

Infrastructure PPP investments in Emerging Markets

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Abstract

Infrastructure investments are essential to achieve economic prosperity, promoting growth and enhancing well-being. Recently, public entities started to link project finance with private sector involvement, what was made mainly through Public Private Partnerships (PPPs). The private sector participation is critical, bringing more funds, expertise and efficiency to the development of projects in several essential areas (energy, transport, water and telecommunications), particularly to emerging countries. Nevertheless, different country risk factors affect PPPs arrangements and the private investment intensity. The empirical analysis performed show that the market size and purchasing power are critical determinants of infrastructure flows. The institutional quality matters mostly for the decision to invest in emerging countries.

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1 Introduction and background

Much more investment will be needed in developing countries, to achieve the Millennium Development Goals (MDGs), specifically, the goal of reducing poverty.¹ In this respect, the private sector investment has a fundamental role to play, inducing economic growth and poverty reduction. But in order to foster private participation, emerging countries should pursue macro-economic stability and improve their institutional framework, namely, strengthening procedures for contract enforcement and dispute settlement and developing a coherent set of policies for trade, tax and competition.

Additionally, the private participation in infrastructure projects may be encouraged with Public Private Partnerships (PPPs). These partnerships appear to emerging countries as a key instrument to promote economic growth and enhancing well-being. Nevertheless, the implementation of PPPs in these countries is a challenging task. For instance, according to Pessoa (2006), problems may arise with the lack of an appropriate regulatory framework, with underdeveloped capital markets or with non-competitive industries, that are dependent from investments made by a few of international and large companies.

Another aspect that is worth mention is that usually Multilateral Development Banks (MDBs) participate in these infrastructure PPPs. Besides their primary lending functions, they also act like an “anchor”. Private investors see this MDB participation as providing a protective “umbrella”, therefore, as a mechanism of risk reduction and of credit enhancement.

It should be noted that infrastructure projects face particular challenges and risks, namely, the existence of natural monopolies that exclude competition, the assets nature (capital-intensive, immobile and not easily redeployed for other uses), outputs are usually non-tradable, existence of pricing problems related to political sensitiveness of the services to be provided and the long-term tenor that increase the uncertainty surrounding the projects.

All these factors contribute to enhance the riskier nature of infrastructure investments² that combining with emerging countries risks, lead to the conclusion, at first glance, that such ventures were not appealing for private investors. But the reality shows another

¹The MDGs were established in 2000, when leaders of countries from the entire world committed to devote every effort in order to achieve eight development goals by 2015. They include reducing extreme poverty and hunger, reducing child mortality, improving maternal health, achieve universal primary education, fighting disease epidemics and developing a global partnership for development.

²See for instance, Grimsey and Lewis (2002), for more details.

picture. The 1990's, surprisingly, face a boom in Foreign Direct Investment (FDI) to infrastructure projects in developing countries. Some explanations to this exponential growth presented by Ramamurti and Doh (2004) are the end of natural monopolies making regulation less needed, the prospect of quick profits for first-movers and the use of Project Finance to reduce the risks. Another aspect mentioned is the adoption of favorable legal measures and the end of outright expropriations, creating a new climate for FDI in emerging countries.

As an additional illustration of the private sector interest in such projects, Straub (2008) points out the case of seven Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Mexico and Peru), where private investment represented 16,4% of total investment in infrastructure in the period 1980-85, and if we consider the period of 1996-2001, the percentage increase to 62,9%.

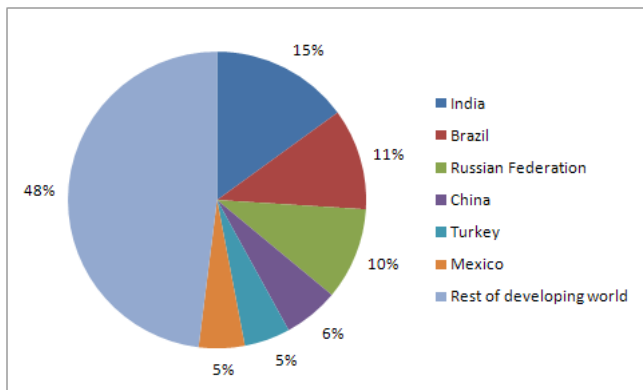
According to the PPI Database³, the peak of the private infrastructure boom was 1997, thereafter a number of factors led to a reduction in the number and amount of projects, namely, the financial crisis of 1997-98, the slowdown in economic activity, the bursting of the dot-com and telecommunications bubbles and also, the fact that privatization was a one-time phenomenon. More recently and after a downward trend from 1998 to 2003, private investment in infrastructure projects increase from 2004 to 2008, although in this last year the number of projects face a small decline.

Although outside of the time span of the present empirical study, it should be mentioned that the environment for PPP projects has been impacted by the recent financial crisis, particularly through a selectivity effect, concerning the type of projects and countries where to invest, and through more difficult and stringent financial conditions. As a result, some planned projects are still being delayed, restructured, or, to a lesser extent, canceled.

Albeit this environment, global investment commitments to new PPPs projects in emerging countries exhibit a growth trend. It should be emphasized that these investment levels are attributed to just a few economies. The so-called BRIC countries of Brazil, Russia, India and China, plus Mexico and Turkey, all emerging economies, have concentrated investments over the last years, reaching about half of private infrastructure flows. As illustrated in Figure 1, the investment volume in 2008 in these countries reach near 60%.

