized here suggests that corruption deters private participation in infrastructure, much in accordance with the expectations of the theoretical perspectives briefly accounted for above. Interestingly, Banerjee et al. (2006), find conflicting results. The authors employ the PPI Database and the ICGR 'Control of Corruption Index', just like Hammami et al. (2006), but find that the higher the prevalence of corrupt practices in a country, the higher the number of PPI projects and the higher the costs and revenues associated with the projects. In terms of magnitude, the results suggest that a one-unit increase in the corruption index is associated with 31% more private infrastructure investment. This is surprising given the results of Hammami et al. (2006), but could be explained in differences in explanatory variables, control variables and specifications. This suggests that the effect of corruption is sensitive to specification, which will need to be kept in mind in the analysis of the current paper. Another possible explanation to the findings of Banerjee et al. (2006) is that the authors study the effect of corruption on project revenues and costs. The positive effect of corruption on these could capture cost overruns in projects as a result of corruption, requiring revenues to rise to recover costs over the contract period. This effect is pointed out as a possible impact of corruption on infrastructure projects in Estache (2014).

3.3 PPP FEATURES AND THEIR IMPLICATIONS

Public-Private Partnerships in infrastructure differ from each other in several important ways. As we have already seen, the degree of private participation can be thought of as the key dimension along which PPPs vary. This has implications for the role of PPPs in the wider economy, although the literature addressing these implications is limited.

Zangoueinezhad and Azar (2015) use a growth model to assess the impact of PPPs on economic growth, with data from China, Brazil and India over the period 1990 – 2009. They find that PPP type has a higher impact on growth than both the number of PPP projects and the total level of PPP investment. The same conclusion is made in PwC (2008), and both studies attribute the relatively higher impact of contractual type on growth to the varying degree of private-sector participation in PPPs. Higher participation by the private sector increases the degree of transfer of knowledge and resources and implies stronger efficiency incentives for the partnership.

Further, in a review of the literature on PPPs, Dintilhac et al. (2015) find that the impact of PPPs on service delivery, efficiency, labor market and income distribution vary with the PPP type employed. The authors fall short in

elaborating on these effects, but conclude that PPP type matters. Relatedly, Thomsen (2005) concludes that contractual type affects the efficiency gains made in a PPP project, as well as its probability of distress. This result is attributed to the differences in risk allocation between different PPP types, also related to the degree of private sector participation.

Corruption is generally expected to affect the degree of private participation in PPPs for the same reasons and in the same ways as it affects the prevalence and value of PPPs (see a brief account of theoretical underpinnings in section 3.1.1). Institutional quality in general, and corruption in particular, hinder private investment and raises the risks faced by private investors. The expectation is thus that corruption lowers the degree of private involvement in PPPs, as indicated by the empirical results of Hammami et al. (2006).

3.3.1 PPPs & Foreign Direct Investment

Public-Private Partnerships also vary in the involvement of international investors, with immediate implications for cross-border capital flows, or Foreign Direct Investment. As Thomsen (2005) points out, the PPI market is to a large extent dominated by multinational firms. Not all PPP projects in the PPI Database involve international investors, however, allowing for an analysis of the role of corruption in determining the extent of foreign investment in PPPs.

There is a considerable literature concerning corruption and FDI that is not specific to infrastructure or PPPs. The empirical findings point to a negative impact of corruption on FDI. Habib and Zurawicki (2002) use the level of corruption in a country, as measured by Transparency International's Corruption Perception Index (CPI), to empirically assess its effect on FDI. Analyzing IMF data from 1996-1998, covering 89 countries, the authors find that CPI significantly and negatively affects inward FDI. In another important contribution to the literature on corruption and international investment, Wei (1999) compares corruption to taxation in an empirical assessment of the effect of both on foreign investment. Using data on fourteen source countries and forty-five host countries, the author finds that an increase in the host-country corruption level is associated with a decrease in its inward FDI. Driffield et al. (2010) find that the corruption level in the home country of investing firms, in addition to host-country corruption level, affects FDI flows. The authors refer to the distance in corruption level between home and host country as *relative corruption.* Using firm-level data on a set of host countries in Central and Eastern Europe, they find that relative corruption lowers FDI, such that the larger the difference between home and host country corruption levels, the lower the FDI into the home country. This finding suggests that investing firms are more likely to invest in a country in which the corruption level is similar to its home country.

Kirkpatrick et al. (2006) assess the effect of overall quality of the regulatory framework, of which corruption is one aspect, on FDI in infrastructure. Using the World Governance Indicators, they find that regulatory quality significantly and positively impacts FDI in infrastructure.

Empirical results of previous research suggest that corruption deters FDI in general. Therefore, corruption can be expected to be associated with lower participation of international investors in Public-Private Partnerships in infrastructure.

3.3.2 Assistance from multilateral institutions

Public-Private Partnerships have received considerable support from donor agencies and Multilateral Development Banks (MDBs) over the past decades. Such support is said to play an enabling role in PPPs in low- and middle-income countries, as MDBs can provide not only finance through donations and loans, but also know-how, policy advise and capacity building (Hammami et al. 2006). MDBs can also provide a third-party guarantee, improving the creditworthiness of a project and thereby facilitating private investment in PPPs (Basilio 2015). According to Hammami et al. (2006), "*(MDBs) get involved by providing a combination of expertise, guarantees, loans, equity finance, syndication, or risk management, all of which are essential for successful PPPs"* (pp. 12). The World Bank has and continues to strengthen their support to PPPs, referring to the ability of PPPs to improve the quality and delivery of basic infrastructure services (World Bank, 2016b). About a fifth of the PPPs currently in the World Bank PPI Database receive support from Multilateral Development Banks.

The academic literature on the role of MDBs in PPPs is very limited. Basilio (2015) is, to the best of my knowledge, the only paper that studies the determinants of multilateral development support in PPPs. The paper uses the World Bank PPI Database, covering 96 countries over the period 1990 – 2007, to test the effect of a set of explanatory variables on the likelihood of MDB participation in a given project. Despite corruption presenting a considerable risk to private investors in PPPs, Basilio does not include corruption in the set of explanatory variables. The findings do, however, suggest that political risk affects the extent of MDB participation, such that higher risk raises MDB support.

The role of corruption in determining MDB support to PPPs has not yet been studied. Given the risk presented by corruption and the role of MDBs in lowering the risks faced by investors, this paper intends to address this knowledge gap. The effect of corruption on MDB participation could be either positive or negative. On the one hand, higher levels of corruption might deter MDBs from giving loans to projects where the government is involved. On the

other hand, and perhaps the more likely scenario, the need for MDB support is probably higher in more corrupt environments. The role of MDBs in facilitating private investment is expected to increase in importance with the level of risk faced by investors, as indicated by the results of Basilio (2015). In light of this, I expect corruption to raise MDB support in PPPs.

3.4 HYPOTHESES

This paper studies the effect of corruption on three salient features of Public-Private Partnerships in infrastructure; seeking to answer the following three research questions:

How does corruption affect the extent of private participation in infrastructure PPPs in low- and middle-income countries?

How does corruption affect the extent of foreign ownership in infrastructure PPPs in low- and middle-income countries?

How does corruption affect the extent of bilateral and multilateral support to infrastructure PPPs in low- and middle-income countries?

The degree of private participation, international investment and donor support potentially play important roles in determining the impact of PPPs on the wider economy. Not least because PPPs in infrastructure can be considered important vehicles of private investment, FDI and international donor support into the economy. Little research has been done on the interaction between corruption and these three features of PPPs, despite previous findings suggesting that corruption levels might have a considerable impact on all. With these research questions, this paper therefore seeks to address knowledge gaps and limitations of extant literature.

In addition to addressing the limited research that has been conducted on corruption and these features of PPPs, this paper diverts from extant literature in several ways. First, it studies Public-Private Partnerships in particular, while most extant research treat PPPs and other types of private-sector participation in infrastructure as one and the same. Second, it includes recent data from 2010 and later, thereby updating some previous works, such as Hammami et al. (2006) and Basilio (2015). Third, this paper focuses specifically on the role of corruption in PPPs, which few other papers have done.

In light of the findings of the literature cited above, these are the three hypotheses that this paper seeks to test:

H_1. Country corruption level negatively impacts the degree of private participation in Public-Private Partnerships in infrastructure in low- and middle-income countries.

H_2. Country corruption level negatively impacts the probability of foreign ownership in Public-Private Partnerships in infrastructure in low- and middle-income countries.

H_3. Country corruption level positively impacts the probability of donor support in Public-Private Partnerships in infrastructure in low- and middle-income countries.

4 DATA & VARIABLE SELECTION

The empirical framework used in this paper employs econometric models to assess the relationship between corruption and three salient features of Public-Private Partnerships. This section introduces the data and variables used in this analysis.

4.1 DATA ON PUBLIC-PRIVATE PARTNERSHIPS

The main dataset used in this paper is the World Bank Private Participation in Infrastructure Database. This dataset records detailed information on infrastructure projects in which one or several private entities assumes at least some operating risk. For each project, more than 50 fields of information is recorded, including country, sector, financial closure year, investment volume, project type and sub-type, technology and ownership. The projects in the database are all completed in low- and middle-income countries and have reached financial closure (World Bank Group, 2016c). The data used in this paper contains 8 953 projects, covering 117 countries across six regions over the time period 1996 to 2015.

Projects are classified in four sectors: energy, ICT, Transport, and water and sewerage. Energy represents the largest sector for PPIs in the dataset, with around 40 percent of projects, followed by the ICT sector at about 34 percent. The water sector is the smallest sector in the dataset, suggesting that private participation is not as common in water and sewerage services.

Latin America and the Caribbean (LAC) represents the largest PPI region in the dataset, with about 31 percent of the projects. This is in stark contrast to the Middle East and North Africa, representing only around three percent of projects. The rest of the projects are distributed relatively evenly – ranging from 14 to 20 percent – across the remaining four regions: East Asia and Pacific; Europe and Central Asia; South Asia and Sub-Saharan Africa.

