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When bigger is better: Investment volume drivers in infrastructure public-private partnership projects

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ABSTRACT

This research studies the factors that favour the establishment of high-investment infrastructure public-private partnership (PPP) projects. We analyse 9121 PPPs, hosted in 107 developing countries, in the period 1997–2017. We find that PPP projects adopting contractual forms in which the private party takes more risks, awarded through competitive methods and benefitting from indirect government support programmes, are characterized by a larger investment volume. A more business-friendly economy and robust institutions configure the most conducive environment to establish larger investment PPPs. Furthermore, multilateral development banks' support of the projects relates positively to their investment volume.

1. Introduction

Public-private partnerships (PPPs) constitute an important mechanism to govern the transactions involved in the development and operation of huge infrastructures from different sectors, such as energy, water, transport, or information and communication technologies (ICT). More formally, PPPs are defined by the Green Paper of the Commission of the European Communities (2004, p. 3) as "forms of cooperation between public authorities and the world of business which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service" [1]. The main characteristics of PPPs are the long duration of the agreement; the complex funding of the project participating in the private sector and, sometimes, other stakeholders such as multilateral development banks; the involvement of the private sector at different stages in the project; and the allocation of the different projects' risks between the public and private partners.

PPPs, as a transaction governance mechanism, have grown a lot in the last decades, especially in developing countries. Ref. [2] explain that nowadays PPPs are performed in more than 130 developing countries, representing 15–20% of the total investment in infrastructure in these locations. This economic relevance has increased the attention from academic literature; in consequence, we find a number of important papers dealing with different research topics of interest for PPPs. Some of the most analysed topics include the factors that determine the success or failure of a project [3–5]; the factors that attract private participation in these markets [6–9]; or the distribution of projects' risks between public and private partners [10,11], among others.

Despite the growing number of academic research articles on PPPs, some relevant topics remain underexplored. This is the case for factors that determine the investment volume of the project. Ref. [12,13] analyse factors that determine the investment volume in PPPs but consider the aggregated investment in all the PPP projects per country. Thus, these authors work at a country-aggregated level, which could hide factors affecting the volume of investment at the project level. As far as we know, the only article that has analysed the investment volume at the project level is that by Ref. [9]. However, these authors focus their research on the impact of the level of corruption of the project's host country on the PPP investment volume, neglecting other potentially important factors.

Assuming a priori positive value for money and successful execution of the project, the determinants of investment can also assess different angles of the project's performance, *ex ante* because of its capability to agglutinate investments at once, and *ex post* through the impact of the investor volume.

Ex ante performance is assessed because there may be projects with a

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certain degree of discretion or being deployed through different proposals —e.g. less ambition in terms of impact, quality or spectrum of users—or they may be executed in phases independently instead of one single project, being possible that these phases later become paralysed [14,15]. This can happen, inter alia, when there are uncertainties surrounding the project, whether arising from the project itself, the environment, or the agents carrying it out, as well as a lack of investors [9]. Under these circumstances, greater fully executed investment volume may be associated before the start of the PPP with better performance due to the greater capacity to mobilize resources from different economic agents at one time [13]. Besides large investment volumes' PPPs could act as a bigger source of financing for institutions by reducing their fiscal deficit [16].

Positive *ex post* performance would occur because large investment volumes are associated with larger projects to meet the needs of a greater number of users, and when the proportional investment per user is decreasing, it favours investment-user economies of scale [17]. In fact, large investment projects experience increasing worldwide relevance since their transformative nature, by changing institutional relationships [18,19], and creating new social benefits and opportunities for many economic agents [20]. Ref. [21] point out that those projects reaching a larger scale—infrastructure megaprojects[1]—are transformational, impacting millions of people, and are often differentiated by the amount of their capital investment. These authors consider that high-investment projects have experienced important growth in the last years in response to the projections of required infrastructures to sustain the estimated global economic growth. Ref. [22] highlight the McKinsey & Company estimations predicting that the worldwide required investment in infrastructures up to 2030 will reach US$57 trillion. These forecasts are even lower than those from the Organization for Economic Co-operation and Development (OECD), which estimates the worldwide infrastructure investment per year to be US$6.3 trillion in the period 2016–2030 [23].

The benefits of high-investment projects do not only address the economic perspective. Ref. [24] explains why infrastructure megaprojects enjoy increasing relevance, highlighting four sublimes, one of them economic but the others related to other issues. Firstly, the "technological sublime" refers to the advances achieved by engineers and technologists from performing large and innovative projects. Projects such as the building of the longest tunnel, the largest wind turbine, or the first of anything, push the boundaries of science and technology. Secondly, the "political sublime" refers to the benefits obtained by politicians from promoting this type of project. These benefits shape the visibility, prestige, and relevance that could lead politicians to be re-elected. Thirdly, the "economic sublime" refers to all the economic interests surrounding high-investment infrastructure projects. The huge amount of money required to perform these projects generates business opportunities and wealth for multiple stakeholders, encompassing, among others, private contractors, landowners, bankers, investors, workers, etc. Finally, the "aesthetic sublime" refers to the non-material utility obtained from the grandeur, beauty, and prestige of the great infrastructures that often emerge as icons that generate a brand image (e.g. San Francisco's Golden Gate Bridge).

In the abovementioned context, as a positive *ex ante* signal due to the attraction of investments, *ex post* benefits through a greater number of users, as well as generating spillover effects, the drivers of projects' investment volume constitute an interesting research topic when "bigger is better".

Thus, in this paper, we want to fill the gap in PPP literature and expand previous empirical evidence by analysing the drivers of investment volume at the project level, testing the impact of different variables related to the characteristics of the project and different attributes of the economic and institutional environments. Moreover, we analyse the role of other relevant stakeholders by studying the impact of the support provided by multilateral development banks (MDBs), and how different factors of the economic and institutional environments interact with this effect. For this aim, we analyse a broad sample of 9121 PPP projects in infrastructures established in the period 1997–2017 in 107 developing countries and registered in the Private Participation in Infrastructures database of the World Bank (WBPI). The empirical findings of this research are of interest to practitioners, policymakers, and other stakeholders who seek to take advantage of the promotion of large investment infrastructure projects.

The rest of the paper is structured as follows. In the second section, we set out the research hypotheses; the third section explains the data and methods used; and the fourth section reports the empirical results. The paper ends with the main conclusions in the fifth section.

2. Research hypotheses

What does the investment volume of PPP projects depend on? Several theoretical perspectives (that can complement one another) allow us to answer this question and identify factors that affect investing. One approach that underlies others is stakeholder theory [25], which considers these collaborations as a set of economic agents, where the institutional part carrying out a project selects the private part to satisfy users and third-party agents that may be part of or be affected by it [26]. In this context, in general, the government must first identify the best type of PPP that will govern the agreement, which makes it possible to distribute more of the risks/investor volume to the private party [11]. Once the necessary type of agreement has been established, the public part will go to the market, encouraging competition through specific government support to increase the number of possible private investors, in line with public choice theory [7]. After that, following principal agent theory, the public part or principal will mitigate adverse selection of the potential private party or agent in order to achieve maximum efficiency through a competitive mechanism award [27]. These projects usually include other stakeholders such as MDBs that, in addition to financing and providing follow-up support, can act as a signal in the market to attract private investors [28,29]. Neo-institutionalism theory contends that the set of potential stakeholders will anticipate greater efficiency and investment in environments with more favourable institutional frameworks [10], while transaction costs theory (TCT) anticipates better market functioning when the costs of transacting are lower facilitating the achievement of the project [5,13]. Besides, TCT provides a valuable lens through which to analyse the effect on investment by profit-seeking organizations of different hazards, such as those emerging from the economic and institutional environments [30].

Thus, the investment volume can be analysed through the aforementioned factors in a more detailed way, grouping them into project characteristics—PPP type, awarded method, government support, MDB—and the economic and institutional environment where the project is carried out, which can influence the volume of investment.

Concerning the project characteristics, the specific contractual type adopted to govern the relationship between the public and the private partners could constitute an important driver to determine investment in the project. PPP agreements are not a homogeneous transaction governance mechanism: there are different types of PPP according to the risks and responsibilities transferred from the public sector to the private [11]. One of the main reasons behind the promotion of PPPs to build and/or operate infrastructures is the attraction of private funding that can help to overcome public budgetary constraints and alleviate excessive public spending [13]. Another factor that spurs PPPs is a lack of skills, human capital, and technology in the public sector to perform some specific complex projects [31]. PPPs can harness private skills and resources that could improve the efficiency of the infrastructure's provision and operation [11,32]. Thus, the scope to obtain efficiency gains

[1] Megaprojects refer to projects characterized by an investment of $1billion or more [65].

by private involvement in PPP projects will be greater as the project becomes larger and more complex. Additionally, the transference of risks and responsibilities from the public to the private sector could constitute an effective mechanism to avoid private contractors' opportunistic behaviours, alleviating the principal-agent problem emerging in PPP agreements [33]. For example, if the same private contractor that builds the infrastructure takes responsibility for maintaining and operating this infrastructure subsequently, the incentive to underinvest during the infrastructure construction phase diminishes since it could jeopardize performance during the operating phase [5,33]. Thus, we hypothesize that for those PPP projects adopting specific contractual forms in which the private investor takes more responsibilities and risks, the investment volume will be larger.