³The World Bank's Private Participation in Infrastructure Database, available at <http://ppi.worldbank.org>.

Figure 1: Geographical concentration of investments to infrastructure projects in 2008



Source: World Bank and PPIAF

Izaguirre (2010) explains that one of the consequences of the recent financial crisis, is that the number of projects has shrunk although overall financial flows have remained relatively steady, but investments were concentrated in these emerging countries. Moreover, if the BRIC countries, plus Turkey, were excluded, investments would have fallen by 32% in 2009, comparing to 2008.

Particularly in a context of a worldwide financial crisis, these topics are gaining relevance and are of major relevance to all engaged in the PPP markets, moreover when infrastructure investments are seen as an anti-cyclical measure to stimulate economies.

The purpose of this work is to examine how different country’ risks affect infrastructure investments in emerging countries. It is well accepted that political, legal, social, economic and financial risks assume particular relevance in emerging countries, what may influence investments flows. To explore this issue, we perform an empirical analysis of the cross-country determinants of investments in infrastructure PPPs, using emerging countries data, from 1990 to 2007.

While there have been some studies examining the determinants of FDI to developing countries (see for instance, Neumayer and Spess (2005), Singh and Jun (1995), Rose-Ackerman and Tobin (2005)) or of MDBs flows (Neumayer (2003)), few empirical studies address the particular topic of infrastructure projects.

To the best of our knowledge, the first empirical attempts are provided by Banerjee et al. (2006) and Hammami et al. (2006). Both studies examine the effects of several institutional variables on infrastructure investments.

Using these studies as a starting point, we extend their work in several directions. First, we use only projects that share the main characteristics of PPPs and not, the full database available. Projects that are management and lease contracts and full privatizations are therefore excluded.⁴ Second, we use more recent data (1990 to 2007), new explanatory variables and new methodological approaches.

Our main contribution rest on testing simultaneously a vast variety of variables, proxies for the different risk dimensions of a country, in an attempt to provide a more complete “picture” of the drivers of infrastructure flows to emerging markets. Such aggregate analysis is relevant because different risk dimensions interact with each other. If we focus on a particular dimension, the results will be probably misleading and inaccurate.

In the following section, we present the hypotheses to be tested and proxies used as measures of different risk attributes. In Section 3, we discuss the methodology. Section 4 is devoted to the data and in Section 5, we discuss the results. Section 6 concludes the paper.

2 Conceptual framework and hypothesis development

A fundamental prerequisite for PPPs is private sector involvement. But particularly to emerging countries, what factors determine the level of such investments? And which risk is the more influential?

In the empirical analysis that follows, we investigate the question of how the political, legal, social, economic and financial environment in host countries influence risk perceptions and hence, the participation of the private sector in infrastructure PPPs.

Political Risk

We expect to find a clear relationship between private investments in PPPs arrangements and the political risk of a country. More precisely, private sector will prefer to invest in politically stable countries - the higher the political risk of a country, the lower the degree of private sector involvement.

⁴This aspect was also emphasized by Pessoa (2008), mentioning that not all forms of private sector involvement in public provision are PPPs.

Hypothesis 1 - Investment in infrastructure PPPs is negatively related to the level of political risk.

As proxies for the level of political risk, that may affect infrastructure investments we use measures of the democratic regime (related to the access to government offices: elections and their competitiveness) and of democratic governance, meaning the process whereby government make and implement legally binding decisions, all drawn from Beck et al. (2000). Political risk is higher for countries where governments do not exhibit political checks and balances⁵ or that restrains electoral competition.

- Index of Political Competitiveness, a variable that characterize the competitiveness of elections. It measures the number of parties competing in elections and range from 1 (low) to 7 (high competitiveness). More political competitiveness will lead to a reduction of the political risk of a country, with more transparent and accountable governments, which are pre-requisites for PPPs to be successful.
- The quality of governance affects a country's ability to benefit from international capital flows. A key element in the description of any political system is the number of decision makers whose agreement is necessary before policies can be changed and it is generally accepted that countries with multiple decision makers may offer greater protection to investors from arbitrary government actions - to measure that we will use the variable *checks* that is a measure of government accountability. As an additional measure of the relationship of the executive and legislative branches we collect information on a country's political system - countries are classified as direct presidential (0), strong president elected by assembly (1) or parliamentary(2).

Legal Risk

A PPP is, in essence, a bundle of contracts - financial and non-financial contracts. Typically these contracts are naturally incomplete and prone to opportunistic behaviour. Therefore, private investors must ensure they have legal rights and that the local law enforcement is efficient. It is expected that countries with strong legal protection will be able to raise more long-term private capital to develop infrastructure projects, thus:

⁵Checks and Balances is a system of distribution of powers among the executive, legislative and judicial branches of government, used to balance the powers and prevent one branch to obtain power in excess.

Hypothesis 2 - Investment in infrastructure PPPs is negatively associated with the level of legal risk.