The database includes information on the status of the project, indicating whether it is active, concluded, distressed or cancelled. Only 1.5 percent of projects are concluded, and four percent are either distressed or cancelled, meaning almost 94.5 percent of projects in the database are active.

4.2 Classification of contract types

Most of the literature on Public-Private Partnerships does not distinguish between PPPs and other types of private participation in infrastructure provision. A notable exception is Basilio (2015), who uses the World Bank PPI database but excludes some contract types from the analysis. In this paper, I exclude management contracts, all Divestitures, and one type of Greenfield project, in order to capture the effects of corruption on PPPs specifically.

The classification of contract types into PPPs and Non-PPPs is far from straightforward. The PPI Database defines all Brownfield projects and all management and lease contracts as PPPs, and defines all Divestitures as Non-PPPs. It also defines most, but not all, Greenfield projects as PPPs, without further specification of which sub-types are considered PPPs. Basilio (2015) defines all Brownfield and Greenfield projects as PPPs, but excludes management and lease contracts and full privatization. Table 1 lists all the types of PPI contracts included in the PPI Database, with indicators of the respective classifications into PPPs and Non-PPPs. The classification is a result of the definitions in the database, Basilio (2015) and my own assessment.

TABLE 1. TYPES OF PPIS AND SELECTED FEATURES

Sub-type of PPI	Type of PPI	PPP / Non-PPP	Operation and Maintenance	Investment	Market Risk	Ultimate ownership	Contract duration (years)
Management Contract	Contract	Non-PPP	Private	Public	Public	Public	3 to 5
Lease contract	Contract	PPP	Private	Public	Semi-private	Public	8 to 15
Rehabilitate, Operate, Transfer	Brownfield	PPP	Private	Private	Semi-private	Public	20 to 30
Rehabilitate, Lease or Rent, and Transfer	Brownfield	PPP	Private	Private	Majority private	Public	20 to 30
Merchant	Greenfield	Non-PPP	Private	Private	Majority private	Public	20 to 30
Build, Rehabilitate, Operate and Transfer	Brownfield	PPP	Private	Private	Private	Public	20 to 30
Build, Operate, and Transfer	Greenfield	PPP	Private	Private	Private	Semi-private	20 to 30
Build, Lease, and Transfer	Greenfield	PPP	Private	Private	Private	Semi-private	20 to 30
Build, Own, and Operate	Greenfield	PPP	Private	Private	Private	Private	30+
Rental	Greenfield	PPP	Private	Private	Private	Private	30+
Partial Privatization	Divestiture	Non-PPP	Private	Private	Private	Private	30+
Full Privatization	Divestiture	Non-PPP	Private	Private	Private	Private	Indefinite

(Source: Hammami et al. 2006, Basilio 2010, World Bank PPI Database, author's assessments)

Management contracts are not considered PPPs in this paper, as they are closer to traditional public procurement of management and operation services and the whole spectrum of risk remains with the government. Lease contracts, on the other hand, will be considered PPPs, as some risk is assumed by the private entity. Further, merchant contracts are not defined as PPPs, as in this set-up the private sector entity is responsible for the whole project from construction to delivery, assumes all risk and receives no guarantees from the government. Finally, all Divestitures are considered Non-PPPs, as projects in this category are either partially or fully privatized through the sale of equity in a state-owned enterprise or facility. Because they are closer to traditional privatization, they are not defined as PPPs. This classification is in line with the definition in the PPI Database. Out of 8 953 projects included in the dataset, 5 223 projects are defined as PPPs, corresponding to 58.34 percent.

4.3 DEPENDENT VARIABLES

This paper tests the effect of corruption on three features of Public-Private Partnerships: the degree of private participation in the PPP; the involvement of international investors in the PPP; and the support of Multilateral Development Banks in the PPP. This section presents the corresponding dependent variables, and some visual presentations of the dataset with respect to the dependent variables are found in Appendix I.

4.3.1 DEGREE OF PRIVATE PARTICIPATION

The degree of private participation in a PPP project is measured here as its private ownership share, recorded for each project in the PPI Database. This variable simply measures the total proportion of project ownership that belongs to one or several private-sector entities. The sample's average private ownership is high: among PPPs, it is 93 percent, and in the whole sample of PPIs, it is 91 percent.

This measure of private participation presents some challenges, notably because it does not capture potential transfers of ownership from the private to the public sector at the end of the contract period, common in some forms of PPPs. Private ownership share as recorded in the database thus differs from ultimate project ownership. The variable also presents relatively low variation in the dataset, which may impair estimation. An alternative to using this measure of degree of private participation would be to employ a constructed index, as in Hammami et al. (2006). The authors assign a score to each contract type, thereby constructing an index that increases in private-sector participation in the different contract types. The obvious problem with such an index is that it is based on subjective assessment and a rather rough assignment of index scores to the different contract types. Also, the construction of the index implicitly assumes that the scores are equally spaced, a strong assumption, especially as the specifics of the types vary on a case-by-case basis in practice.

In light of this, and for the sake of a more straightforward interpretation of estimates, private ownership share is used to proxy for the degree of private participation in a given project. Considering its limitations, however, results must be interpreted with caution. Average private ownership shares for each of the PPP types are reported in Table 2 below.

TABLE 2. AVERAGE PRIVATE OWNERSHIP SHARE PER PPP TYPE

Sub-type of PPP	Average private ownership share
Lease contract	94.48
Rehabilitate, Operate, Transfer	90.31
Rehabilitate, Lease or Rent, and Transfer	96.84
Build, Rehabilitate, Operate and Transfer	93.46
Build, Operate, and Transfer	89.67
Build, Lease, and Transfer	99.33
Build, Own, and Operate	95.79
Rental	99.18

4.3.2 Foreign ownership

The PPI Database includes information on the owners of each project, and their respective ownership shares and country of origin. As the database also gives the project location, it is possible to compare the location of the partnership with the origin of the owners, allowing for the distinction between domestic and foreign ownership for each project. The projects have between one and five documented owners, and the ownership structure may consist of exclusively domestic firms, exclusively foreign firms, or any combination of domestic and foreign owners. A dummy variable is created to indicate whether any of the project owners is a foreign firm. This variable thus distinguishes between ownership structures where all the owners are domestic firms, on the one hand, and those where at least one owner is a foreign firm, on the other. This means the variable captures any cross-border capital flows into a PPP.

A little less than half of the PPP projects in the sample have at least one foreign owner, at 45.84 percent of projects. Interestingly, when looking at all the PPIs in the sample, including Non-PPPs, the proportion of projects with foreign ownership increases to 60 percent. Between Divestiture and Merchant projects, about 80 percent have at least one foreign owner. This may have interesting implications for the results of this paper, as the distinction between PPPs and other PPIs represents one aspect that differs between this paper and extant literature.

4.3.3 Multilateral & bilateral development assistance

To capture MDB support, a dummy variable is created to distinguish between projects that get no support and projects that get support of any kind, size and origin. The database gives information on multilateral and bilateral support, specifying the institutions involved and the dollar-value of the support, wherever possible. Creating a dummy variable allows me to assess the effect of corruption on the likelihood that a given project receives any bilateral or multilateral support. Using the dollar-value size of the support as the dependent variable would have been problematic, as the values would be either zero or a very high number. The use of a dummy variable to capture the probability of MDB support is in line with the method used in Basilio (2015).

Only about 13 percent of PPPs in the sample receive any multilateral or bilateral support, in the form of loans, guarantees or donations. Among Non-PPPs this proportion increases to 19 percent, again highlighting the difference between PPPs and private participation in infrastructure in general. A closer look at the data suggests that Divestitures drive the higher proportion of Non-PPPs receiving donor support, indicating that partial and full privatization processes receive much international support.

4.3 CORRUPTION MEASURE

The explanatory variable of interest in this paper is the corruption level of the country in which the Public-Private Partnership is undertaken. Existing literature uses a variety of corruption indicators, differing in structure, data collection, perspectives and definitions. Indicators are typically based on either expert assessments, or surveys of households and firms, or are constructed as a composite of several other measures (Perrotta, 2012).

This paper uses the Control of Corruption Indicator, part of the World Governance Indicators created by the World Bank and Daniel Kauffman. The indicator is constructed as a composite variable, combining data from 30 different sources. The sources report on the perceptions of citizens, experts and business representatives of the prevalence and extent of corruption. The WGI Database defines the Control of Corruption measure as *"capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests"* (World Bank Group, 2017).

The measures of corruption collected from the different data sources are combined into one indicator through an aggregation method in several steps. After assigning the data points to the relevant WGI variables, observations are rescaled to run between 0 and 1. An Unobserved Components Model is then used to create weighted average of the observations from each data source, normalizing the measure to make the information comparable across sources. The resulting measure of corruption runs from -2.5 to 2.5, where a higher value corresponds to better control of corruption, in other words less corruption (World Bank Group, 2017).

There are a number of risks and drawbacks with using a composite indicator such as the WGI Control of Corruption Indicator. One is that the indicator relies heavily on the quality of the underlying sources, and any inaccuracies or inconsistencies in these will have a direct impact on the composite. In addition, the implicit assumption that more sources give a better indicator may not hold, if the different sources consult each other, as pointed out in Perrotta (2012). Another drawback of the WGI database is that the indicators are not sector-specific. Information specific to the infrastructure sector would provide higher accuracy, as the sector is known to struggle with high levels of corruption that may even be higher than the average level of the economy as a whole. Despite these risks, there are a number of factors pointing in favor of the use of WGI as explanatory variable in this paper.