H1. PPP projects in which the private sector assumes more risks are characterized by a larger investment volume.

Another relevant project characteristic that could impact the investment volume is the method of awarding the contract. There are different methods to select the private partner(s) in a PPP project. These methods can be classified into two different philosophies: competitive versus direct negotiation methods. Ref. [27] explain that the contract awarding method could be relevant for attracting private investors. Competitive bidding is more transparent than direct negotiation and could allow selection of the private partner that can perform the project most efficiently. Ref. [34] explain that the failure of a PPP project could be caused by drawbacks in the tendering process related to lengthy duration, high transaction costs, and a lack of transparency and competition. Ref. [35] point out that transparency and efficiency gains from competitive awarding methods attract private investment. Moreover, the scope for efficiency gains from a competitive awarding method will be greater if the project is more complex and larger. Thus, we hypothesize that those projects awarded by competitive methods will be characterized by a larger investment volume.

H2. PPP projects awarded by competitive methods are characterized by a larger investment volume.

Public authorities can undertake different types of direct and indirect support programme to encourage private investors to engage in PPP projects. These support programmes could be useful for reducing the uncertainties faced by private contractors during a project's execution. Fewer uncertainties lead to lower transaction costs that favour the promotion of PPPs and may decrease by diversifying the risk with another agent—the public part—and generating greater confidence of the public in the private partners [11]. Ref. [7] assess the effectiveness of these programmes and find that the projects benefitting from them attract more private investment. More concretely, these authors find that capital, revenue, and in-kind subsidies provided by the public sector are the more effective support programmes to attract private funding to PPP projects. These findings lead us to pose the following research hypothesis:

H3. PPP projects benefitting from government support programmes are characterized by larger investment volume.

Although analyses of PPP agreements tend to be focused on the public and private partners, other stakeholders can play an important role in the promotion and execution of these agreements, especially in the case of high-investment infrastructure projects, due to their scale and complexity. MDBs represent a good example of these other stakeholders. These institutions not only provide funding to the project but also other types of support, such as helping the government to perform the necessary reforms to achieve a more business-friendly institutional environment, offering guarantees that reduce the risk carried by the partners in the agreement, and assisting in project preparation and other technical issues, among others [28,29],.

In the same vein, Ref. [36] argues that MDBs provide operational assistance to projects, leading to a more exhaustive upfront review of the project *ex ante*, and a more appropriate allocation of risks between the public and private partners and closer oversight of implementation of the project *ex dure*. Furthermore, MDBs offer political assistance to PPP projects, which is useful to solve conflicts between the public and private partners that could emerge during the enforcement of the agreement. In this way, the support of MDBs could reduce the transaction costs emerging from the uncertainties surrounding PPP agreements and could have a positive impact on the attractiveness and performance of the projects. For instance Ref. [36] and Ref. [29] find that the likelihood of success of PPP projects with multilateral support is greater than that of projects without this support. Ref. [37] find that renewable energy PPP projects supported by MDBs attract more private investment. Ref. [38] point out that MDBs such as the World Bank or the Asian Development Bank (ADB) have typically taken a leading role in funding infrastructure megaprojects. In the same vein, Ref. [39] explains that MDBs have sponsored a new wave of mega-infrastructure projects across the Americas, fostering the trade and economy of the region. In this regard, Ref. [40] highlight the renaissance of MDBs after the 2008 global financial crisis, aiming for a renewed mandate in promoting economic recovery in all regions of the world. For these authors, "within this role, the infrastructure agenda and its financing has become central in all their operations, so that MDBs can be seen today as the actual implementing agencies of the new investment consensus" [40]. Thus, we establish the following research hypothesis:

H4. PPP projects with MDBs' support are characterized by a larger investment volume.

In addition to a PPP's characteristics and the support of MDBs, the economic environment where the project is performed can impact its investment volume. Developing countries suffer from weaknesses in their economies that could hinder the attraction of private investment in PPP markets [41]. The economic imbalances provoked by the 2008 global financial crisis meant that developing countries had problems attracting private investment in their PPP markets [7]. Previous literature has empirically shown how the attractiveness and performance of PPP projects are influenced by the economic conditions of the country where the project is deployed. Thus, Ref. [12] highlight macroeconomic stability as a relevant factor to attract private initiative to PPP markets. Ref. [13] find that a sound economic environment (in terms of economic freedom) relates positively to the effective execution of PPPs. Ref. [5] find that the robustness of the economic environment positively impacts the likelihood of success of the PPP. Ref. [37] find that private investment in renewable energy PPP projects is greater in opener and freer markets. Thus, we pose the following research hypothesis:

H5. PPP projects performed in sounder economic environments are characterized by a larger investment volume.

The institutional environment where the project is performed can also impact its investment volume, especially in developing economies [41]. Previous academic literature has found empirical evidence that different issues in PPP agreements are sensitive to several institutional dimensions. For instance, Ref. [12] highlight the relevance of the quality of the institutions to attract investment in PPP markets. More concretely, these authors identify control of corruption and effective rule of law as the most relevant institutional dimensions. Similarly, Ref. [10] finds that a sound institutional framework in terms of lower corruption, civil freedom, and a better regulatory framework positively impacts private participation in transport PPP projects. Ref. [13] find that good regulatory quality and effective rule of law are positively related to the effective execution of PPPs. Ref. [42] finds that judicial independence and good regulatory quality attract private investment to PPP markets. Ref. [8] find that good records on governance indicators (control of corruption, government effectiveness, regulatory quality, and rule of law) alleviate the negative impact of risk on private investment in PPP projects. Ref. [5] find that the likelihood of success of a PPP project is greater when the project is performed in an institutional environment with good records in control of corruption, rule of law, and regulatory quality. Ref. [37] find that institutional quality positively impacts

private participation in renewable energy PPP projects. These empirical evidences suggest that robust institutional environments reduce the transaction costs emerging from environmental uncertainties surrounding PPP agreements, favouring the establishment of large investment projects. Thus, we propose the following research hypothesis:

H6. PPP projects performed in sounder institutional environments are characterized by a larger investment volume.

Economic and institutional environments not only directly impact PPPs' investment volume, but they can also interact with other investment volume drivers. More concretely, the effect on projects' investment volume of MDBs' support could be different according to the institutional and economic environment where the project is performed. In this regard, Ref. [28] finds that MDBs' support for PPP projects is greater in poorer countries where legal and financial systems are less developed. Ref. [36] shows that the impact on PPPs' likelihood of success of MDBs' support is more relevant where the projects are performed in countries with weak institutional development. Ref. [37] determine that the positive effect of MDBs' support in the attraction of private investment to renewable energy PPP projects is less relevant when the project is established in countries with better records in governance indicators and economic freedom. Thus, we pose the following research hypotheses:

H7a. The positive effect of MDBs' support on PPP projects' investment volume is less relevant when the project is performed in a sounder economic environment.

H7b. The positive effect of MDBs' support on PPP projects' investment volume is less relevant when the project is performed in a sounder institutional environment.

Fig. 1 summarizes the research hypotheses established.

3. Data and methods

3.1. Data

To test the research hypotheses established in the previous section, we analyse a broad sample consisting of 9121 PPP infrastructure projects established in the period 1997–2017 in 107 developing countries. Fig. 2 plots the distribution of the projects in the sample among the different countries. Brazil has the greatest number of projects (1,463), while the average number of projects per country is 85.

Our data sources are mainly three: i) the WBPI, from which we obtained data about the characteristics of projects and the support of MDBs; ii) the World Bank's Governance Indicators (WGI) to approach the institutional environment; and iii) the Heritage Foundation to approach the economic environment. We obtained additional data from World Bank to establish different controls in the models at the country level. Next, we explain in detail the variables obtained from the different sources.

3.1.1. Dependent variable

Our dependent variable is the total volume of investment in PPP projects. This information is obtained from the WBPI and is expressed in millions of current US dollars for each project. Following [9,13], among others, we apply a logarithm to the variable (Log_Invest).

3.1.2. Research hypotheses variables

To test H1, we consider the subtype of PPP adopted to perform the project. The World Bank classifies PPPs into four types according to the risks transferred from the public sector to the private. In turn, these four types encompass twelve subtypes. Following [5], we consider an ordinal variable (Subtype) that can adopt values in the range 1–12, 1 being the contractual form in which the private sector retains less risk and 12 the subtype of PPP in which the private sector assumes more risk.