As proxies for the level of legal development, we use the following, also used in previous studies (see for instance Esty and Megginson (2003), Gatti et al. (2008) or Subramanian et al. (2008)):

- Creditor rights index - We measure the creditor rights in the country in which the project is located based on LaPorta et al. (1998) index and expanded by Djankov et al. (2007). The authors show that legal creditor rights are an important determinant of private credit development. The creditor rights index varies between 0 (poor creditor rights) and 4 (strong creditor rights).
- Contract enforcement days - The number of calendar days to resolve a payment dispute through courts, also from Djankov et al. (2007). LaPorta et al. (1998) emphasizes the importance of legal enforcement as well the quality of the laws on the books (measured by the creditor rights index). Both measures of the quality of the legal system matters and provide a complementary analysis (laws on the books and its applicability).
- Legal origin - A dummy variable that identifies a country's legal origin. This variable was first proposed by LaPorta et al. (1998) with four possibilities - English, French, German and Nordic - and expanded by Djankov et al. (2007), adding a fifth category - Socialist (transition).⁶ A link between the origin of a country's legal tradition and the operation of its financial system was first established by LaPorta et al. (1998). The authors have found that countries with common law legal institutions provide better protection to creditors than do countries with civil law institutions. More recently, reinforcing this idea, Beck et al. (2004) empirically demonstrate that countries with civil law, provide creditors with weaker legal rights and as a consequence, firms face higher obstacles in contracting for external finance than

⁶The English legal origin includes the common law of England, and the former colonies, U.S., Australia and Canada. The French legal origin includes the civil law of France and also, countries Napoleon conquered (including Portugal and Spain) and former colonies. The German legal origin includes the laws of the Germanic countries in Central Europe, but also countries in East Asia. The Nordic legal origin - laws of the four Scandinavian countries. And the Socialist legal origin - for the new countries that emerged from the breakup of the Soviet Union, plus Mongolia. The Socialist category does not apply to countries that have gone back to their pre-communist legal systems, where they were assigned to their pre-war legal systems.

firms in other countries.

Economic and Financial Risks

The macroeconomic environment can also affect project risks and the participation of private sector in PPPs, thus:

Hypothesis 3 - The private sector investment in a PPP is lower for countries with higher economic and financial risks.

In general, economic and financial risks assessments improve for countries with larger economic size (GDP), lower inflation, low external debt and more developed financial markets. Each determinant of economic and financial development derives from the theoretical literature, for instance, Cantor and Packer (1996), Eichengreen and Mody (2000) or Altunbas and Gadanecz (2003), found that the following macroeconomic fundamentals are important as explanatory variables of the capital flows to emerging markets:

- Real GDP per capita and economic growth, used to measure the evolution of the country's wealth.
- Inflation rate and international reserves. As Cantor and Packer (1996) argue, a high rate of inflation points to structural problems in the government's finances and is a focus of instability. Therefore a controlled inflation and the existence of significant international reserves are indicators of a country macroeconomic stability.
- External debt and general government balance. It is expected that governments with large deficits and high debt burden will be more interested in PPPs to solve infrastructure problems. But at the same time, these two variables are a focus of economic instability increasing the risk level of a country. A higher debt burden imply a higher risk of default and the weight of the burden increases as a country's external debt rises relative to its foreign currency earnings (exports of goods and services). In addition, governments with large and structural deficits increase foreign indebtedness, which may become unsustainable over time.
- Fuel exports as a measure of a country's natural resources. As mentioned in Rose-Ackerman and Tobin (2005), the existence of natural resources is expected to attract

much more investment regardless of other relevant factors, and this is also true for infrastructure projects.

- Population - An additional factor that should be accounted for, is the dimension of the market. Concerning PPPs, it is an important feature of the attractiveness of a project to the private sector, specifically, if projects are to be financed also with user charges. Therefore, PPPs tend to be more common in larger markets.

Linking infrastructure development more effectively with private finance markets would help to leverage and mobilize more capital. By contrast, underdeveloped financial markets makes the private participation on infrastructure projects relatively more difficult, particularly, as reported by de Mästle and Izaguirre (2008), when domestic investors are becoming more prominent as a major source of funds to infrastructure projects. There is no single measure of financial development, but we use the following, mostly commonly used and drawn from Beck et al. (2009):⁷

- Liquid liabilities of the financial system to GDP - is a traditional measure of financial depth and measure the size of the financial intermediary sector relative the size of the economy. This indicator shows the degree to which the financial sector mobilizes domestic savings - larger depth should reflect greater financial development.
- Financial claims on the private sector by deposit money banks and other financial institutions divided by gross domestic product (GDP) - countries with higher private credit to GDP, usually have higher rates of economic growth;
- And finally, we will use the ratio of deposit money bank assets to the sum of deposit money and central bank assets. This is a measure of the relative importance of commercial *vs* central banks. It has been shown that countries where commercial banks have a higher role in financial intermediation (rather than central banks) also face a higher degree of financial development.

Social Risks

As a final dimension to be assessed in its importance for PPPs projects we include measures of human development that we roughly call “social factors”. Concerning the level of private sector investments, the effect of such “social” factors, if any, is not so

⁷See, for instance, Esty (2003).

clear, as for instance, if we try to explain MDBs participation in infrastructure projects, given their “development” mission. Nevertheless, recent empirical studies have showed that civil freedom may encourage foreign direct investment (see, for instance, Harms and Ursprung (2002)).

Hypothesis 4 - Investment in infrastructure PPPs is higher for countries with higher respect for human rights and civil liberties.