First, the WGI dataset covers all the countries in the PPI Dataset, which not all corruption indicators do (e.g. BEEPS, which only covers Europe and Central Asia). Second, WGI provides data on a more consistent basis than most other corruption indicators. For the period 1996 to 2016, it includes data for almost

every year. This allows me to match corruption scores in the WGI data with almost each country and year in the PPI data. The years for which no corruption score is reported – 1999, 2001 and 2016 – are dropped from the dataset. Given the composite nature of the corruption measure, in which the underlying data sources may vary between the years, imputing corruption scores for the missing years would be misleading. After adjusting for the missing years by dropping them, each country in the PPI data is assigned a corruption score for each year that it appears in the dataset. In other words, each PPP project is assigned a corruption score corresponding to its location and year of financial closure. As corruption scores for the countries in the sample have changed over the time period 1996 – 2015, this makes the corruption measure more accurate to each project than selecting only one year for which corruption score is reported. For example, the average corruption score for the sample of countries studied has changed from – 0.49 in 1996 to – 0.21 in 2015.

Several studies cited in the literature review of this paper use the Control of Corruption Indicator. D'Oelo et al. (2015) find that better Control of Corruption is associated with more private investment into infrastructure. Jensen and Blanc-Brude (2005) find similar results for the water sector, and Kirckpatrick et al. (2006) find that overall regulatory quality, as measured by WGI, lowers FDI in infrastructure.

The average corruption score for the whole sample is – 0.43, the lowest score being – 1.82 for Haiti in 1996 and the highest 1.57 for Chile in 2012. Among the regions, Sub-Saharan Africa has the worst average corruption score at -0.77, followed by South Asia and Europe and Central Asia at around -0.66 respectively. The best region, in terms of corruption scores, appears to be Latin America and the Caribbean.

Interestingly, the average corruption score for the sample of PPPs is higher than that of the whole sample, at – 0.32. For the Non-PPPs, the average is – 0.57, indicating that PPPs appear, on average, to be located in places and at times with higher control of corruption than Non-PPPs. Indeed, the difference in mean corruption scores between PPPs and Non-PPPs is shown to be significant at the 1 percent level, using a t-test. Again, this highlights the difference between partnerships and other projects involving the private sector. Any such results should of course be interpreted with caution, as alternative PPP and Non-PPP classifications might have effect.

4.4 CONTROL VARIABLES

Control variables are included to capture market conditions expected to influence the degree of private participation; foreign ownership and MDB support.

Population size, GDP per capita, GDP growth, tax revenue (% of GDP), and inflation are included in all specifications to account for macroeconomic and market conditions. These variables are retrieved from the World Development Indicators Database.

To account for the quality of the infrastructure stock and the need for infrastructure in the sample countries, as recommended in Kirkpartick et al. (2006), electric power transmission and distribution losses (%) and mobile cellular subscriptions (per 100 people) are included as control variables. These variables are retrieved from the World Development Indicators Database.

In the specifications using the degree of private participation and foreign ownership as their dependent variable, a dummy variable indicating donor support is included. Donor support might play a facilitating role in he partnership between the private and public sector, and might therefore encourage private and/or foreign investment in PPPs.

To capture the potential effects of regional differences and trends, dummies for regions are included in all specifications, as well as time dummies to capture any time-specific shocks and trends. Finally, sector dummies are included to capture sector-specific conditions and trends, such as general technological sophistication. Table 3 presents the pairwise correlations among the control variables. Summary statistics for the variables included in the empirical analysis are presented in Table 15 (Appendix II.).

TABLE 3. PAIRWISE CORRELATIONS AMONG INDEPENDENT VARIABLES

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
(1) corruption score	1.00							
(2) GDP per capita	**0.58**	1.00						
(3) GDP growth	-0.21	-0.36	1.00					
(4) population (ln)	-0.27	-0.42	0.61	1.00				
(5) inflation (ln)	-0.13	-0.08	-0.21	-0.16	1.00			
(6) tax revenue	0.34	0.37	-0.28	-0.47	0.01	1.00		
(7) electricity losses	-0.13	-0.23	-0.27	-0.20	0.23	-0.13	1.00	
(8) mobile users	0.19	**0.50**	-0.15	-0.12	-0.18	0.35	-0.21	1.00

5 EMPIRICAL METHOD

Three main equation models comprise the empirical framework of this analysis. The respective models test the effect of corruption on each of the PPP features of interest: the degree of private participation; the likelihood of international investor participation; and the likelihood of bilateral or multilateral support to a project. The hypotheses tested, as developed in section three, are:

H_1. Country corruption level negatively impacts the degree of private participation in Public-Private Partnerships in infrastructure in low- and middle-income countries.

H_2. Country corruption level negatively impacts the probability of foreign ownership in Public-Private Partnerships in infrastructure in low- and middle-income countries.

H_3. Country corruption level positively impacts the probability of donor support in Public-Private Partnerships in infrastructure in low- and middle-income countries.

Hypothesis one is tested using a linear model, hypotheses two and three using linear probability models, all models are estimated using Ordinary Least Squares (OLS).

5.1 DEGREE OF PRIVATE PARTICIPATION

The dependent variable used to test hypothesis one is private ownership share, measured as a percentage and thus running from 0 to 100, taking on any value in-between. Ordinary Least Square (OLS) is used to estimate the parameters in the linear model:

$$private\ ownership\ share_{ijt} = \beta_0 + \beta_1 corruptionscore_{jt} + \boldsymbol{\beta x}_{jt}$$

where $private\ ownership\ share_{ijt}$ measures the private ownership share of project i in country j in year t; $corruptionscore_{jt}$ measures the Control of Corruption score for country j in year t; $\boldsymbol{x}$ is a vector of explanatory variables for each country j in year t and the parameter of interest is β_1.

As the dependent variable is fractional, an alternative to estimating a linear model would be to use a fractional logit model, as recommended in Wooldridge (2002), as the linear model allows for fitted outcomes to take values below zero and above one. However, the interpretation of estimates in the fractional logit model is much less straightforward than in the linear model, justifying the use of the linear model despite its shortcomings.

5.2 FOREIGN OWNERSHIP & MDB SUPPORT

Hypotheses two and three will be tested using binary dependent variables, to capture the effect of corruption on the *probability* of international owners and MDB support respectively. The relationship is specified as a linear probability model, estimated using OLS. The linear probability model presents a simple way of estimating the effect of the independent variables on the probability of an outcome. A drawback with using a linear model in estimating probability outcomes, as with the fractional dependent variable above, is that the outcome may take on values outside the unit interval [0,1] for certain values of the independent variables. An alternative would be to employ discrete choice models such as probit and logit instead, but again, for the benefit of simplicity in estimation and interpretation, the shortcoming of the linear probability model is a relatively small price to pay.

The model takes the form:

$$P(y = 1|\, \boldsymbol{x}) = \beta_0 + \boldsymbol{\beta x}$$

The specification estimated for hypothesis two is thus:

$$P\big(foreignowner_{ijt} = 1 \,\big|\, \text{corruptionscore}_{jt};\, \mathbf{x}_{jt}\big) = \beta_0 + \beta_1 \text{corruptionscore}_{jt} + \boldsymbol{\beta x}_{jt}$$

Testing the null hypothesis

$$H_{2,0}\colon\ \beta_1 = 0$$

Similarly, for hypothesis three, the equation is specified as:

$$P\big(donorsupport_{ijt} = 1 \big|\, \text{corruptionscore}_{jt};\, \mathbf{x}_{jt}\big) = \beta_0 + \beta_1 \text{corruptionscore}_{jt} + \boldsymbol{\beta x}_{jt}$$

Testing the null hypothesis

$$H_{3,0}\colon \beta_1 = 0$$

The probability outcomes $foreignowner_{ijt}$ and $donorsupport_{ijt}$ are the respective binary dependent variables, indicating any foreign ownership and donor support to a project i in country j in year t. Further, $corruptionscore_{jt}$ measures the Control of Corruption score for country j in year t; $\boldsymbol{x}$ is a vector of explanatory variables for each country j in year t. In each specification, β_1 estimates the parital effect of $corruptionscore_{jt}$ on the probability of foreign ownership and donor support respectively.

Standard errors are robust and clustered on the country level in all relevant specifications (those with 30 clusters or more) to account for within-country correlation, as recommended in Basilio (2015). Note that each group of dummy variables (region, sector and year dummies) is only included in specifications where the group is jointly significant, that is, where it adds to the fit of the model.

6 Results

6.1 Degree of private participation

The estimation output of models using private ownership share as dependent variable is reported in tables 4 – 6, where table 4 reports the results for the whole sample of PPPs and table 5 and 6 break the sample down by region and sector respectively.

The output of table 4 shows significance of the effect of corruption score on the share of private project ownership at the 10 percent level. The effect is positive, such that a one-unit increase in the corruption score corresponds to an increase in private ownership share of roughly 2.5 on a scale from 0 to 100. This suggests that higher control of corruption increases the degree of private participation in an infrastructure PPP project, all else equal. This finding supports hypothesis one, but since the effect of corruption is only significant at the 10 percent level, it must be considered rather weak support. Only two other variables appear as significant in table 4 – population size and an indicator for MDB support. The effect of MDB support on private ownership share is significant at the 5 percent level, negative in direction and slightly larger in magnitude than the estimated effect of corruption score. This suggests that a project receiving development assistance has a lower private ownership share, by roughly 3.3 percentage points,

compared to a project that does not receive such support. This result could reflect a potential preference among MDBs for projects with a relatively higher share of public sector ownership. This explanation seems plausible, given that MDBs are likely to favor support to governments over support to profit-seeking private actors. Population size, transformed by natural logs, is significant at the one percent level as a predictor of private ownership share, implying that less populous countries tend to have lower private participation in infrastructure PPPs, all else equal. Region dummies are jointly significant in this specification, so are the year dummies. Countries in North Africa and the Middle East have, on average, lower private ownership in infrastructure PPPs than the baseline group East Asia and the Pacific, while those in South Asia have slightly higher private ownership. None of the other indicators included to reflect the macroeconomic conditions for private investment are found to be significant in this specification. Note that the constant is larger than 100, which should not be the case given that the dependent variable cannot take on values larger than 100. This may be a result of the low variation in the dependent variable, which is a limitation in using private ownership share as a dependent variable. However, as the constant is not interesting in its own right, it should not be a major concern.