To test H2, we consider a dummy variable (D_Competitive), adopting the value of 1 when the project has been awarded by a competitive method and zero otherwise [37].

To test H3, we include in the models a dummy variable (D_Gov), adopting the value of 1 when the project benefits from some type of government support and zero otherwise. To obtain further empirical evidence, we substitute D_Gov with two dummy variables controlling the type of support provided by the government, direct or indirect. Thus, D_Gov_Direct/D_Gov_Indirect adopts the value of 1 when the project has direct/indirect government support and zero otherwise [7].

To test H4, we build a dummy variable (D_MDB) that takes the value of 1 when the project has multilateral support and zero otherwise [28,36]. To provide further empirical evidence, we control for the type of multilateral support and substitute D_MDB with three dummy variables, D_Equity, D_Loan, and D_Guarantee, that adopt the value of 1 when the project receives that type of multilateral support and zero otherwise.

To test H5, we consider several indicators of economic freedom provided by the Heritage Foundation. More concretely, we consider firstly the index of economic freedom (Heritage_EF) that measures the openness of the economic and entrepreneurial environment. This index adopts values in the range 0–100, a higher number meaning greater openness. Heritage_EF is built from different economic and political dimensions. Some of them are directly linked to the attraction of private investment. Thus, we consider three additional specific market indicators: property rights (Heritage_PR), business freedom (Heritage_BF), and investment freedom (Heritage_IF). Heritage_PR measures "the extent to which a country's legal framework allows individuals to acquire, hold, and utilize private property, secured by clear laws that the government enforces effectively".[2] This dimension is very relevant in the attraction of private investment, since previous literature identifies expropriation risk as one of the factors hindering involvement of the private sector in PPPs in developing countries [43,44]. Heritage_BF concerns "the ease of starting, operating, and closing a business", being those environments where private initiative finds ease of operation more conducive to attract private investment in PPP markets. Heritage_IF relates to the extent to which "individuals and firms would be allowed to move their resources into and out of specific activities, both internally and across the country's borders, without restriction". It is reasonable to expect that those countries with fewer restrictions in investment flows can attract more money to PPP projects.

To test H6, we consider the WGI that cover six institutional dimensions: control of corruption (CC), government effectiveness (GE), political stability (PS), regulatory quality (RQ), rule of law (RL), and voice and accountability (VA).[3] Previous literature has used WGI to understand the institutional environment of PPP projects (see, among others, [8,10]). We consider each of the dimensions, but we also build a variable that is the average of the six dimensions (G), following previous literature, to control the institutional environment from a general perspective [5]. We also use an alternative method to build an overall indicator of the institutional environment from the WGI measures. Following [45], we perform a factorial analysis of the WGI measures and extract a single factor (F) that represents the quality of the overall institutions of the country where the PPP project is performed. Following previous literature (see, among others [11]), the variables pertaining to the economic and institutional environments adopt the value of the previous year of the investment, t-1.

Finally, to test H7a and H7b, we build several variables by interacting D_MDB with each of the proxies of the economic and institutional environments. To build the interaction terms, we use mean-centred variables in order to avoid multicollinearity problems [46].

3.1.3. Control variables

In addition to the variables used to test the research hypotheses, we

[2] The definitions of the Heritage foundation indicators come from the methodology book available on its website.

[3] A detailed definition of each of the indicators can be found in Ref. [66].

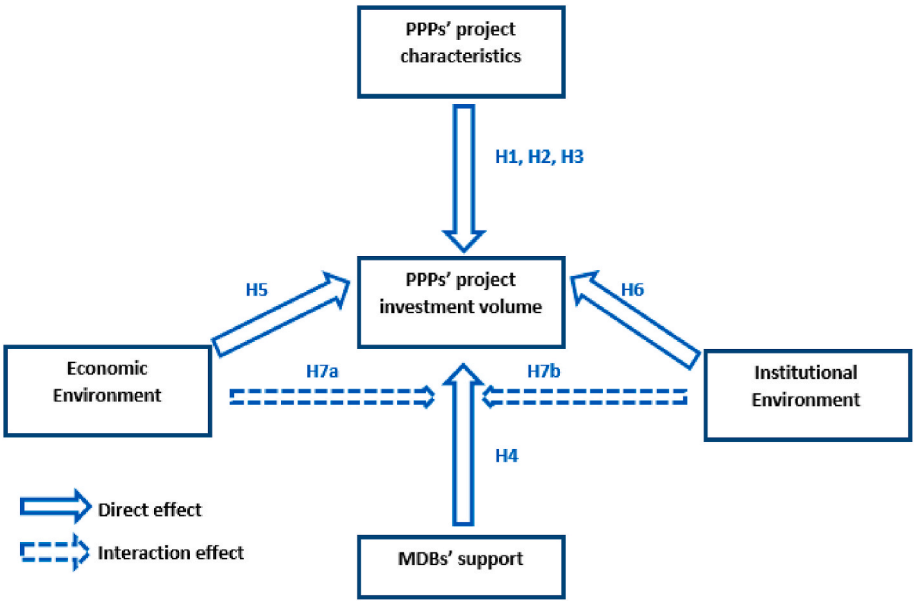

Fig. 1. Summary of research hypotheses.

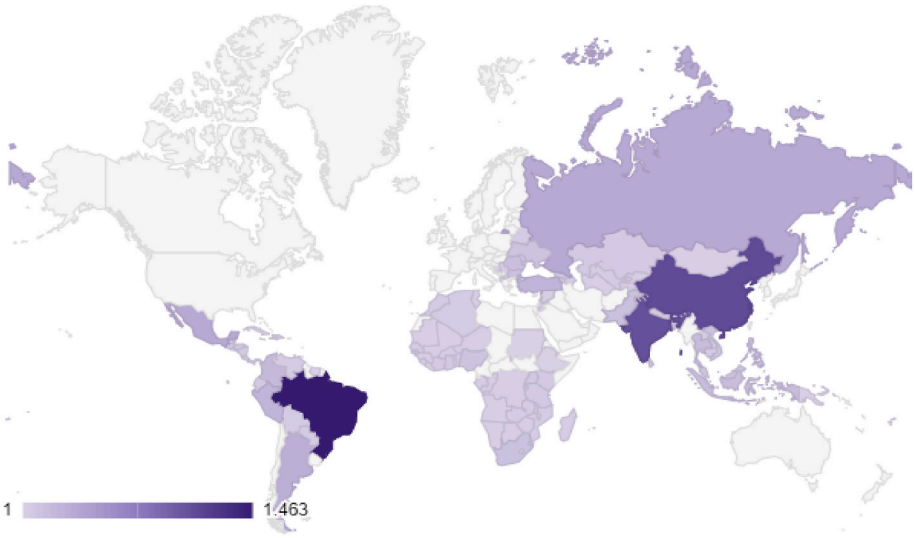

Fig. 2. Distribution of PPPs' projects among countries.

establish in models several controls at both project and country levels that could impact our dependent variable. At the project level, we control for the economic sector of the project, as different sectors could require different volumes of investment. The projects included in the sample belong to four different sectors: water, energy, ICT, and transport. Thus, we include in the models the dummy variables D_Water/D_Energy/D_ICT that adopt the value of 1 when the project belongs to the sector and zero otherwise (we take the transport sector as the base category to avoid multicollinearity problems) [4,5,47]. We also consider several dummies to control for the period in which the PPP was established since this could affect the project's investment volume. With this aim, we split the full sample (1997–2017) into symmetric cohorts of seven years and include in the models a dummy variable for each of them except for the last (2011–2017), which is taken as the base category to avoid multicollinearity problems. Thus, D_1997/D_2004 takes the value of 1 when the project is deployed in the periods 1997–2003/2004–2010 and zero otherwise [9]. To control for regional idiosyncrasies, we control for the continents where the projects are performed. Thus, we include the dummy variable D_Asia/D_America/D_Africa that adopts the value of 1 when the project is established in Asia/America/Africa and zero otherwise (we take Europe as the base category to avoid multicollinearity problems) [4,11,47].

At the country level, we control for the size of the market where the project is deployed, including the log_GDP of the country where the project is performed. In addition, we include a variable pertaining to the degree of development of the country where the project is deployed (Income) that can adopt the value of 1, 2, or 3, 1 indicating the lowest degree of development and 3 the highest. The size of a country and its degree of development could spur the formalization of larger PPP projects. Following previous literature (see, among others [11]), the variables log_GDP and Income adopt the value of the previous year of the investment, t-1. Furthermore, we control for the religious heterogeneity of the country where the project is performed (Rel) considering the variable constructed by Ref. [48] based on data from Encyclopaedia Britannica. Greater religious diversity could translate into higher coordination and transaction costs and therefore make it more difficult to

implement PPP agreements. Ref. [47] find that higher levels of within-country religious diversity lead to a higher risk of project failure.

Table 1 reports the summary statistics of the variables described. Table A1 in Appendix 1 shows the correlation matrix.