Besides the traditional measure of per capita income, as a proxy of well-being and economic development (also included in our study), we will use two proxies for human rights and social development, drawn from the “Cingranelli-Richards (CIRI) Human Rights Dataset” and also a measure of civil liberties, from the survey “Freedom in the world”:

- Empowerment Rights Index - This is an additive index constructed from the Freedom of Movement, Freedom of Speech, Workers’ Rights, Political Participation and Freedom of Religion indicators. It ranges from 0 (no government respect for these five rights) to 10 (full government respect for these five rights).
- Physical Integrity Rights Index - This is an additive index constructed from the Torture, Extrajudicial Killing, Political Imprisonment and Disappearance indicators. It ranges from 0 (no government respect for these four rights) to 8 (full government respect for these four rights).
- Civil liberties are measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.

In addition, it was our initial purpose to test whether regional differences have an effect on infrastructure investments through PPPs. To accomplish that dummies for regions were considered - East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa (the reference sector), South Asia and Sub-Saharan Africa. Nevertheless, given the high levels of collinearity, and in order to improve the results accuracy, the final regressions of Section 5 do not include regional dummies.⁸

⁸It was not surprising that regional dummies face high levels of collinearity with other measures of a country’s economic, financial and institutional development, because besides the geographical dimension also to classify countries in one of these regions, the World Bank uses as the main criterion the gross national income (GNI) per capita

Finally, we include time dummies in all regressions to capture potential time-specific effects that may influence the intensity of infrastructure projects, expressed in their real dollar value.

3 Methodology

The dependent variable is the *real dollar value of the investments* in infrastructure projects (per country and year), therefore the response variable is nonnegative, partly continuous and assume the value zero with positive probability.⁹ In this situation, is appropriate to use “corner solution models”, if we consider that the zero outcome is the result of a maximization process, or otherwise, to use “two-part models” or “sample selection models”, if we assume that the decision to invest is a completely different process from the mechanism explaining the levels of investment. A critical factor influencing the choice of the model is the interpretation placed upon the observed zeros.¹⁰ The estimation method is, in general, Maximum Likelihood Estimation (MLE).

Tobit is usually the starting point. The standard Tobit model has a censoring value at zero, and the latent variable is linear in regressors with an additive error term, normally distributed and homoscedastic. Thus,

$$y^* = \mathbf{x}'\beta + \epsilon, \quad \text{where} \quad \epsilon|\mathbf{x} \sim \text{Normal}(0, \sigma^2) \quad (1)$$

The observed y is defined,

$$y = \begin{cases} y^* & \text{if } y^* > 0 \\ - & \text{if } y^* \leq 0 \end{cases} \quad (2)$$

Nevertheless, because the Tobit model relies on strong assumptions of normality and homoscedasticity of the error term, better results are often provided by more general

⁹In addition, we have tested as dependent variable the infrastructure investment as a share of GDP, but this percentage is very small for all countries, showing very little variation.

¹⁰Using OLS is not a good option, because similarly to the LPM for binary responses, we may get negative predicted values for y .

models, namely, Two-Part models or using Heckman sample selection models. There are many different situations where the problem at study may be seen as a two-part decision, of first to engage in an activity and then deciding the level of the activity. If we expect independence between these two parts, a Two-Part model is the better choice. Alternatively, if the same factors that influence one part are expected to influence the other, with decisions intertwined, then the suitable model is the bivariate selection model.

A Two-Part model is appealing because it is possible to explain y with two different mechanisms: a Probit or a Logit model to explain the probability of $y = 0$ versus $y > 0$ and a second process, may explain “how much” y using only the positive outcomes. As such, we have a model that specifies the censoring mechanism and a model for the outcome conditional on the outcome being observed.

If we define a binary indicator variable $d = 1$ for *participants* in the activity under study, and $d = 0$ for *nonparticipants*, the Two-Part model is given by,

$$f(y|\mathbf{x}) = \begin{cases} Pr[d = 0|\mathbf{x}] & \text{if } y = 0 \\ Pr[d = 1|\mathbf{x}]f(y|d = 1, \mathbf{x}) & \text{if } y > 0 \end{cases} \quad (3)$$

for some choice of density $f(\cdot)$, although proper choices of $f(\cdot)$ should ensure positive values for the *participants*, for instance, the log-normal.

Usually, the same regressors appear in both parts of the model and concerning the estimation, the two parts are assumed to be independent: first, with all the observations, a binary choice model is estimated; second, using only observations with $y > 0$, the parameters of the density $f(y|d = 1, \mathbf{x})$ are estimated.