Table 5 shows the same regression model estimated for each of the different regions in the dataset. Note that the sample is very small for specification (4), and rather small for specification (6), so the results of these should be interpreted with caution. The output shows that corruption is a significant predictor of private ownership share for some regions, while for others it is not. Column 1 shows that the effect of corruption on private ownership share is significant on the one percent level for a sample of projects in East Asia and the Pacific. The same can be said for countries in North Africa and the Middle East (column 4), but since the sample of projects in this region is so small, no strong conclusions can be drawn from this result. For Latin America and the Caribbean, corruption score is significant at the 10 percent level. For these three regions, a better control of corruption is associated with a higher private ownership share in infrastructure PPPs, again supporting hypothesis one. In terms of magnitude, the effect appears considerably larger than when the model is run on the whole sample of PPPs. For East Asia and the Pacific, a one-unit improvement in the Control of Corruption index is associated with an increase in private ownership by approximately 16 percentage points. For the other regions, corruption appears to affect private ownership in the opposite direction, such that a better control of corruption is associated with lower private ownership. These estimates are not significant at any conventional level, however, and therefore no conclusions can be drawn about them. In this output, as in table 4, the effect of MDB support on private ownership appears to be negative wherever significant.

The output of table 6 shows the same model estimated for each of the different sectors in the dataset. The results suggest that control of corruption is a

significant determinant of private ownership share in the transport and water sectors, but not in the other two. Again, the effect of control of corruption is positive, further supporting hypothesis one.

6.2 FOREIGN OWNERSHIP

Tables 7 – 9 present the output of models estimated with an indicator of foreign project ownership as dependent variable. These models estimate the effect of corruption and the control variables on the probability that a project has at least one corporate owner from a different country. Again, the tables report the estimation results for the whole sample (table 7) and for breakdowns of the sample into regions (table 8) and sectors (table 9).

The output of table 7 shows no significance for the effect of corruption score on the probability of foreign ownership of a project. MDB support, on the other hand, appears as a highly significant predictor of foreign ownership. This finding suggests that a project receiving MDB support has a higher probability, by 0.13, of having at least one foreign owner, compared to a project not receiving such support. This finding supports the potential mediating role of MDBs in partnerships between governments and international investors. In predicting foreign project ownership, population, GDP per capita, inflation and electricity losses are significant in this specification, supporting the role of some market and macroeconomic conditions, although these effects appear to be almost insignificant in magnitude.

Table 8 reports the output of the same model estimated for each region. Again, note that the sample is very small for specification (4), and rather small for specification (6), so the results of these should be interpreted with caution. Control of corruption is a significant predictor of foreign ownership only for projects in East Asia and the Pacific, and Europe and Central Asia, at the 5 and 10 percent significance level respectively. This is reported in column 1 and 2 of table 8. The direction of the estimated effect for both these regions suggests that a better control of corruption is associated with a lower probability of foreign project ownership, all else equal. This finding is in contrast to hypothesis two, which expects better control of corruption to give higher probability of foreign ownership. The coefficients are rather large, implying that corruption has a considerable effect on foreign ownership in these regions. A one-unit increase in the Control of Corruption indicator is associated with a .41 drop in the probability of foreign ownership in projects in East Asia and the Pacific, for instance. For the other regions, the coefficients on corruption score are interchangeably negative and positive, but are in all cases statistically insignificant.

Breaking down the sample by sector shows that corruption score is a significant predictor of the probability of foreign ownership in the ICT sector and the water and sewerage sector, as reported in table 9 column (2) and (4). Note that in the ICT sector, the estimated effect of corruption on the probability of foreign ownership is larger than one; at 1.56 This highlights a serious shortcoming in the linear probability model, as a predicted probability should not fall outside the unit interval. Figure 3 (Appendix II) shows that the distribution of corruption score for projects in the ICT sector is mostly concentrated below zero, so when plugging in real values for corruption score in the predicted model, the large estimate might not be a big problem. The magnitude aside, Control of Corruption is highly significant and is estimated to positively affect the probability that a project has at least one foreign owner. In the water and sewerage sector, the effect of corruption on foreign ownership is predicted to work in the opposite direction, such that better control of corruption lowers the probability of foreign ownership in PPP projects. This estimate is significant at the 5 percent level, and considerable in magnitude, at -.23.

In contrast to results for private ownership, MDB support is positive where it is significant, suggesting that MDBs help attract foreign investors into partnerships with government. This might also reflect a preference among MDBs for supporting projects where at least one owner is international.

No conclusion about the effect of country corruption score can be made with confidence based on the estimates in tables 7, 8 and 9. Hypothesis two is only supported in the sub-sample of PPP projects in the ICT sector. Other significant coefficients on corruption score suggest that corruption works in the opposite direction, implying that better control of corruption deters foreign investment.

6.3 MDB SUPPORT

Tables 10 – 12 report the output of models estimating the effect of corruption on the probability that a project receives MDB support.

Table 10 shows that for the sample of PPPs as a whole, control of corruption is not a significant predictor of MDB support. Only population size and GDP growth are significant in predicting the probability of MDB support, and these estimates suggest that a project is more likely to get development assistance if located in a country with smaller population and slower growth, which seems intuitive given the role of MDBs.

In table 11, the same model is estimated for each region in the sample. Given small samples for specification (4) and (6), the results of these should be interpreted with caution. The output shows that the effect of corruption on the probability of MDB support is significant in East Asia and the Pacific; Europe

and Central Asia; and South Asia (columns 1, 2 and 5). The effects are all negative, suggesting that a higher control of corruption is associated with a lower probability of MDB support to a PPP. In terms of magnitude, the effects are considerable, ranging between 0.27 and 0.39. In South Asia, for instance, a one-unit increase in the Control of Corruption index lowers the probability that a project received MDB support by 0.39, a sizeable reduction in probability. This finding supports hypothesis three for these three regions.

Breaking the sample down by sector reveals that corruption score is a significant predictor of MDB support in the ICT sector and the transport sector, as shown in table 12. The estimates are significant at the 10 percent level. Population size seems to go further in predicting MDB support, being significant at the one percent level for three out of four sectors.

The main insight from the results of the models with an indicator of MDB support as dependent variable is that corruption score is at most a weak predictor of MDB support to an infrastructure PPP. It is not possible to draw any general conclusions in relation to hypothesis three, but to say that control of corruption holds some explanatory power in sub-sections of the sample. Where the estimated effect is significant, it supports hypothesis three, suggesting that a project is more likely to receive MDB support if located in a country with lower control of corruption, all else equal. This effect might reflect the facilitating role of MDBs in markets where private investors face high risk in the form of high levels of corruption.

The results are discussed further in the next section, following a sensitivity analysis of the results.

6.4 Sensitivity analysis

Table 13 reports the estimated coefficients and corresponding standard errors for the control of corruption variable in a few variations of the baseline model and sample presented in the tables above. Variations are estimated to consider a few key empirical issues, and to check to what extent the results obtained are sensitive to alternative specifications of the main model. For comparison, row 1 of Table 13 presents the estimated coefficients presented in Tables 4, 7 and 10 above.

Specification 2 estimates the baseline model excluding only the variable GDP per capita. Table 3 (above) shows that this variable has the highest pairwise correlations in the correlation matrix for all control variables. As such a high correlation may be cause for some concern, it was removed from the baseline model for the sake of sensitivity analysis. The estimates, reported in row 2 of table 13, shows that removing GDP per capita raises the significance level of the

corruption estimate in the MDB support model. The estimated coefficients for the other two models do not change in significance level, although for the foreign ownership model, it changes in sign. Since this coefficient is insignificant for all specifications tested, however, it means very little.

Specification 3 excludes the mobile subscriptions variable from the baseline regression model. A VIF-test on the baseline model shows that this variable is the only one that could raise concern with regards to collinearity with the constant, with a VIF value above 9. The estimated corruption coefficients are reported in row 3, and show that the results are not sensitive to the exclusion of the mobile subscriptions variable.

In specification 4, I add a control for PPP type to the baseline regression (see Table 1 for some key features of each type). If corruption score affected the outcome variables primarily via differences between the PPP types, this would change the significance of the estimated coefficients on corruption score. Since only private ownership is significantly predicted by corruption in the main model, the primary objective of adding additional controls in a sensitivity analysis is to test whether the significance disappears. Column 1, row 4 of Table 13 shows that this is not the case – the coefficient on corruption score remains significant at the 10 percent level, and almost identical in magnitude.

Finally, in row 5, coefficients are reported for the baseline model estimated for a sample of both PPPs and Non-PPPs from the PPI Database. The results do not change, except for an increase in significance for the private ownership model. This result implies that there are no considerable differences between projects defined as PPPs and those considered Non-PPPs in this paper, and that the significance of the result does not depend on the classification of projects into PPPs and Non-PPPs.

7 DISCUSSION

The results presented above support hypothesis 1. Corruption level is found to significantly predict the degree of private participation in infrastructure PPPs, measured as project ownership share borne by the private sector. The result holds for a few variations of the regression model.

This finding suggests that corruption presents a considerable barrier to private sector participation in Public-Private Partnerships in infrastructure. This is well aligned with the general perception in extant literature – that corruption limits private investment. One theoretical perspective on this finding places corruption in the broader notion of institutional quality, and suggests that corruption

represents poor quality of institutions, thereby hindering private investment. Another theoretical perspective views corruption as a risk faced by investors, which discourages private investment and thereby should deter private participation in PPPs. The nature of PPPs implies a high degree of interaction between the public and private sectors. High levels of corruption could mean that entering a partnership with the government implies too much risk for the private sector entity, affecting the investment decision. Private sector actors may prefer to stay 'at an arm's length' from the public sector when the risks and costs associated with corruption are high. The found effect of corruption level on private investment in PPPs might also reflect a higher preference by a corrupt government for retaining high control over assets, in comparison to a less corrupt government. The extent to which rent-seeking activities by government officials in infrastructure projects is possible might depend, in part, on the degree of control individual officials have in such projects. A lower degree of private participation in PPP projects implies that the public sector retains a higher degree of control over assets. The available data does not allow for further empirical analysis of the specific channels through which control of corruption affects any of the outcome variables, and I can only speculate about the motivations of private and public investors in relation to corruption. As mentioned above, in a literature review on corruption and infrastructure, Estache (2014) concludes that the literature, on average, expects *and* finds that corruption limits entry to the market by potential investors. The results of this paper support this conclusion. They are also in line with the findings of Hammami et al. (2006), finding that corruption significantly and negatively affects the degree of private participation in PPPs, measured as an index from 1 to 12.