3.2. Methods

To test the research hypotheses posed in section 2, we run several regressions. Given the nature of our data—PPP projects nested in countries—we regress generalized linear models (GLM) with multilevel fixed effects, allowing the intercepts of regressions to vary across countries [9,49]. We propose the following models, whose number appears in parentheses. We first build a base model with the control variables; subsequently, we include in the base model additional variables to test the different research hypotheses [5]. The base model in a linear format is as follows:

$$Log\_Invest_{i,j,t} = \alpha + \beta_1 D\_1997_{i,j,t} + \beta_2 D\_2004_{i,j,t} + \beta_3 D\_Asia_{i,j,t} + \beta_4 D\_America_{i,j,t} + \beta_5 D\_Africa_{i,j,t} + \beta_6 D\_Water_{i,j,t} + \beta_7 D\_Energy_{i,j,t} + \beta_8 D\_ICT_{i,j,t} + \beta_9 Log\_GDP_{i,j,t-1} + \beta_{10} Income_{i,j,t-1} + \beta_{11} Rel_{i,j,t} + u_j + \varepsilon_{i,j} \quad (M1)$$

where $Log\_invest_{i,j,t}$ is the log of the volume of investment of the project i (expressed in millions of current US dollars), established in the country j in the year t. Subsequently, the control variables appear, u_j representing the unobserved country effects shared by all the projects established in the same country and $\epsilon_{i,j}$ being the unobserved project effects.

To test H1–H3, we add to the base model the research hypotheses variables at the project characteristics level. The model in a linear format is as follows:

$$Log\_Invest_{i,j,t} = BASE\ MODEL + \beta_{12} Subtype_{i,j,t} + \beta_{13} D\_Competitive_{i,j,t} + \beta_{14} D\_Gov_{i,j,t} + u_j + \varepsilon_{i,j} \quad (M2)$$

To further analyse H3, we control for the type of government support in model 3.

$$Log\_Invest_{i,j,t} = BASE\ MODEL + \beta_{12} Subtype_{i,j,t} + \beta_{13} D\_Competitive_{i,j,t} + \beta_{14} D\_Gov\_Direct_{i,j,t} + \beta_{15} D\_Gov\_Indirect_{i,j,t} + u_j + \varepsilon_{i,j} \quad (M3)$$

To test H4, we add to model 2 the variable controlling for multilateral support.

$$Log\_Invest_{i,j,t} = MODEL\ 2 + \beta_{15} D\_MDBs_{i,j,t} + u_j + \varepsilon_{i,j} \quad (M4)$$

To further analyse H4, we control for the type of multilateral support.

$$Log\_Invest_{i,j,t} = MODEL\ 2 + \beta_{15} D\_Equity_{i,j,t} + \beta_{16} D\_Guarantee_{i,j,t} + \beta_{17} D\_Loan_{i,j,t} + u_j + \varepsilon_{i,j} \quad (M5)$$

To test H5, we add to model 4 the different proxies for the economic environment. Since these indicators are highly correlated, we include each one separately to avoid multicollinearity problems.

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} Heritage\_EF_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad (M6)$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} Heritage\_PR_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad (M7)$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} Heritage\_BF_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad (M8)$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} Heritage\_IF_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad (M9)$$

Table 1
Summary statistics.

Label	Obs	Mean	SD	Min	Max	Source
Dependent Variable						
Log_Invest	9121	4.268175	1.637661	−3.50656	10.47972	WBPI
Hypotheses Variables						
Subtype	9121	7.753426	2.21618	1	12	WBPI
D_Competitive	9121	0.352922	0.477905	0	1	WBPI
D_Gov	9121	0.161276	0.367806	0	1	WBPI
D_Gov_Direct	9121	0.07565	0.264451	0	1	WBPI
D_Gov_Indirect	9121	0.087162	0.282087	0	1	WBPI
D_MDBs	9121	0.192852	0.394559	0	1	WBPI
D_Equity	9121	0.046267	0.210074	0	1	WBPI
D_Guarantee	9121	0.04221	0.20108	0	1	WBPI
D_Loan	9121	0.155794	0.36268	0	1	WBPI
Heritage_EF	9121	56.77478	6.09944	21.4	76.9	Heritage Foundation
Heritage_PR	9121	39.49841	13.17718	5	90	Heritage Foundation
Heritage_BF	9121	58.62584	11.49797	17.3	90.6	Heritage Foundation
Heritage_IF	9121	46.16599	15.08501	0	90	Heritage Foundation
G	9121	−0.3328	0.373737	−2.10032	0.879893	WGI
F	9121	−7.25E-10	0.957461	−4.31272	3.369133	WGI
CC	9121	−0.42429	0.387092	−1.72293	1.216737	WGI
GE	9121	−0.18369	0.40079	−1.88415	1.267115	WGI
PS	9121	−0.60212	0.637673	−2.84465	1.320035	WGI
RQ	9121	−0.16359	0.447331	−2.29754	0.939969	WGI
RL	9121	−0.38747	0.416925	−2.13	1.07713	WGI
VA	9121	−0.23562	0.749597	−2.25043	1.142669	WGI
Control Variables						
D_1997	9121	0.192304	0.394132	0	1	WBPI
D_2004	9121	0.445456	0.497043	0	1	WBPI
D_Asia	9121	0.436794	0.496016	0	1	WBPI
D_America	9121	0.334832	0.471958	0	1	WBPI
D_Africa	9121	0.127398	0.333437	0	1	WBPI
D_Water	9121	0.073895	0.261615	0	1	WBPI
D_Energy	9121	0.424296	0.494263	0	1	WBPI
D_ICT	9121	0.349962	0.476984	0	1	WBPI
Log_GDP	9121	26.31143	2.092483	19.33661	30.04613	World Bank
Income	9121	2.554106	0.596917	1	3	World Bank
Rel	9121	0.4332357	0.2184984	0	0.8603	[48]

To test H6, we add to model 4 the different proxies for the institutional environment. Since these indicators are highly correlated, we include each one separately to avoid multicollinearity problems. Furthermore, since institutional environment variables are highly correlated with economic environment variables, we do not consider both types of variable in the same model to avoid multicollinearity problems.

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} G_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M10)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} F_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M11)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} CC_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M12)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} GE_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M13)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} PS_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M14)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} RQ_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M15)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} RL_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M16)}$$

$$Log\_Invest_{i,j,t} = MODEL\ 4 + \beta_{16} VA_{i,j,t-1} + u_j + \varepsilon_{i,j} \quad \text{(M17)}$$

Finally, to test H7a and H7b, we add to models 6–17 an interaction term between D_MDBs and the economic or institutional environment indicator appearing in each model. These models correspond to those ranging from 18 to 29 in the following empirical findings section. To avoid multicollinearity problems, interaction terms are built from demeaned variables [5].

4. Empirical findings and discussion

Table 2 displays the results for models 1–5. The diagnostic tests show the convenience of all these models. The Wald χ^2 statistic leads us to reject the null hypothesis that all the coefficients in each model are simultaneously equal to zero. The likelihood ratio (LR) test indicates that multilevel models are more appropriate than linear regressions. The VIF (variance inflation factor) test shows that the models do not suffer from multicollinearity problems.

Focusing on estimated coefficients, model 1 only considers the control variables. The estimated coefficients on these control variables draw several interesting findings. Firstly, projects performed in the first years of the period analysed are characterized by a lower volume of investment than those performed later. This result reflects the important growth experienced by large investment infrastructure projects in developing countries in the last decades [2,20]. Secondly, the continent where the project is performed does not impact its investment volume since the estimated coefficients on continent dummy variables are not significant. This means that the prevalence of large investment projects is similar in all parts of the world. Thirdly, the economic sector of the PPP impacts its investment volume. More concretely, projects in the water and energy sectors require a lower volume of investment than projects belonging to the transport and ICT sectors. This result highlights the relevance of controlling for the economic sector of the project since each sector could present specific idiosyncrasies [5].

Two of the country-level controls show significant estimated coefficients. More concretely, the positive and significant coefficient on Log_GDP indicates that those projects performed in countries with a greater GDP attract a greater volume of investment. This result is not striking, since one of the main risks faced by private investors in these projects is lack of demand for the infrastructure provided [12,32,50]. This risk is lower when the project is performed in a big country [37], making it easier to establish PPP projects of a greater size. Furthermore, large-scale infrastructures are more necessary in countries with a larger GDP to sustain economic production. The negative and significant coefficient on the Rel variable means that those projects performed in countries with greater religious diversity are characterized by a lower volume of investment. Religious diversity could be a source of conflict and coordination problems [47], leading to greater transaction costs that hinder the development of PPP projects.

Once we have presented the results from the base model, we focus on testing the research hypotheses. Model 2 tests hypotheses 1–3. The estimated coefficient on the Subtype variable is positive and significant, which means that those projects ruled by contractual forms in which the private party takes more risks and responsibility show greater investment volume. This result is consistent with our H1. Private money and the efficiency gains from private involvement in the provision of

Table 2
Empirical results from models 1-5.