Concerning the bivariate sample selection model (type 2 Tobit or just, Heckman sample selection model) a joint distribution for the censoring mechanism and outcome is considered. In this specification, a censoring latent variable differs from the latent variable generating the outcome of interest. The model includes a *participation equation*,

$$y_1 = \begin{cases} 1 & \text{if } y_1^* > 0 \\ 0 & \text{if } y_1^* \leq 0 \end{cases} \quad (4)$$

and a resultant *outcome equation*, that

$$y_2 = \begin{cases} y_2^* & \text{if } y_1^* > 0 \\ - & \text{if } y_1^* \leq 0 \end{cases} \quad (5)$$

In this formulation, y_2 is observed when $y_1^* > 0$, and no particular value of y_2 is necessarily observed when $y_1^* \leq 0$. For the latent variables, we have linear models with additive errors, that should be uncorrelated, to ensure consistency in the estimation of β_2 .

$$\begin{aligned} y_1^* &= \mathbf{x}'_1 \beta_1 + \epsilon_1 \\ y_2^* &= \mathbf{x}'_2 \beta_2 + \epsilon_2 \end{aligned} \quad (6)$$

With the additional assumption that the correlated errors are joint normally distributed and homoscedastic, estimation by ML is straightforward. But this is still a strong assumption and an alternative estimation procedure that relies on weaker distributional assumptions is the Heckman Two-Step procedure or Heckit estimator. Using the positive values of y_2 , the following model is estimated by OLS,

$$y_{2i} = \mathbf{x}'_{2i} \beta_2 + \sigma_{12} \lambda(\mathbf{x}'_{1i} \hat{\beta}_1) + v_i \quad (7)$$

where v is an error term, $\hat{\beta}_1$ is obtained by first-step probit regression of y_1 on \mathbf{x}'_1 and $\lambda(\mathbf{x}'_{1i} \hat{\beta}_1)$ is the estimated inverse Mills ratio. Testing for correlation between the errors is to test if $\sigma_{12} = 0$ and in the presence of correlation, sample selection correction is needed.

This is a more general framework, because the error terms do not need to follow a normal distribution. The main advantages of this model include its simplicity, the wider applicability and the fact that requires weaker distributional assumptions than using MLE.

4 Data

In this study, the dependent variable is from the Private Participation in Infrastructure (PPI) Project Database (World Bank), using projects that reached financial closure from 1990 - 2007. We collect data on 72 different countries, also classified in six regions - East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia and Sub-Saharan Africa. According to the database, infrastructure projects are classified into four broad categories of private participation: management and lease contracts, concessions, greenfield projects and divestitures. For the purpose of this work, only concessions, greenfield projects and partial divestitures will be used - types of private participation that could be considered PPPs, sharing the key characteristics of long term nature of the relationship, distribution of risks between the public and the private partner, bundling of different project phases and private finance.¹¹ The investment amounts represent the total investment commitments entered into by the project entity at the beginning of the project (at contract signature or financial closure).

For the explanatory variables, the first set of data pertains to the political systems, where all the indicators are drawn from Beck et al. (2000). The second set of data includes proxies for the quality and enforceability of the legal system and are computed for 129 countries by Djankov et al. (2007) (expanding the former data set of LaPorta et al. (1998) only available for 49 countries). Concerning macroeconomic data, all the variables are available from the World Bank's World Development Indicators. Proxies for a country's level of financial development are taken from Beck et al. (2009), available in the World Bank's Financial Development Database, and finally, proxies to measure the degree of social development of a country and respect for human rights are from "The Cingranelli-Richards (CIRI) Human Rights Dataset"¹² and from the survey "Freedom in the world".¹³

It should be noted that the explanatory variables capture several country attributes that are expected to have a significant effect on infrastructure investment through PPPs. The variables were chosen to minimize collinearity problems and to maximize the number of nonmissing observations. It should be noted that several other variables were tested,

¹¹Projects included in the database do not have to be entirely privately owned, financed or operated. Some include public participation as well.

¹²Available on-line at <http://ciri.binghamton.edu/index.asp>

¹³Available on-line at <http://www.freedomhouse.org/template.cfm?page=439>.

namely, *corruption* in the political dimension and *religion* in the social dimension, but were excluded due to problems on data availability. Moreover, because it is expected correlation among the observations within each country, clustered robust standard errors will be used when possible. Table 4 gives the summary statistics and includes more detailed information on the variables (see the Data Appendix).

5 Results and discussion

As a starting point, Table 1 shows some descriptive statistics for the dependent variable, *real dollar value of investments*, expressed in logs and levels.

Table 1: Descriptive statistics for PPPs investments and MDAs financial support

Dependent variable (*)	Number of observations	Mean	Std. Dev.	Skewness	kurtosis	Min	Max
Investment	732	37838.81	577121	18.44	375.14	0	12900000
Investment (y>0)	679	40792.35	599153	17.76	347.86	0.15	12900000
ln (investment)	679	4.95	2.24	0.41	5.01	-1.88	16.38

legend: (*) Expressed in real terms

The analysis of the previous descriptive statistics lead to the following conclusions: investment values are zero for 53 observations (7.24% of the sample); the positive values are very right-skewed and with the logarithmic transformation, skewness is reduced from 17.76 to 0.41 and the kurtosis is now 5.01, more close to the normal value of 3.

Table 2 presents the results obtained through the regression of the proxies for the different risk dimensions, on the real dollar value of investments in PPPs, expressed in logs. Different specifications were used: Tobit, a Two-Part model and Heckman selection model (MLE).