The effect of corruption on the degree of private participation in infrastructure PPPs appears to be driven mainly by projects in East Asia and the Pacific, and in the transport and water sectors. What may be special about these sub-sets of the sample? Figure 4 in Appendix II shows that the PPP type BOT is more common in East Asia and the Pacific (and in Middle East and North Africa, the other region where corruption score is a significant predictor of private participation in PPPs) than in other regions. Figure 5 (Appendix II) shows that BOTs, BROTs and ROTs are the most common types in the transport and water sectors. Table 2 (above) lists average private ownership shares by PPP type, showing that BOT, BROT and ROT are the PPP types with the lowest average private ownership shares in the sample. It is thus the case that the regions and sectors in which corruption score significantly predicts private ownership in PPPs feature mainly those PPP types with relatively low private ownership shares. Corruption appears to affect the degree of private participation via the choice of PPP contract type, such that in markets where corruption is higher, investments are more likely to take contractual forms that on average imply lower private ownership. However, row 4 of table 12 (above) shows that the estimated effect of corruption on private ownership in the sample as a whole does not change

when controlling for PPP type. Other differences between the regions and sectors could be important. Hammami et al. (2006) point out that there are some fundamental differences in the nature of the investments between the infrastructure sectors. In the water sector, goods and services are highly public in their nature, which could mean that private investors are more sensitive to high levels of corruption in this sector. The same could be said about the transport sector, where projects include ports, railways, roads and airports. The transport sector is also very capital intensive (Hammami et al. 2006), which could also add to private investors' sensitivity to corruption – in a highly corrupt environment, investors might shun away from making highly capital intensive investments into goods that are very public in their nature. The ICT sector, on the other hand, typically involves more innovation and advanced technology, which might require more participation from the private sector and make private ownership relatively more attractive in this sector. Private investors might therefore not consider corruption as important a determinant in the ICT sectors as in other sectors. As pointed out above, however, the current analysis builds on speculations and the data available does not give further insights on the motivations of private and public investors.

In contrast to hypothesis 1, no support is found for hypothesis 2. Corruption appears to have no significant effect on the participation of international investors in infrastructure PPPs. This finding is in contrast to much of the literature on corruption and FDI, which finds that corruption deters FDI. One explanation for this finding could lie in the fact that the sample includes a wide range of both host and home countries. Previous research finds that it is not only the corruption level in the host country that determines FDI flows, but also the difference in corruption levels between the host and the home country of investing firms (Driffield et al. 2010). It could be the case that relative corruption goes further in explaining FDI flows in infrastructure PPPs than the corruption level in the host country alone. Accounting for relative corruption is outside the scope of this analysis, but might be a topic for future research.

The ICT sector is the exception here, as the only sub-set of the sample in which support for hypothesis 2 is found. The specific conditions of the ICT sector appear to mean that corruption deters foreign investment into infrastructure PPPs. As pointed out above, projects in the ICT sector typically involve more advanced technology and more innovation than the other sectors. Figure 6 (Appendix II) also shows that the ICT sector has a higher share of projects with at least one foreign owner than the other sectors, suggesting that foreign ownership is relatively more important in this sector. The significance of corruption score in predicting the involvement of foreign investors in ICT might thus reflect corruption as an obstacle to investments that involve sharing of advanced technologies and innovations. As foreign investors face a higher

degree of uncertainty and risk in highly corrupt markets, they might be deterred from investments that require that they share sophisticated technology, which requires considerable resources to develop.

The fact that the estimates of the effect of corruption on foreign ownership alternate in direction might reflect the possibility that corruption deters international investment in some cases, but attracts it in others. Foreign investors may find it easier to participate in infrastructure projects in markets where corruption levels are high and the government has poor control of corruption, if these markets are also characterized by poor governance and public administration. This potential effect is in line with the view of corruption as ”grease” in the economic system, proposed by some scholars and summarized briefly on page 12 above. According to this hypothesis, firms can cut through bureaucratic red tape by bribing officials, thereby overcoming inefficiencies in the market. The results suggest that this might be the case in East Asia and the Pacific, and in Europe and Central Asia, as well as in the water sector. This should be interpreted with caution, however. A limitation of this analysis is that it is not possible to disentangle the different possible effects of corruption.

No support is found for hypothesis 3 in an analysis of the whole sample, and corruption is found to be at most a weak predictor of MDB support in some regions and sectors. In these sample sub-sets where corruption score significantly predicts MDB support, the estimate does support hypothesis 3, suggesting that MDBs are more likely to participate in PPPs in more corrupt markets. This seems intuitive given that MDBs are said to play a facilitating role in the partnership between the public and private sector, in which corruption might be a considerable risk and constraint.

Corruption is found (above) to be a significant predictor of *private participation* in PPPs in the transport sector, suggesting that private investors are sensitive to corruption in this sector. The sector is highly capital intensive, meaning that risk in the form of corruption could play a relatively more important role in investment decisions. This might explain why corruption is also found to be a significant predictor of MDB support in this sector. The same effect could be at play in the ICT sector. Since ICT is characterized by relatively advanced technology and innovation, MDBs could play an important role in facilitating private investment that requires the sharing of expensive technology. This might explain why corruption is a significant predictor of MDB support in the ICT sector.

As the effect of corruption on MDB support in PPPs has, to the best of my knowledge, not been studied before, there are no previous results to compare this

to. Basilio (2015) finds that political risk, as measured by checks and balances, significantly increases the probability of MDB support to a PPP project. The author concludes that MDBs participate more in PPPs in markets with less accountable governments. If corruption can be thought of as a different proxy for accountability of government, the overall results of this thesis are not in line with the findings of Basilio (2015).

As with the involvement of foreign investors, there might be different and opposing effects of corruption on the probability of MDB support. On the one hand, MDBs might refrain from supporting Public-private partnerships with a highly corrupt public sector. On the other hand, MDBs might play an important role in assisting such partnerships, *especially* with a highly corrupt government. I deemed the latter effect more plausible, partly based on the results of Basilio (2015), but the empirical analysis does not allow for a separation of these two potential and opposing effects. However, where the estimates are significant they are negative, supporting the latter explanation and hypothesis 3.

7.1 Empirical limitations & Validity

Studying corruption implies empirical challenges inherent in the non-observable nature of corruption. A country's corruption level is impossible to directly measure, and there are a number of alternative proxies and indices in the field, all of which cannot provide more than imperfect approximations of the actual prevalence and severity of corruption in a country. The choice to use the World Governance Indicators measure, Control of Corruption, comes with some drawbacks, as indicated in the Data and Variable Selection section above. As with any index variable, the interpretation of the magnitude of estimated effects is unfortunately not very straightforward. What does a one-unit increase in the Control of Corruption indicator mean? It is important here to point out that the WGI indicators all come with nontrivial margins of error, as emphasized in D'Oelo et al. (2015). This implies that a 'one-unit change' in the Control of Corruption measure means very little, as it could fall within the indicator's margin of error. To conclude, too much emphasis should not be placed on the size of estimated effects, but rather on their sign and significance. Despite the shortcomings of the WGI corruption index, it has been frequently used by scholars and may be considered an acknowledged measure of control of corruption.

Another empirical issue worth to mention relates to the classification of projects in the PPI Database into PPPs and Non-PPPs. As mentioned above, this classification is far from straightforward and my own subjective assessment plays a role. In the sensitivity analysis above, however, I show that running the baseline regression on an extended sample of both PPPs and Non-PPPs gives similar results as running it on the sample of PPPs only. The estimated effect of

corruption on the degree of private participation becomes slightly more significant in the extended sample, suggesting that the results may be even stronger for the projects classified here as Non-PPPs. The estimate for foreign ownership and MDB support remain insignificant in the extended sample. This finding implies that the main results hold for the sample of all PPIs in the PPI Database for the years studied. This could be seen as an indication that distinguishing between PPPs and Non-PPPs is redundant, and that there may be no need to analyze PPPs separately from other types of private participation in infrastructure. On the other hand, the effect of corruption on private ownership share increases in significance in the extended sample, suggesting that there might indeed be a case for studying PPPs separately, as called for in previous literature (e.g. Dintilhac et al. 2015). It could reflect the possibility that investors are less sensitive to corruption in projects classified as PPPs, and that estimations of this effect in literature that does not make the distinction are overestimated. This would be true only for analyses of the effect of corruption on the degree of private participation, however, and not on the other two features of PPPs. This implication should be interpreted with caution, as it partly hinges on my assessment in classifying the different types of projects.

As for omitted variable bias in the estimated models, it is unlikely that all possible confounding factors have been controlled for, and such bias can therefore not be excluded as a possibility. A particular concern might be that previous literature sometimes includes controls for factors related to political risk, governance and institutional quality, in addition to a corruption measure (see e.g. D'Oelo et al. 2015; Hammami et al. 2006). Since I do not control for such factors, it might be possible that my estimates on Control of Corruption capture some other effects of governance and institutional quality. However, there is a strong case for not including such variables in this analysis, for two main reasons. First, in this study I am interested in the effect of corruption particularly on some features of PPPs. Previous papers that include other governance controls are interested in the effects of institutional quality, in general, on infrastructure PPPs. Studying the effect of corruption in addition to the effect of quality of public administration, government effectiveness, checks and balances and similar measures of governance quality seems futile, since these, to a certain extent, must be seen to measure the same thing. Second, and relatedly, other such measures show high pairwise correlation with the Control of Corruption variable used here. Table 14 (Appendix II) shows pairwise correlations among Control of Corruption and the other WGI variables. All correlations are high, most above 0.50, and including them in the estimation model would thus have been problematic.