	Model 1	Model 2	Model 3	Model 4	Model 5
Subtype (H1)		0.1200*** (0.0095)	0.1189*** (0.0095)	0.1218*** (0.0094)	0.1197*** (0.0094)
D_Competitive (H2)		0.0949** (0.0373)	0.1024*** (0.0376)	0.1014*** (0.0369)	0.1031*** (0.0369)
D_Gov (H3)		0.0498 (0.0461)		0.0376 (0.0455)	0.0413 (0.0455)
D_Gov_Direct (H3)			−0.0315 (0.0626)		
D_Gov_Indirect (H3)			0.1166** (0.0590)		
D_MDBs (H4)				0.6034*** (0.0409)	
D_Equity (H4)					0.1306 (0.0809)
D_Guarantee (H4)					0.6065*** (0.0781)
D_Loan (H4)					0.5262*** (0.0481)
D_1997	−0.1998*** (0.0624)	−0.1971*** (0.0619)	−0.1915*** (0.0620)	−0.2216*** (0.0609)	−0.2237*** (0.0608)
D_2004	0.0362 (0.0416)	0.0154 (0.0420)	0.0195 (0.0421)	0.0107 (0.0414)	0.0119 (0.0414)
D_Asia	−0.2432 (0.2170)	−0.1608 (0.2106)	−0.1650 (0.2104)	−0.1366 (0.2035)	−0.1389 (0.2019)
D_America	0.0006 (0.2192)	0.0419 (0.2125)	0.0449 (0.2123)	−0.0343 (0.2053)	−0.0212 (0.2036)
D_Africa	0.1681 (0.2275)	0.2373 (0.2211)	0.2360 (0.2208)	0.2900 (0.2137)	0.2722 (0.2121)
D_Water	−1.3754*** (0.0731)	−1.4342*** (0.0727)	−1.4450*** (0.0729)	−1.4513*** (0.0718)	−1.4488*** (0.0718)
D_Energy	−0.4665*** (0.0472)	−0.7138*** (0.0521)	−0.7256*** (0.0525)	−0.7436*** (0.0515)	−0.7386*** (0.0515)
D_ICT	0.1527*** (0.0521)	−0.2499*** (0.0650)	−0.2492*** (0.0650)	−0.2964*** (0.0643)	−0.2835*** (0.0644)
Log_GDP	0.4915*** (0.0333)	0.4769*** (0.0324)	0.4797*** (0.0325)	0.4808*** (0.0317)	0.4800*** (0.0316)
Income	−0.0715 (0.1061)	−0.0642 (0.1032)	−0.0664 (0.1031)	0.0042 (0.1000)	0.0120 (0.0994)
Rel	−0.5230* (0.2690)	−0.5142** (0.2613)	−0.5093* (0.2611)	−0.5560** (0.2528)	−0.5487** (0.2510)
Intercept	−7.3554*** (0.8067)	−7.8127*** (0.7825)	−7.8691*** (0.7842)	−8.1963*** (0.7643)	−8.1894*** (0.7617)
Prob > χ^2	1064.88***	1257.3***	1260.41***	1508.49***	1528.17***
LR Test	626.03***	592.33***	571.00***	594.26***	587.66***
VIF	2.18	2.21	2.14	2.14	2.04
Pseudo-R^2	0.3093	0.3379	0.3393	0.3699	0.3714
Obs.	9121	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

infrastructures will have a greater scope as the project becomes more complex. The execution of more complex and larger projects will require a greater volume of resources. Besides, as private investors take on more risks and responsibilities, more residual rights on project assets are allocated to the private partner [33,51]. Ref. [27] find that more residual rights controlled by private investors (which occurs when the Subtype variable adopts higher values) spur private investment in these projects. The estimated coefficient on the D_Competitive variable is positive and significant, meaning that those projects awarded by competitive methods are characterized by a greater investment volume. This finding, consistent with our H2, could be explained by the efficiency gains obtained from competition. Competition in the awarding process leads to transparency, which is an important attribute in the attraction of private investment , [27,35,52]. Besides, competitive bidding could contribute to alleviating the transaction costs emerging from the principal-agent relationship by favouring selection of the optimal private partner [27].

The estimated coefficient on D_Gov is positive but non-significant: that is to say, the presence of government support programmes does not significantly impact the investment volume of the project. This result would lead us to reject H3. However, it is necessary to consider that there are different types of government support programme. To explore H3 further, we run model 3 in which we control for the type of government support, direct or indirect. Direct government support programmes include capital subsidies (consisting of direct government payments for capital investment in the project), revenue subsidies (being payments from the government for revenue support), and in-kind support (consisting of in-kind contributions to the project, such as the land where the infrastructure is built). Indirect government support programmes shape either contingent liabilities covering a broad range of risks (payment, debt, revenue, exchange rate, construction cost, interest rate, and tariff rate guarantees) or government policies (tax reduction or government credit).

Thus, the results from model 3 show that the type of government support matters. More concretely, we obtain that indirect support programmes have a positive impact on the project investment volume, whereas the estimated coefficient on D_Gov_Direct is non-significant. Our results for H3 are consistent with the empirical evidence obtained for H1. Direct government support programmes could cover part of the required investment for the project be executed, leading to lower residual rights controlled by private investors (the investing party usually retains control of the investment; [51]). This type of support could be more necessary in helping projects presenting difficulties to attract the money of private investors. Conversely, indirect government support programmes could be an effective tool in more attractive projects to alleviate the risks faced by private investors during enforcement of the contract, fostering the involvement, engagement, and, consequently, investment of the private partner. Thus, when controlling for the type of government support, we cannot reject H3 when considering indirect support programmes.

Model 4 tests H4. The results achieved show that the support of multilateral development banks positively impacts the project's investment volume. This result allows us not to reject H4 and aligns with previous literature showing a positive impact of MDB support on different aspects of PPP projects, such as the likelihood of success [29,36], or the degree of private participation [5]. MDBs can provide different types of support to PPP projects. In our sample, this support can adopt three forms: equity, guarantee, or loan. Equity means that some MDBs, such as the International Finance Corporation (IFC) or the ADB, are authorized to invest directly in the project; a guarantee refers to coverage of political risk and partial credit guarantees; a loan consists of lending resources to execute the project. Thus, in model 5, we further explore H4 and control for the type of support provided. The results achieved indicate that the effect of MDBs' support is positive when this support is in the form of a guarantee or loan. The estimated coefficient on D_Equity is positive but non-significant. This empirical evidence is interesting for multilateral institutions since it reveals the most effective type of support to promote large investment projects.

Table 3 reports the estimated coefficients for models 6–9. These models allow us to test H5, related to the impact of the economic environment on PPP investment volume. Again, the diagnostic test results confirm the convenience of all models. The estimated coefficients on control variables and the variables testing H1–4 hold their sign and significance, showing the robustness of our results. Focusing on economic environment indicators' estimated coefficients (Heritage_EF, Heritage_PR, Heritage_BF, and Heritage_IF), we can observe that all are positive and significant, meaning that a sounder economic environment favours the establishment of PPP projects with a larger volume of investment. These results lead us not to reject H5. This empirical evidence is not striking, since freedom and security of economic activity are key aspects in the development of PPP agreements. In this regard, Ref. [13] show that economic freedom is essential to the effective execution of PPPs. Ref. [53] find that business friendliness positively impacts the willingness of the private party to take on more risks and responsibilities in port PPP projects. Ref. [37] find that a more open market increases private participation in renewable energy PPPs. Besides, the expropriation risk is highlighted in previous literature as one of the main restraints in the development of PPPs in developing countries [10,44,54]. Thus, it is reasonable that those projects performed in markets that are

Table 3
Empirical results from models 6-9.