Table 2: Determinants of investments in PPPs

Dependent variable: Real Dollar value of investments (ln)	Tobit	Two-Part Model		Heckman MLE	
	(1)	y>0 (2)	dy (3)	y>0 (4)	dy (5)
Political system	-0.278** (-2.22)	-0.068 (-0.57)	-0.359** (-1.96)	-0.073 (-0.53)	-0.366 (-1.50)
Index Political Competitiveness	0.296*** (3.03)	0.158 (1.53)	0.193* (1.81)	0.161 (1.53)	0.199 (1.09)
Checks (number)	-0.040 (-0.82)	-0.034 (-0.85)	-0.054 (-0.72)	-0.034 (-0.89)	-0.056 (-0.58)

... table 2 continued

Dependent variable: Real Dollar value of investments (ln)	Tobit	Two-Part Model		Heckman MLE	
	(1)	y>0 (2)	dy (3)	y>0 (4)	dy (5)
Creditor rights	0.007 (0.08)	-0.042 (-0.62)	0.076 (0.69)	-0.041 (-0.61)	0.077 (0.68)
Contract enforcement days (ln)	-0.255 (-1.49)	-0.245 (-1.59)	-0.026 (-0.14)	-0.245 (-1.63)	-0.022 (-0.11)
English legal origin dummy	0.204 (0.84)	-0.132 (-0.61)	0.673* (1.76)	-0.124 (-0.46)	0.682 (1.62)
German legal origin dummy	0.520 (1.41)	0.380 (1.01)	0.288 (0.55)	0.382 (1.03)	0.287 (0.55)
Socialist legal origin dummy	0.506 (1.62)	0.785* (1.76)	0.104 (0.35)	0.782* (1.77)	0.115 (0.26)
Physical Integrity Index	-0.022 (-0.40)	-0.027 (-0.55)	0.010 (0.16)	-0.027 (-0.55)	0.011 (0.16)
Empowerment Index	0.062 (1.37)	0.085* (1.92)	-0.001 (-0.02)	0.084* (1.89)	-0.002 (-0.03)
Civil liberties	0.203* (1.85)	0.166 (1.62)	0.103 (0.70)	0.166* (1.68)	0.100 (0.61)
Deposit money bank assets	0.552 (0.95)	0.493 (0.95)	0.274 (0.37)	0.495 (0.96)	0.283 (0.37)
Liquid liabilities to GDP	0.774 (1.25)	1.109* (1.99)	-0.654 (-0.61)	1.105** (2.05)	-0.659 (-0.61)
Private credit to GDP	0.635 (1.22)	0.493 (1.13)	0.085 (0.08)	0.493 (1.17)	0.080 (0.08)
General government balance to GDP	-0.113*** (-6.61)	-0.083*** (-5.80)	-0.056** (-2.18)	-0.083*** (-4.63)	-0.056** (-2.06)
External debt to total exports	-0.001 (-0.19)	-0.001 (-0.20)	0.010 (1.25)	-0.001 (-0.20)	0.010 (1.17)
Economic growth	0.016 (0.71)	-0.001 (-0.03)	0.018 (0.76)	-0.000 (-0.02)	0.018 (0.71)
Fuel exports	0.007 (1.44)	0.003 (0.85)	0.005 (0.62)	0.003 (0.82)	0.005 (0.63)
Real GDP per capita (ln)	1.368*** (11.72)	1.093*** (7.71)	0.658*** (3.42)	1.100*** (6.55)	0.657*** (3.39)
Inflation rate	-0.001* (-1.89)	-0.000* (-1.79)	-0.000 (-0.85)	-0.000 (-1.44)	-0.000 (-0.85)
Population (ln)	1.296*** (14.60)	1.064*** (9.58)	0.549*** (3.74)	1.069*** (9.27)	0.551*** (3.44)
International reserves	0.092*** (2.77)	0.058* (1.83)	0.103** (1.99)	0.058* (1.95)	0.102* (1.71)
Time dummies	jointly significant***	jointly significant***	jointly significant***	jointly significant***	jointly significant***
Constant	-31.381*** (-14.06)	-23.843*** (-11.59)	-14.916*** (-3.66)	-24.006*** (-8.17)	-14.985*** (-3.46)
Number of observations	732	679	705	732	732
Log-likelihood value	-1503.90	-1192.95	-131.53	-1324.47	
(Pseudo) R-Squared	15.62%	60.64%	30.08%		
BIC	3271.63	2640.19	512.27	3123.83	

Legend: * statistically significant at 90% level, ** at 95% level *** at 99% level.
Clustered robust t statistics in parentheses, except Tobit

The general analysis of Table 2 indicates that a country's economic conditions are fundamental in attracting investments for infrastructure projects. Particularly, richer countries with larger markets attract more funds, meaning that emerging countries with a greater ability to pay for infrastructure services are rewarded with higher investment flows. Macroeconomic stability is also important, as a controlled inflation and more

reserves lead to a positive effect on investments through PPPs.

In addition, governments facing high deficit levels are more interested in PPPs for the development of infrastructure projects, otherwise unaffordable, but this is a factor of economic instability and as such, a negative sign on this coefficient means that these countries are penalized with lower investments.

Concerning the political environment, the higher the elections competitiveness, the higher the propensity for PPPs investments. As expected, more transparent and accountable governments will create a more favorable environment for those projects. Slightly unusual is the sign and significance of the *Political system* coefficient, because it seems that more democratic regimes do not encourage infrastructure investments through PPPs. Usually, democracy facilitates the adoption of market-oriented reforms, in which we include the choice of PPPs to develop critical infrastructure projects in emerging countries.