An important concern with respect to internal validity, as mentioned above, is also that the analysis does not allow for potential opposing effects of corruption to be detected. It may be the case that corruption, under some circumstances,

attracts private or foreign investment, and this analysis does not allow for more than speculation on this question.

These empirical issues represent limitations to the internal validity of the analysis. On the other hand, the analysis uses what is probably the most comprehensive dataset on infrastructure PPPs in low- and middle-income countries, a dataset employed by most papers on the topic of private participation in infrastructure. As the dataset covers 117 countries across six regions, this analysis is conducted on a very considerable proportion of infrastructure PPPs in low- and middle-income countries. It also uses a measure of corruption that is acknowledged by scholars in spite of its shortcomings. Further steps to improve the internal validity are taken in the estimation process, by controlling for market conditions and infrastructure quality as well as including time, region and sector dummies where appropriate.

With regards to external validity, it cannot be assumed that these results would hold in a different set of countries or a different time period. For instance, the results are likely to be different for a set of high-income countries, for the reason that many of the controls, including Control of Corruption, are likely to be considerably different in a sample of high-income countries. The nature of Public-Private Partnership may also be different in high-income countries.

8 Conclusion

This paper has intended to shed light on Public-Private Partnerships, as an important alternative for enhancing access to basic infrastructure in low- and middle-income countries. It has aimed to further the understanding of specific features of Public-Private Partnerships, by investigating the effects of corruption on three key aspects of such partnerships: the degree of private-sector participation; the participation of foreign investors; and development assistance. These key features potentially play important roles in determining the impact of PPPs on the wider economy, not least because PPPs in infrastructure are important channels of private investment, FDI and international donor support into the economy. Extant research has paid very little attention to these features of Public-Private Partnerships, and this paper is to the best of my knowledge the first empirical assessment of the effect of corruption on FDI and development assistance in PPPs.

The results indicate that corruption presents a constraint on private-sector participation in Public-Private Partnerships. This is in line with the literature on corruption and investment, which typically finds that corruption limits private investment. In contrast, no conclusions can be made about the effect of

corruption on the other two features – the participation of foreign investors and of donor agencies – based on the findings of this analysis. Breaking down the sample by region and sector, however, reveals that corruption significantly affects these PPP features in certain regions and sectors. Overall, these results suggest that corruption may, in some regions and sectors, attract foreign investment into Public-Private Partnerships. In addition, the break-down of the sample suggests that corruption increases the probability that a project receives support from a Multilateral Development Bank. The results also suggest that receiving development assistance significantly predicts the degree of private-sector participation and the involvement of international investors in Public-Private Partnerships.

It is my hope that these findings inspire further research on the specific features of Public-Private Partnerships, and the determinants and impacts of these. Future research could consider the impact of relative corruption levels on FDI in Public-Private Partnerships, taking into account the corruption level in the home countries of foreign investors. There is also room for further research on potential opposing effects of corruption on these features of Public-Private Partnerships, to understand if it is possible that corruption, under certain circumstances, is conducive to private or foreign investment. Future research could also investigate further the impacts of Public-Private Partnerships on the wider economy, and empirically assess the role of PPPs as channels of private investment, FDI and development assistance.

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APPENDIX I. REGRESSION RESULTS

I.A. DEGREE OF PRIVATE PARTICIPATION, TABLES 3-5

TABLE 4. PRIVATE OWNERSHIP SHARE, WHOLE SAMPLE

VARIABLES	
Corruption Score	2.53*
	(1.37)
MDB support	-3.34**
	(1.33)
Population (ln)	-1.37***
	(0.47)
GDP per capita	-0.00
	(0.00)
GDP growth	-0.31
	(0.19)
Inflation (ln)	0.61
	(0.54)
Tax revenue	-0.15
	(0.17)
Electricity losses	-0.11
	(0.13)
Mobile subscriptions	-0.05
	(0.04)
Regions	
Europe and Central Asia	4.06
	(2.65)
Latin America and the Caribbean	0.83
	(2.06)
Middle East and North Africa	-21.82**
	(10.10)
South Asia	6.33***
	(1.84)
Sub-Saharan Africa	2.41
	(2.87)
Constant	124.86***
	(9.12)
Observations	3,584
Adjusted R-squared	0.11
Region Dummies	Jointly significant
Year Dummies	Jointly significant

Robust standard errors clustered at country level reported in parentheses
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

TABLE 5. PERCENT PRIVATE OWNERSHIP, BREAK-DOWN BY REGION

VARIABLES	(1) East Asia & Pacific	(2) Europe & Central Asia	(3) Latin America & the Caribbean	(4) Middle East & North Africa	(5) South Asia	(6) Sub-Saharan Africa
Corruption Score	16.17***	-1.74	4.01*	56.18***	-0.91	-6.38
	(3.79)	(5.54)	(2.16)	(14.84)	(2.02)	(7.21)
MDB support	1.43	-3.96**	-2.27*	20.90	-1.26	-17.63***
	(2.30)	(1.98)	(1.28)	(12.82)	(1.53)	(5.55)
Population (ln)	-4.46***	-1.18	-0.37	10.20	1.10*	-1.98
	(1.02)	(0.79)	(0.54)	(8.11)	(0.57)	(3.14)
GDP per capita	-0.00	-0.00	-0.00	-0.00*	0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	-0.56	-0.05	0.97***	-1.68	-0.33*	-0.40
	(0.43)	(0.34)	(0.37)	(1.79)	(0.17)	(0.49)
Inflation (ln)	5.04**	0.90	0.02	-8.47*	0.77	-1.97
	(2.22)	(1.05)	(0.44)	(4.49)	(1.05)	(2.24)
Tax revenue	-0.97**	0.94	0.09*	0.34	0.07	-0.07
	(0.50)	(0.81)	(0.05)	(0.36)	(0.33)	(0.38)
Electricity losses	-0.26	-0.57	-0.20	0.57	-0.23	0.03
	(0.35)	(0.37)	(0.15)	(1.49)	(0.17)	(0.13)
Mobile subsc.	-0.12*	-0.12	-0.07	0.27***	0.00	0.09
	(0.07)	(0.08)	(0.05)	(0.08)	(0.03)	(0.08)
Constant	196.53***	104.29***	106.58***	-67.51	75.77***	138.68**
	(25.06)	(9.11)	(9.08)	(139.70)	(11.36)	(55.02)
Observations	835	311	1,318	36	943	141
Adjusted R-squared	0.17	0.29	0.13	0.65	0.05	0.17
Year Dummies	YES	YES	YES	NO	NO	NO
Sector Dummies	YES	NO	YES	NO	YES	NO

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

TABLE 6. PERCENT PRIVATE OWNERSHIP, BREAK-DOWN BY SECTOR

VARIABLES	(1) Energy	(2) ICT	(3) Transport	(4) Water & Sewerage
Corruption Score	2.00	3.22	7.58***	7.55***
	(2.47)	(2.85)	(2.53)	(1.90)
MDB support	-1.60	-23.96***	-2.19	1.95
	(1.14)	(3.73)	(1.95)	(2.72)
Population (ln)	-1.66***	-2.22**	-1.87**	-1.70*
	(0.60)	(1.08)	(0.70)	(0.88)
GDP per capita	-0.00	0.00**	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	-0.38	2.26***	-0.74*	-0.23
	(0.34)	(0.48)	(0.41)	(0.29)
Inflation (ln)	1.20	-9.51***	0.27	3.64***
	(1.01)	(1.60)	(1.18)	(1.11)
Tax revenue	-0.03	-0.23***	-0.52	-1.64***
	(0.29)	(0.05)	(0.46)	(0.15)
Electricity losses	-0.13	0.00	0.46**	0.37*
	(0.19)	(0.18)	(0.20)	(0.21)
Mobile subscriptions	-0.04	-0.12***	-0.23**	-0.09
	(0.05)	(0.04)	(0.09)	(0.08)
Constant	131.55***	153.19***	126.46***	131.04***
	(10.18)	(17.98)	(18.80)	(17.19)
Observations	2,053	119	949	463
Adjusted R-squared	0.16	0.65	0.18	0.17
Year Dummies	YES	NO	YES	YES
Region Dummies	YES	NO	NO	NO

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

TABLE 7. FOREIGN OWNERSHIP, WHOLE SAMPLE

VARIABLES	
Corruption Score	-0.05
	(0.04)
MDB support	0.13***
	(0.03)
Population (ln)	-0.07***
	(0.01)
GDP per capita	-0.00*
	(0.00)
GDP growth	0.01
	(0.00)
Inflation (ln)	-0.03*
	(0.01)
Tax revenue	0.00
	(0.00)
Electricity losses	-0.00*
	(0.00)
Mobile subscriptions	-0.00
	(0.00)
Constant	2.23***
	(0.28)
Observations	4,891
Adjusted R-squared	0.23
Region Dummies	Jointly singificant
Year Dummies	Jointly significant

Robust standard errors clustered at country-level reported in parentheses.
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