	Model 6	Model 7	Model 8	Model 9
Heritage_EF (H5)	0.0112***			
	(0.0040)			
Heritage_PR (H5)		0.0105***		
		(0.0022)		
Heritage_BF (H5)			0.0057***	
			(0.0020)	
Heritage_IF (H5)				0.0049***
				(0.0017)
D_1997	−0.2163***	−0.3137***	−0.2409***	−0.2469***
	(0.0608)	(0.0643)	(0.0612)	(0.0617)
D_2004	0.0190	0.0026	0.0049	0.0292
	(0.0414)	(0.0416)	(0.0414)	(0.0420)
D_Asia	−0.1502	−0.1841	−0.1518	−0.1184
	(0.2031)	(0.2102)	(0.2017)	(0.2047)
D_America	−0.0691	−0.0750	−0.0358	−0.0713
	(0.2053)	(0.2120)	(0.2034)	(0.2067)
D_Africa	0.2651	0.1758	0.2756	0.2580
	(0.2134)	(0.2216)	(0.2118)	(0.2150)
D_Water	−1.4534***	−1.4554***	−1.4477***	−1.4537***
	(0.0718)	(0.0717)	(0.0718)	(0.0718)
D_Energy	−0.7445***	−0.7434***	−0.7419***	−0.7408***
	(0.0515)	(0.0514)	(0.0515)	(0.0515)
D_ICT	−0.2877***	−0.2885***	−0.2922***	−0.2861***
	(0.0643)	(0.0642)	(0.0643)	(0.0643)
Log_GDP	0.4821***	0.4841***	0.4834***	0.4945***
	(0.0315)	(0.0324)	(0.0316)	(0.0324)
Income	−0.0327	−0.0674	−0.0441	−0.0352
	(0.1007)	(0.1041)	(0.1007)	(0.1015)
Rel	−0.5295**	−0.5061*	−0.5365**	−0.4854*
	(0.2526)	(0.2603)	(0.2508)	(0.2552)
Subtype	0.1218***	0.1234***	0.1212***	0.1222***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
D_Competitive	0.1004***	0.0989***	0.1018***	0.1023***
	(0.0369)	(0.0369)	(0.0369)	(0.0369)
D_Gov	0.0416	0.0450	0.0356	0.0468
	(0.0455)	(0.0455)	(0.0455)	(0.0456)
D_MDBs	0.6008***	0.6027***	0.6017***	0.6023***
	(0.0409)	(0.0409)	(0.0409)	(0.0409)
Intercept	−8.7752***	−8.4379***	−8.4777***	−8.6984***
	(0.7896)	(0.7831)	(0.7681)	(0.7908)
Prob > χ^2	1518.82***	1520.41***	1519.1***	1512.92***
LR Test	544.40***	523.99***	543.04***	567.80***
VIF	2.15	2.12	2.16	2.16
Pseudo-R^2	0.3786	0.381	0.3788	0.3736
Obs.	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

more respectful of private property are characterized by a larger volume of investment.

Tables 4 and 5 show the results for models 10–13 and 14–17, respectively. These models allow us to test the impact of different institutional dimensions on the investment volume of PPPs. The diagnostic tests' results show the convenience of all the models. In all models except one (model 13), the estimated coefficient on the variable representing the institutional dimension adopts a positive and significant value.

Models 10 and 11 consider indicators of the overall institutional quality (G and F, respectively). Both models point out the same empirical evidence: a sounder overall institutional environment favours the establishment of PPP projects characterized by a greater investment volume. This result is reasonable since the institutional environment could constitute a source of transaction costs, hindering the development of PPPs [42]. A sounder overall institutional framework leads to lower uncertainties and consequently reduces transaction costs, making it easier to attract private investors to PPP markets. Focusing on the specific dimensions of the institutional environment, five of the six dimensions have a positive and significant impact on the project's investment volume. These dimensions are control of corruption (CC, model 12), political stability (PS, model 14), regulatory quality (RQ, model 15), rule of law (RL, model 16), and voice and accountability (VA, model 17). All these results together allow us not to reject H6. Previous literature has shown the relevance of these institutional dimensions for different aspects of PPP projects. Corruption is a source of inefficiency and transaction costs [55] and is particularly important for large and uncommon projects [56]. Our finding aligns with the empirical evidence obtained by Ref. [4] that lower levels of corruption in the host country of the project favour PPP performance. Similar results are obtained by Ref. [5]. Ref. [37] find that a better record in control of corruption positively impacts the private investors' participation in renewable energy PPPs. The result obtained for PS points out that those projects performed in countries with greater political stability are characterized by a greater investment volume. Previous literature has shown the relevance of political stability for the development of PPPs. Ref. [57] identify PS as one of three critical factors to attract private investment to PPP markets. Ref. [58] point out that the problems emerging from the incompleteness of PPP contracts could be exacerbated in a context of political instability. Given that one of the partners in PPP projects is the government, greater risk of a drastic government change could discourage private investors from engaging in PPP projects with unstable public partners, since the risk of materialization of unforeseen events during the contract execution will be greater. Regulatory quality (RQ) and rule of law (RL) positively impact PPPs' success [5]. In addition, Ref. [13] find that good records on these two institutional dimensions

Table 4
Empirical results from models 10-13.

	Model 10	Model 11	Model 12	Model 13
G (H6)	0.4470***			
	(0.0981)			
F (H6)		0.1385***		
		(0.0368)		
CC (H6)			0.2371***	
			(0.0832)	
GE (H6)				−0.0244
				(0.0824)
D_1997	−0.2563***	−0.2538***	−0.2410***	−0.2194***
	(0.0611)	(0.0612)	(0.0611)	(0.0614)
D_2004	0.0163	0.0094	0.0034	0.0111
	(0.0416)	(0.0413)	(0.0414)	(0.0414)
D_Asia	−0.0675	−0.1196	−0.1229	−0.1337
	(0.2098)	(0.2068)	(0.2051)	(0.2042)
D_America	−0.0395	−0.0336	−0.0386	−0.0324
	(0.2117)	(0.2090)	(0.2072)	(0.2059)
D_Africa	0.2590	0.2326	0.2366	0.2942
	(0.2201)	(0.2179)	(0.2164)	(0.2146)
D_Water	−1.4497***	−1.4511***	−1.4450***	−1.4505***
	(0.0717)	(0.0718)	(0.0718)	(0.0719)
D_Energy	−0.7405***	−0.7429***	−0.7433***	−0.7434***
	(0.0515)	(0.0515)	(0.0515)	(0.0515)
D_ICT	−0.2855***	−0.2905***	−0.2945***	−0.2964***
	(0.0642)	(0.0642)	(0.0643)	(0.0643)
Log_GDP	0.4711***	0.4667***	0.4768***	0.4832***
	(0.0316)	(0.0316)	(0.0316)	(0.0327)
Income	−0.1021	−0.0837	−0.0547	0.0102
	(0.1056)	(0.1045)	(0.1030)	(0.1022)
Rel	−0.5878**	−0.5499**	−0.5429**	−0.5544**
	(0.2600)	(0.2570)	(0.2550)	(0.2534)
Subtype	0.1214***	0.1214***	0.1216***	0.1218***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
D_Competitive	0.0955***	0.0972***	0.0992***	0.1017***
	(0.0369)	(0.0369)	(0.0369)	(0.0369)
D_Gov	0.0430	0.0405	0.0388	0.0373
	(0.0455)	(0.0455)	(0.0455)	(0.0455)
D_MDBs	0.6029***	0.6030***	0.6033***	0.6034***
	(0.0409)	(0.0409)	(0.0409)	(0.0409)
Intercept	−7.5058***	−7.5773***	−7.8150***	−8.2812***
	(0.7775)	(0.7769)	(0.7735)	(0.8182)
Prob > χ^2	1526.84***	1522.29***	1517.24***	1507.5***
LR Test	532.98***	545.46***	567.41***	566.61***
VIF	2.1	2.12	2.14	2.16
Pseudo-R^2	0.3825	0.3784	0.3717	0.369
Obs.	9121	9121	9121	9121

***Significant at 1%; ** Significant at 5%; *Significant at 10%.

Table 5
Empirical results from models 14-17.

	Model 14	Model 15	Model 16	Model 17
PS (H6)	0.2361***			
	(0.0482)			
RQ (H6)		0.3364***		
		(0.0683)		
RL (H6)			0.3591***	
			(0.0805)	
VA (H6)				0.1440**
				(0.0689)
D_1997	−0.2386***	−0.2728***	−0.2523***	−0.2247***
	(0.0604)	(0.0612)	(0.0610)	(0.0612)
D_2004	0.0279	0.0087	0.0240	0.0110
	(0.0413)	(0.0412)	(0.0415)	(0.0415)
D_Asia	−0.0626	−0.0621	−0.1413	−0.0625
	(0.2050)	(0.2071)	(0.2082)	(0.2094)
D_America	−0.0035	−0.0308	0.0078	−0.0674
	(0.2066)	(0.2089)	(0.2106)	(0.2091)
D_Africa	0.2835	0.3200	0.2149	0.3172
	(0.2149)	(0.2171)	(0.2194)	(0.2171)
D_Water	−1.4451***	−1.4572***	−1.4569***	−1.4470***
	(0.0717)	(0.0717)	(0.0717)	(0.0718)
D_Energy	−0.7371***	−0.7392***	−0.7427***	−0.7426***
	(0.0515)	(0.0514)	(0.0515)	(0.0515)
D_ICT	−0.2855***	−0.2812***	−0.2899***	−0.2923***
	(0.0642)	(0.0643)	(0.0642)	(0.0643)
Log_GDP	0.4934***	0.4591***	0.4659***	0.4822***
	(0.0313)	(0.0315)	(0.0316)	(0.0320)
Income	−0.0738	−0.0565	−0.0806	−0.0169
	(0.1017)	(0.1021)	(0.1040)	(0.1020)
Rel	−0.6588**	−0.5574**	−0.5322**	−0.5709**
	(0.2549)	(0.2568)	(0.2586)	(0.2564)
Subtype	0.1216***	0.1210***	0.1212***	0.1220***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
D_Competitive	0.0962***	0.0963***	0.0979***	0.1002***
	(0.0369)	(0.0369)	(0.0369)	(0.0369)
D_Gov	0.0452	0.0422	0.0389	0.0385
	(0.0455)	(0.0455)	(0.0455)	(0.0455)
D_MDBs	0.6040***	0.6003***	0.6040***	0.6031***
	(0.0408)	(0.0408)	(0.0409)	(0.0409)
Intercept	−8.1981***	−7.4391***	−7.4359***	−8.1422***
	(0.7540)	(0.7724)	(0.7797)	(0.7722)
Prob > χ^2	1540.9***	1533.98***	1526.94***	1506.84***
LR Test	608.16***	532.20***	551.35***	501.65***
VIF	2.14	2.11	2.1	2.15
Pseudo-R^2	0.3656	0.3865	0.38	0.382
Obs.	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