Another controversial result is related to the civil liberties measure, that ranges from 1 for countries with complete freedom to 7, for those with no freedom. Apparently, more civil liberties are associated with lower investments in infrastructure projects. A possible explanation for this result is provided by Banerjee et al. (2006), who claim that more civil rights usually imply that projects to proceed must ensure civic approval, what in turn will increase the transaction costs and further increase the already lengthy process of structuring an infrastructure PPP.

Time dummies appear statistically relevant in all specifications. Not surprisingly time-specific events are systematic drivers of investment flows to infrastructure PPPs.

These findings are supported by Hammami et al. (2006), who had found that larger markets, stable inflation and more political competitiveness lead to more PPPs investments. In addition, a significant time effect was also reported.

If we focus our analysis in the Two-part model, more interesting conclusions could be drawn. In this specification (column 2 and 3), y is modelled first as a Probit regression for $y = 0$ versus $y \neq 0$ and next, the positive values are modelled with another distribution (using OLS, in this case). It is worth mention that the Probit model fits the data quite well, achieving 93.33% of observations correctly classified.

Therefore, in column 3, the results stress the importance of the institutional quality and of legal systems, that matters mostly for the decision whether to invest or not. Besides the importance of the political proxies mentioned before, it is also possible to

see, that countries with an English legal origin are rewarded with higher investments than French civil law countries. Column 2 highlight that for positive values of y , more developed financial systems and countries that respect more human rights (measured by the empowerment index) benefit with more investments. The economic variables, already mentioned, maintain in general their importance in the “two parts of the model”.

Given the assumption that the two parts of the model are independent, the joint likelihood of the Two-Part model is the sum of the likelihood values presented in Table 2: -1324.48. Testing for homoscedasticity, the “Breusch-Pagan / Cook-Weisberg test for heteroscedasticity” gives a $\chi^2(1)=0.01$ with the corresponding p-value=0.9156, therefore, do not rejecting the homoscedasticity hypothesis. But the hypothesis of normality of the residuals, is strongly rejected (results not reported).

When we drop the assumption of independence of the two parts of the model, an alternative model can be used - the bivariate selection model estimated through MLE (Heckman MLE). In this specification, the same variables were used in both equations (selection equation and outcome equation). Columns 4 and 5 exhibit the results.

Because multicollinearity problems may arise given that exactly the same regressors are used in both equations for y_1^* and y_2^* , a collinearity diagnostic was performed with the inverse Mills ratio term $\lambda(\cdot)$ and the other regressors. No serious problems were detected that worth correction, because all the VIF values were small (Mean VIF=1.97).

Comparing the results from the Two-Part Model and Heckman MLE, similar coefficient estimates were obtained in the two equations with almost the same statistical significance achieved. The log likelihood of the two models is respectively, -1324.48 vs. -1324.47 and in addition the LR test of independence of the equations obtained with Heckman MLE: $H_0 : \rho = 0$, gives a $\chi^2(1)=0.02$ with a p-value of 0.89. As such, the estimated correlation between the errors is not significantly different from zero and the hypothesis that the two parts are independent cannot be rejected.

We also used Heckman’s two-step method (or Heckit estimator), but the same qualitative results were obtained and no apparent improvement was achieved (for convenience, results are not reported). Testing the hypothesis of independence of the errors, through the coefficient of lambda (the error covariance σ_{12} - recall equation 7), the z-statistic is 0.16 with a p-value=0.88. Thus, we do not reject the independence of ϵ_1 and ϵ_2 , reinforcing the empirical evidence that favors the choice of a Two-Part Model.

As a final conclusion comparing the Two-Part model with Heckman specifications, we may say that the unobserved factors that explain the selection process are independent from the unobserved factors that explain the amount of investment and hence, the simpler Two-Part model is preferred over more complex formulations.

For comparisons purposes, also the classical Tobit model is presented in column 1. The results point in the same direction as the previous ones, but we must be careful in the interpretation of Tobit estimates given its fragility to minor misspecifications of the error distribution.

To shed more light into the significance of the different risk dimensions, Table 3 presents LR tests using a Two-Part model. Assuming independence of the two equations, LR tests were performed for the “two parts”.

Table 3: Likelihood Ratio tests for PPPs investments

LR tests Two-Part Model N=732	Dependent variable Real Investment in PPPs $y > 0$	
	dy	$y > 0$
Risk dimensions:		
Political	LR chi2(3) = 7.98** (0.0465)	LR chi2(3) = 5.24 (0.1553)
Legal	LR chi2(5) = 6.71 (0.2433)	LR chi2(5) = 17.78*** (0.0032)
Social	LR chi2(3) = 0.67 (0.8794)	LR chi2(3) = 9.00** (0.0292)
Financial	LR chi2(3) = 1.01 (0.7991)	LR chi2(3) = 30.92*** (0.0000)
Economic	LR chi2(8) = 54.75*** (0.0000)	LR chi2(8) = 342.47*** (0.0000)
Time Dummies	LR chi2(15) = 45.28*** (0.0001)	LR chi2(16) = 48.30*** (0.0000)

Legend: * statistically significant at 90% level, ** at 95% level *** at 99% level, p-values in brackets

The results above reinforce the earlier conclusion that factors which influence the decision to invest in infrastructure projects are different from those which determine the amount of the financial flows. More specifically, a stable political environment, good economic prospects and the time effect explain the decision to invest. If we move to the explanation of the investment amount, there is empirical evidence in favor of all risk dimensions except the political environment. Not surprisingly, political stability is more relevant to investors before the start of the project development given the intrinsic characteristics of the infrastructure assets, requiring heavy up-front investments that are usually sunk costs.