TABLE 8. FOREIGN OWNERSHIP, BREAK-DOWN BY REGION

VARIABLES	(1) East Asia & Pacific	(2) Europe & Central Asia	(3) Latin America & the Caribbean	(4) Middle East & North Africa	(5) South Asia	(6) Sub-Saharan Africa
Corruption Score	-0.41**	-0.19*	-0.07	-0.17	0.10	0.09
	(0.20)	(0.10)	(0.05)	(0.20)	(0.12)	(0.10)
MDB support	0.23***	0.19***	0.02	0.04	0.10*	0.06
	(0.07)	(0.06)	(0.04)	(0.06)	(0.06)	(0.11)
Population (ln)	-0.01	-0.16***	-0.11***	-0.12	-0.04***	-0.08
	(0.03)	(0.04)	(0.02)	(0.08)	(0.02)	(0.06)
GDP per capita	-0.00	0.00	-0.00	0.00**	-0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	-0.01	-0.00	0.01	-0.03*	-0.01	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Inflation (ln)	-0.21***	0.04	-0.01	0.22**	-0.04	-0.03
	(0.07)	(0.04)	(0.02)	(0.10)	(0.05)	(0.07)
Tax revenue	-0.01	-0.02*	0.00	0.00	-0.05***	0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Electricity losses	0.01	-0.02***	-0.02***	-0.05*	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)
Mobile subsc.	0.00	-0.00*	-0.00	-0.00*	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	1.20	3.89***	3.06***	2.83*	1.61***	2.09**
	(0.75)	(0.51)	(0.30)	(1.39)	(0.44)	(0.99)
Observations	785	283	1,126	34	883	139
Adjusted R-squared	0.17	0.25	0.21	0.55	0.07	0.09
Year Dummies	YES	NO	NO	NO	NO	NO
Sector Dummies	YES	NO	NO	NO	YES	NO

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

TABLE 9. FOREIGN OWNERSHIP, BREAK-DOWN BY SECTOR

VARIABLES	(1) Energy	(2) ICT	(3) Transport	(4) Water & Sewerage
Corruption Score	0.06	1.56***	-0.02	-0.23**
	(0.08)	(0.13)	(0.07)	(0.09)
MDB support	0.06	0.51***	0.13	0.19*
	(0.07)	(0.15)	(0.08)	(0.10)
Population (ln)	-0.05***	0.37***	-0.09***	-0.12***
	(0.01)	(0.07)	(0.03)	(0.04)
GDP per capita	-0.00*	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	0.01	0.16***	0.03***	0.01**
	(0.01)	(0.03)	(0.01)	(0.01)
Inflation (ln)	-0.02	-0.68***	0.03	0.03
	(0.02)	(0.08)	(0.03)	(0.04)
Tax revenue	-0.02***	0.00	-0.00	0.02**
	(0.01)	(0.00)	(0.01)	(0.01)
Electricity losses	-0.01	-0.03**	-0.01	-0.02***
	(0.00)	(0.01)	(0.01)	(0.01)
Mobile subscriptions	0.00	-0.01***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	1.98***	-4.78***	2.20***	3.00***
	(0.33)	(1.40)	(0.46)	(0.80)
Observations	1,845	132	831	442
Adjusted R-squared	0.19	0.59	0.27	0.28
Region Dummies	YES	YES	YES	NO
Year Dummies	YES	NO	YES	NO

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors clustered at country-level reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

I.C. SUPPORT FROM DONOR AGENCIES AND MDBS, TABLES 9-11

TABLE 10. MDB SUPPORT, WHOLE SAMPLE

VARIABLES	(1) Donor support
Corruption Score	-0.03
	(0.04)
Population (ln)	-0.05***
	(0.01)
GDP per capita	-0.00*
	(0.00)
GDP growth	-0.01***
	(0.00)
Inflation (ln)	0.01
	(0.02)
Tax revenue	-0.00
	(0.00)
Electricity losses	-0.00
	(0.00)
Mobile subscriptions	-0.00
	(0.00)
Constant	1.24***
	(0.24)
Observations	3,662
Adjusted R-squared	0.10
Year Dummies	Jointly significant
Sector Dummies	Jointly significant

Robust standard errors clustered at country level reported in parentheses
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

TABLE 11. MDB SUPPORT, BREAK-DOWN BY REGION

	(1) East Asia & Pacific	(2) Europe & Central Asia	(3) Latin America & the Caribbean	(4) Middle East & North Africa	(5) South Asia	(6) Sub-Saharan Africa
Corruption Score	-0.33***	-0.27*	0.05	-0.20	-0.39***	0.04
	(0.11)	(0.15)	(0.05)	(0.40)	(0.11)	(0.13)
Population (ln)	-0.03	-0.10**	-0.07***	-0.42**	-0.01	-0.05
	(0.03)	(0.05)	(0.01)	(0.20)	(0.02)	(0.05)
GDP per capita	0.00	0.00*	-0.00***	0.00	0.00	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	-0.01	-0.03**	-0.00	0.03	0.01	-0.02***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)
Inflation (ln)	0.05	-0.01	-0.00	-0.02	-0.14***	-0.18***
	(0.05)	(0.05)	(0.01)	(0.10)	(0.05)	(0.07)
Tax revenue	0.00	0.02	-0.01***	-0.00	0.01	0.01
	(0.01)	(0.02)	(0.00)	(0.01)	(0.02)	(0.01)
Electricity losses	-0.01**	0.00	-0.00	-0.01	0.02***	0.00
	(0.01)	(0.01)	(0.00)	(0.04)	(0.01)	(0.00)
Mobile subscr.	0.00	-0.00**	0.00	0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.54	1.59**	1.83***	6.96*	0.04	1.79*
	(0.57)	(0.62)	(0.23)	(3.50)	(0.45)	(0.90)
Observations	860	316	1,352	36	954	144
Adjusted R-squared	0.19	0.22	0.14	0.40	0.15	0.29
Year Dummies	YES	YES	YES	NO	YES	NO
Sector Dummies	NO	YES	YES	NO	YES	NO

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

TABLE 12. MDB SUPPORT, BREAK-DOWN BY SECTOR

VARIABLES	(1) Energy	(2) ICT	(3) Transport	(4) Water & Sewerage
Corruption Score	0.04	-0.19*	-0.09*	0.07
	(0.04)	(0.10)	(0.05)	(0.09)
Population (ln)	-0.04***	0.01	-0.06***	-0.06***
	(0.01)	(0.03)	(0.01)	(0.02)
GDP per capita	-0.00***	0.00**	-0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
GDP growth	-0.01*	0.00	-0.01*	-0.03***
	(0.01)	(0.02)	(0.00)	(0.01)
Inflation (ln)	-0.01	-0.06	-0.01	0.06**
	(0.03)	(0.06)	(0.02)	(0.03)
Tax revenue	0.00	0.00	0.01	-0.02***
	(0.00)	(0.00)	(0.01)	(0.01)
Electricity losses	-0.00	0.04***	-0.00	-0.01
	(0.00)	(0.01)	(0.00)	(0.01)
Mobile subscriptions	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Constant	1.05***	-0.70	1.20***	2.01***
	(0.27)	(0.49)	(0.35)	(0.43)
Observations	2,076	149	958	479
Adjusted R-squared	0.07	0.27	0.14	0.55
Year Dummies	YES	NO	NO	YES
Region Dummies	NO	NO	NO	YES

Note: year and sector dummies only included when they achieve improved model fit, joint significance tested by Wald test. Robust standard errors reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

TABLE 13. SENSITIVITY ANALYSIS OF MAIN ESTIMATION MODEL

		Private ownership		Foreign ownership		MDB support	
	Specification:	coef.	(se)	coef.	(se)	coef.	(se)
(1)	Baseline regression	2.53*	(1.37)	0.02	(0.05)	-0.03	(0.04)
(2)	Without GDP per capita variable	2.21*	(1.20)	-0.08	(0.06)	-0.07**	(0.03)
(3)	Without mobile subscription variable	2.50*	(1.42)	0.02	(0.05)	-0.03	(0.04)
(4)	Controlling for PPP type	2.48*	(1.36)	0.02	(0.05)	0.00	(0.00)
(5)	Sample of PPPs and Non-PPPs	2.57**	(0.04)	-0.05	(0.04)	-0.01	(0.03)

Robust standard errors clustered at country level reported in parentheses
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

APPENDIX II. DESCRIPTIVE STATISTICS

TABLE 14. PAIRWISE CORRELATIONS AMONG WORLD GOVERNANCE INDICATORS

	corruption score	government effectiveness	political stabilty	regulatory quality	rule of law
corruption score	1.00				
government effectiveness	0.72	1.00			
political stabilty	0.57	0.42	1.00		
regulatory quality	0.78	0.69	0.50	1.00	
rule of law	0.78	0.75	0.38	0.59	1.00