are essential for the effective execution of PPPs. Ref. [59] highlights the relevance of effective regulatory quality to the growth of investment in PPP markets. Regulatory quality determines the operational effectiveness of private contractors. PPPs established in frameworks where the regulation does not hinder the operations of private contractors will be more attractive for these contractors. Furthermore, an independent judicial system that does not necessarily favour the government when a conflict between the public and private partners emerges is a key factor to attract the attention of private investors to PPP projects [42]. Finally, the estimated coefficient on VA is positive and significant, meaning that those projects performed in institutional environments with better records in this institutional dimension are characterized by a greater volume of investment. Better records in this dimension lead to more transparency, an important attribute to achieve efficiency and attract private investors [27].

Table 6 shows the results for models 18–21. These models allow us to test H7a. Diagnostic tests confirm the convenience of the models performed. The results for MDBs' support and the economic dimension hold the conclusions extracted from models 4 (Table 2) and 6–9 (Table 3). Focusing on the estimated coefficients on interaction terms, we observe that for three out of four economic environment indicators, these coefficients are negative and significant (Heritage_EF, model 18; Heritage_PR, model 19; Heritage_IF, model 20). This means that the positive effect of MDBs' support on PPPs' investment volume is moderated by a sounder economic environment. These results align with previous literature showing that MDBs' participation in PPP markets is higher in poorer countries and countries with undeveloped financial systems [28], and that MDBs' support is more relevant to attract private investors in renewable energy PPPs when these projects are performed in weak economic frameworks [37]. The empirical evidence obtained leads us not to reject H7a.

Tables 7 and 8 show the results for models 22–29. These models test H7b. Diagnostic tests show again the convenience of the models performed. The results for MDBs' support and the impact of institutional indicators on PPPs' investment volume support the conclusions obtained previously (model 4 and models 10–17, respectively). With regard to the estimated coefficients on interaction variables, we obtain negative and significant results for the two indicators of overall institutional quality (G, model 22 and F, model 23) and three of the six institutional dimensions (CC, model 24; RL, model 28; and VA, model 29).

This empirical evidence points out that MDBs' support has a greater impact on projects' investment volume when the PPPs are performed in institutional environments with weaknesses and leads us not to reject H7b. This finding aligns with previous literature. Ref. [28] finds that MDBs' participation in PPPs is greater in countries with undeveloped legal systems. Ref. [36] finds that MDBs' support affects PPPs' success more when the projects are established in countries with weak institutional development. Ref. [37] find that the support of MDBs is more relevant for attracting private investors to renewable energy PPPs when these projects are performed in weak institutional environments. The empirical evidence related to H7a and H7b reveals an interesting role for MDBs, which emerge as substitutes for the local economic and governance institutions to promote local PPP markets. That is to say, countries with good records on economic and institutional indicators would not need the support of MDBs to achieve the establishment of large investment infrastructure projects.

Table 7
Empirical results from models 22-25.

	Model 22	Model 23	Model 24	Model 25
D_MDBs	0.6011***	0.5943***	0.5963***	0.5896***
	(0.0409)	(0.0411)	(0.0411)	(0.0419)
G	0.5014***			
	(0.1022)			
MDBs*G (H7b)	−0.2029**			
	(0.1018)			
F		0.1596***		
		(0.0384)		
MDBs*F (H7b)		−0.0816**		
		(0.0396)		
CC			0.2766***	
			(0.0862)	
MDBs*CC (H7b)			−0.1732*	
			(0.0968)	
GE				0.0108
				(0.0858)
MDBs*GE (H7b)				−0.1478
				(0.0996)
Subtype	0.1224***	0.1223***	0.1223***	0.1224***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
D_Competitive	0.0971***	0.0978***	0.0997***	0.1021***
	(0.0369)	(0.0369)	(0.0369)	(0.0369)
D_Gov	0.0433	0.0414	0.0397	0.0378
	(0.0455)	(0.0455)	(0.0455)	(0.0455)
Intercept	−7.6640***	−7.5825***	−7.9400***	−8.2565***
	(0.7770)	(0.7812)	(0.7720)	(0.8148)
CONTROLS	YES	YES	YES	YES
Prob > χ^2	1528.29***	1523.87***	1518.69***	1508.35***
LR Test	527.40***	543.78***	566.27***	567.93***
VIF	2.14	2.1	2.11	2.14
Pseudo-R^2	0.3838	0.3792	0.3722	0.3691
Obs.	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

Table 6
Empirical results from models 18-21.

	Model 18	Model 19	Model 20	Model 21
D_MDBs	0.6147*** (0.0413)	0.6041*** (0.0409)	0.6083*** (0.0417)	0.6372*** (0.0421)
Heritage_EF	0.0150*** (0.0043)			
MDBs*Heritage_EF (H7a)	−0.0145** (0.0063)			
Heritage_PR		0.0123*** (0.0024)		
MDBs*Heritage_PR (H7a)		−0.0066** (0.0031)		
Heritage_BF			0.0063*** (0.0022)	
MDBs*Heritage_BF (H7a)			−0.0029 (0.0035)	
Heritage_IF				0.0072*** (0.0018)
MDBs*Heritage_IF (H7a)				−0.0093*** (0.0026)
Subtype	0.1228*** (0.0094)	0.1242*** (0.0094)	0.1214*** (0.0094)	0.1227*** (0.0094)
D_Competitive	0.0987*** (0.0369)	0.0984*** (0.0369)	0.1022*** (0.0369)	0.1010*** (0.0369)
D_Gov	0.0433 (0.0455)	0.0462 (0.0455)	0.0353 (0.0455)	0.0514 (0.0456)
Intercept	−8.1988*** (0.7671)	−8.0927*** (0.7878)	−8.1596*** (0.7628)	−8.6124*** (0.7893)
CONTROLS	YES	YES	YES	YES
Prob > χ^2	1520.21***	1520.57***	1518.9***	1518.97***
LR Test	538.46***	521.96***	540.85***	560.42***
VIF	2.13	2.08	2.13	2.14
Pseudo-R^2	0.3797	0.3819	0.379	0.3752
Obs.	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

Table 8
Empirical results from models 26-29.

	Model 26	Model 27	Model 28	Model 29
D_MDBs	0.6044***	0.6010***	0.5889***	0.6191***
	(0.0408)	(0.0409)	(0.0412)	(0.0416)
PS	0.2453***			
	(0.0505)			
MDBs*PS (H7b)	−0.0364			
	(0.0585)			
RQ		0.3532***		
		(0.0717)		
MDBs*RQ (H7b)		−0.0658		
		(0.0847)		
RL			0.4297***	
			(0.0847)	
MDBs*RL (H7b)			−0.2683***	
			(0.0940)	
VA				0.1746**
				(0.0707)
MDBs*VA (H7b)				−0.1400**
				(0.0686)
Subtype	0.1218***	0.1213***	0.1222***	0.1228***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
D_Competitive	0.0970***	0.0965***	0.0974***	0.1027***
	(0.0369)	(0.0369)	(0.0368)	(0.0369)
D_Gov	0.0452	0.0428	0.0388	0.0374
	(0.0455)	(0.0455)	(0.0454)	(0.0455)
Intercept	−8.3424***	−7.4983***	−7.5716***	−8.2218***
	(0.7556)	(0.7722)	(0.7807)	(0.7749)
CONTROLS	YES	YES	YES	YES
Prob > χ^2	1541.15***	1533.36***	1531.64***	1508.91***
LR Test	607.85***	531.90***	550.08***	490.20***
VIF	2.12	2.09	2.07	2.11
Pseudo-R^2	0.3655	0.3867	0.3812	0.3854
Obs.	9121	9121	9121	9121