6 Conclusions

The link between economic growth and infrastructure investment is obvious and despite the increasing importance of PPPs as a vehicle to promote these investments, particularly to emerging countries, few empirical studies address these topics.

In developing countries, the poor quality of infrastructure services, the financial constraints faced by many governments and underdeveloped local capital markets contributed to involve the private sector in providing infrastructure services. Besides an alternative way to raise the necessary funds, it is expected a more efficient operation, better management and higher technical capability from private agents.

Infrastructure projects are prone to specific risks, given its nature and usually imply commitment for longer maturities, what makes investors particularly exposed to risks and uncertainties. Therefore, private lenders should evaluate the different risk factors, project specific but also, related to the country environment where the project will be developed. This risk assessment will be reflected in the willingness to enter in a PPP arrangement and in the degree of such commitment.

Aggregate empirical studies that evaluate country-specific determinants of infrastructure PPPs, allow to detect trends and provide useful insights about the macroeconomic and structural characteristics that may encourage the intensity of investments and the participation of the different agents.

In this work, it is empirically demonstrated that a country's economic conditions constitutes the most important driver of infrastructure investment flows, particularly, the dimension of the market and users' purchasing power. Also relevant, appear time-specific events.

Investment decisions were taken based mostly on the favorable economic prospects, but also the institutional environment matters to explain the decision to invest. The intensity of such investments is essentially a response to the financial and economic conditions of the host countries, besides an evident time effect, although the effect of legal and social measures can not be neglected.

Finally, given the popularity of PPPs and their exponential growth in recent years also with a lot of controversy around the theme, it is expected that this empirical approach, could add to the scarce literature on the field and contribute to further research.

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A Data Appendix - Variables

Table 4: Summary statistics - Explanatory variables

Variable	Number of observations	Mean	Std. Dev.	Min	Max
Political system	3724	0.636	0.776	0	2
Index of Political Competitiveness	3726	5.861	1.689	1	7
Checks (number)	3695	3.620	3.556	1	18
Creditor rights	3721	1.624	0.905	0	4
Contract enforcement days (ln)	3727	5.914	0.380	3.30	7.29
English legal origin dummy	3727	0.205	0.404	0	1
French legal origin dummy	3727	0.444	0.497	0	1
German legal origin dummy	3727	0.246	0.430	0	1
Socialist legal origin dummy	3727	0.106	0.308	0	1
Physical Integrity Index	3698	2.876	2.090	0	8
Empowerment Index	3427	5.158	3.382	0	10
Civil liberties	3727	4.175	1.448	1	7
Deposit money bank assets	3563	0.868	0.140	0.12	1
Liquid liabilities to GDP	2656	0.408	0.237	0.06	1.30
Private credit to GDP	2653	0.348	0.290	0.02	1.66
Government balance to GDP	3489	-0.457	6.346	-35.02	33.20
External debt to total exports	3465	20.600	19.989	0.02	117.81
Economic growth	3723	5.130	5.473	-32.12	34.50
Fuel exports	3327	10.358	16.688	0	99.657
Real GDP per capita (ln)	3725	7.357	0.903	4.44	9.14
Inflation Rate	3723	82.902	405.424	-23.48	15442.30
Population (ln)	3727	18.578	1.840	14.30	21.00
International reserves	3480	6.558	3.887	0.06	23.69
East Asia and Pacific dummy	3727	0.330	0.470	0	1
Europe and Central Asia dummy	3727	0.153	0.360	0	1
Latin America and Caribbean dummy	3727	0.320	0.466	0	1
Middle East and North Africa dummy	3727	0.022	0.148	0	1
South Asia dummy	3727	0.107	0.309	0	1
Sub-Saharan Africa dummy	3727	0.068	0.252	0	1

Where the independent variables are:

- Political System - presidential(0), assembly-elected presidential (1) or parliamentary (2);
- Index of Political Competitiveness, which varies from 1 (low) to 7 (high competitiveness);
- Checks - number of governmental checks and balances, witch varies from 1 to 18;
- Creditor rights - An aggregate index, which varies from the value 0 for weak creditor rights to 4, meaning strong creditor rights;
- Contract enforcement days - the number of days to resolve a payment dispute through courts, presented em logs and levels;
- Legal origin - English, French, German and Socialist. We will use 3 dummies, being the French civil law the reference;
- Physical Integrity Rights Index, it ranges from 0 (no government respect) to 8 (full government respect);
- Empowerment Rights Index, it ranges from 0 (no government respect) to 10 (full government respect);
- Civil liberties, which varies from 1 (highest degree of freedom) to 7 (the lowest);
- Deposit money bank assets, divided by the sum of deposit money and central bank assets;
- Liquid liabilities to GDP;
- Private Credit to GDP;

- General government balance (percent of GDP);
- External debt (percent of total exports);
- Economic growth - GDP growth (annual %);
- Fuel exports (% of merchandise exports);
- Real GDP per capita - constant 2000 US\$, presented em logs and levels;
- Inflation Rate (annual percent change, GDP deflator);
- Population, total, presented em logs and levels;
- Reserves (in months of imports).