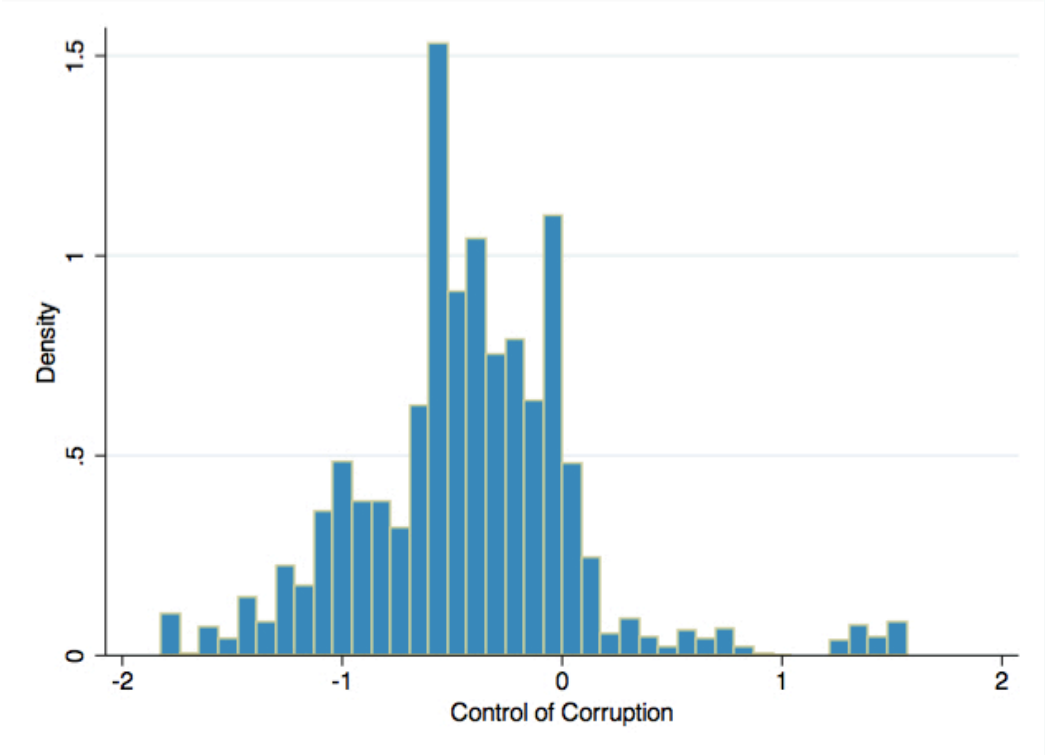

FIGURE 3. DISTRIBUTION OF CONTROL OF CORRUPTION SCORE AMONG PPPS IN THE ICT SECTOR

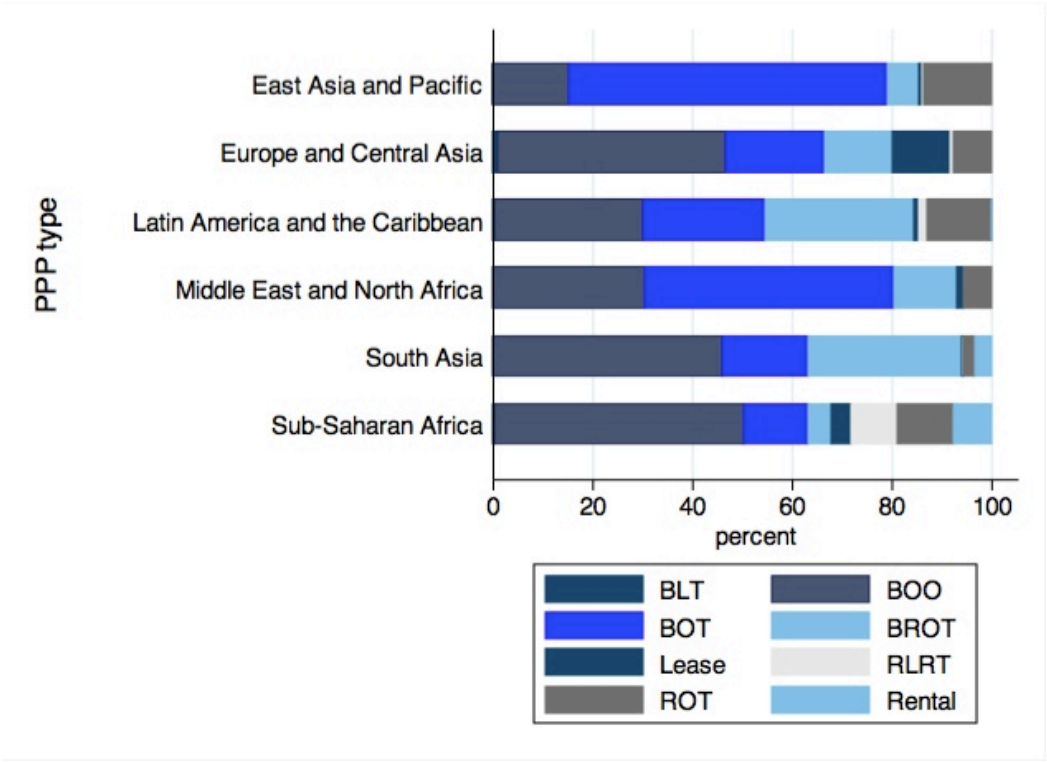

FIGURE 4. PPP TYPE BY REGION

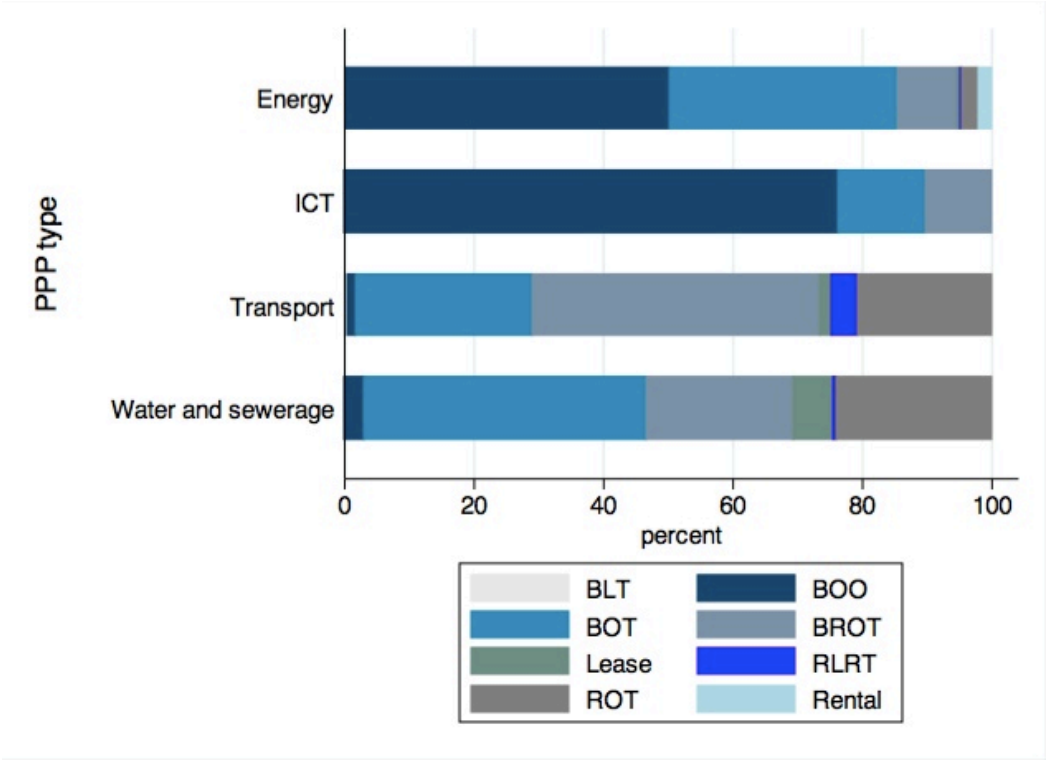

FIGURE 5. PPP TYPE BY SECTOR

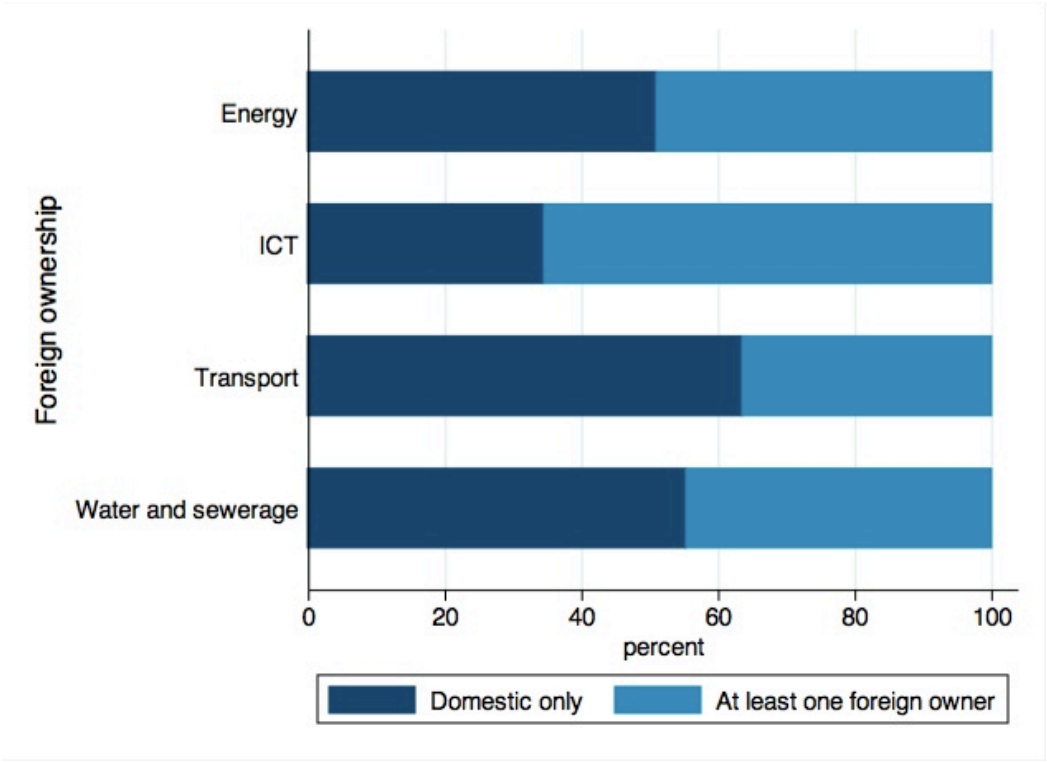

FIGURE 6. FOREIGN PROJECT OWNERSHIP BY SECTOR

TABLE 15. SUMMARY STATISTICS OF VARIABLES USED IN REGRESSION MODELS

Variable	N	mean	sd	min	max
Private ownership share	5099	92.7	17.1	5	100
Foreign ownership	4428	0.46	0.49	0	1
Donor support	5221	0.1	0.3	0	1
Corruption score	5221	-0.3	0.4	-1.8	1.6
Population (1000s)	5221	504 000	562 000	98	1 370 000
GDP per capita	5219	9469	5131	455	26 807
GDP growth	5220	5.5	3.9	-14.8	26.8
Inflation	5198	6.8	7.1	-10.1	98.2
Tax revenue (% of GDP)	4040	13.2	4.7	0.24	90.0
Electricity losses	5478	14.5	6.7	1.50	90.8
Mobile subscriptions (per 100 people)	5209	56.3	45.3	0	180.7