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

We have performed several additional analyses to test the robustness of our empirical findings. Firstly, we estimated all the models, considering the hierarchical structure of our data more exhaustively. Thus, we control for the continents and regions where the project is established through the estimation technique [11]. For that, we regress GLM with multilevel fixed effects, allowing the intercepts of regressions varying across countries, regions and continents. The source of information on the regions is the WBPI database. This additional analysis allows us better to control the idiosyncratic geographical factors that affect our empirical findings. Secondly, we use the log of investment in physical assets instead of the log of total investment as a proxy of the dependent variable. Thirdly, we consider an alternative specification for all the models by building a dummy variable that identifies those projects characterized by a greater volume of investment in our sample (those with a total investment volume above the median) as a proxy of the dependent variable. Thus, we estimate all the models with multilevel mixed-effects logistic regressions as an alternative method of estimation. Fourthly, we consider a stricter definition of projects with a greater volume of investment, and we build a dummy variable adopting the value of 1 when the investment volume of the project is above the 75th percentile. Finally, we consider alternative proxies for the economic and institutional environments. More concretely, as proxies of the economic environment, we use net foreign direct investment (FDI) inflows, expressed as a percentage of GDP, and the sum of exports and imports divided by GDP. Both variables have been used previously in academic literature to measure the attractiveness and openness of an economy (see, among many others, [60,61]). The source of data for building these variables is the World Bank. In the case of the institutional environment, we use "Polconv" from Ref. [62] and the variable labelled "Checks" in the Database of Political Institutions of the World Bank. The Polconv index measures the stability of the political system by quantifying the number of independent branches of power—the executive, legislative and judicial powers—with veto power over policy changes in each country, as well as the degree of alignment between them. The greater the number of branches of power with veto capacity and the lower the alignment between them, the more difficult it is for politicians to change regulations unilaterally, which offers a safer institutional environment for investors [63]. "Checks" is precisely the variable that Professor Henisz himself recommends using on his website as a robustness measure for Polconv. The existence of checks and balances on a country's powers is an indicator of a sounder institutional environment in this country since, similarly to Polconv, this indicates greater difficulty for one of its powers (legislative, executive, or judicial) taking decisions unilaterally, the institutional environment being less uncertain.

In most robustness analyses, the estimated coefficients on the variables that allow us to test the research hypotheses hold the sign and significance of the models reported in Tables 2–8. All these analyses are unreported for the sake of brevity and are available upon request from the authors.

5. Conclusions

PPPs constitute a growing popular transaction governance mechanism to provide infrastructure, especially in developing economies. Academic literature has analysed different matters surrounding PPPs but others remain underexplored. This is the case for determinants of the volume of investment, an interesting topic due to the growing relevance of high-investment infrastructure projects in the last years.

This research fills this gap by analysing a broad sample of PPPs (9121 projects) performed in 107 developing countries in the period 1997–2017. Our findings show that those projects in which the private partner takes more risks and responsibilities, the contract award method is competitive, and the project benefits from indirect government support programmes are characterized by a larger investment volume. These results are relevant to practitioners since they reveal some keys to the development of large PPPs. For instance, PPPs' sponsors should promote contractual forms with the highlighted characteristics to attract investment to PPP markets.

Furthermore, our findings show that governments should engage in indirect support programmes to be more effective in formalizing large investment PPPs. Another relevant factor to promote large investment PPPs is the support provided by MDBs. Our results extend previous empirical evidence controlling for the type of support and show that guarantees and loans are the more effective way to attract money to PPP markets. The economic and institutional frameworks also impact PPPs' investment volume. Thus, a more open and business-friendly economy where the investment flows move freely and the property rights enjoy high protection constitutes the proper environment to establish large investment PPPs. In addition, a sounder institutional environment characterized by control of corruption, political stability, and good records on regulatory quality, rule of law, and voice and accountability relates positively to the execution of large investment PPPs. Public authorities should pursue the continuous improvement of these economic and institutional indicators to create a more favourable environment for the establishment of large infrastructure projects.

Economic and institutional environments not only impact directly on PPPs' investment volume but also interact with MDBs' support effect. Thus, our findings reveal that this type of support is more relevant when the projects are performed in economic and institutional environments presenting weaknesses. These results are of interest for MDBs, which should direct their support towards PPPs performed in countries presenting these weaknesses to be more effective in their promotion of large investment PPPs.

Despite the controls at the project level, it is necessary to consider a potential limitation that emerges from the nature of the dependent variable (the volume of investment in the project). It is possible for some projects that the volume of investment is capped by the government or by other technical factors related to the project. Further research should shed light on this issue. Additionally, further research could enlarge the

empirical evidence provided in this paper. Although the sample analysed in the present research is exhaustive, it focuses on projects performed in developing economies. Further research should explore the factors that favour the establishment of high-investment infrastructure projects in developed markets, where economic and institutional environments present different characteristics. Furthermore, we focus in this research on the role played by formal institutions in the promotion of large investment projects. However, it could be interesting to explore the influence of cultural factors. The huge impact of high-investment projects on people's lives and the communities where they are deployed makes analysis of how local culture and values shape the execution of this type of project of interest. Furthermore, data availability did not allow the inclusion of some relevant controls at the firm level of characteristics in our analyses. Another avenue for further research is to explore more deeply the firm-level characteristics. Lastly, the present work analyses factors that determine investment volumes, but this does not mean that the greater the volume invested, *ab initio*, the greater the probability of being successful in its construction. High-investment infrastructure projects are characterized by their large investment volume, complexity, uncertainty, and the involvement of a large number of public and private partners, sometimes with conflicting interests [64]. In consequence, this kind of project is not free of delays and overruns and we can find academic literature questioning their performance (see, among others, [18,19]). That is why this paper is based on the premise that projects that facilitate greater investment may have certain advantages over those that do not.

CRediT authorship contribution statement

Jorge Fleta-Asín: Conceptualization, Methodology, Software, Data curation, Investigation, Formal analysis, Writing- original draft, Writing-review & editing. **Fernando Muñoz:** Conceptualization, Methodology, Software, Data curation, Investigation, Formal analysis, Writing- original draft, Writing-review & editing.

Declaration of competing interest

None.

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Appendix 1

Table A.1
Matrix Correlation (Part I)*

	Log_Invest	Subtype	D_Competitive	D_Gov	D_Gov_Direct	D_Gov_Indirect	D_MDBs	D_Equity	D_Guarantee	D_Loan
Subtype	**0.1087**									
D_Competitive	**0.0643**	**−0.3462**								
D_Gov	**0.0426**	**−0.1713**	**0.0935**							
D_Gov_Direct	**0.0206**	**−0.2082**	**0.1583**	**0.6524**						
D_Gov_Indirect	**0.0374**	**−0.0309**	**−0.0249**	**0.7047**	**−0.0678**					
D_MDBs	**0.1065**	**0.1198**	**−0.0714**	**−0.0617**	**−0.0705**	−0.0151				
D_Equity	**0.0411**	**0.086**	**−0.0687**	**−0.0597**	**−0.0334**	**−0.0477**	**0.4506**			
D_Guarantee	**0.0845**	**0.0536**	−0.0158	**−0.0313**	**−0.0477**	0.0028	**0.4295**	**0.0498**		
D_Loan	**0.0837**	**0.1099**	**−0.0686**	**−0.0552**	**−0.0566**	**−0.0202**	**0.8789**	**0.3875**	**0.1053**	
Heritage_EF	**0.0889**	0.0078	**0.0599**	**−0.0202**	**−0.0461**	**0.0185**	**0.0772**	**0.0183**	**−0.0205**	**0.0925**
Heritage_PR	**0.1373**	**−0.1204**	**0.1456**	**−0.0421**	**−0.0333**	**−0.025**	**−0.0195**	0.0038	0.0103	**−0.027**
Heritage_BF	**0.067**	**0.0916**	−0.01	**−0.0757**	**−0.1135**	0.0078	**0.0921**	**0.0641**	−0.0156	**0.0964**
Heritage_IF	**0.0611**	**0.0382**	**0.0475**	**−0.1246**	**−0.1084**	**−0.062**	**0.1255**	**0.0435**	0.0084	**0.1344**
G	**0.1169**	**−0.1391**	**0.1797**	0.0124	−0.0019	**0.0179**	**−0.0506**	**−0.0377**	**−0.037**	**−0.0484**
F	**0.114**	**−0.1735**	**0.1801**	**0.0617**	**0.0582**	**0.0269**	**−0.1042**	**−0.0568**	**−0.0605**	**−0.0974**
CC	**0.0782**	**−0.1827**	**0.182**	**0.0246**	**0.0325**	0.0016	**−0.0957**	**−0.0676**	**−0.0486**	**−0.0878**
GE	**0.0989**	**−0.1925**	**0.1411**	**0.1239**	**0.1357**	**0.0371**	**−0.1725**	**−0.0717**	**−0.1007**	**−0.1588**
PS	**−0.0638**	**−0.0519**	0.0074	**−0.0932**	**−0.1062**	**−0.0236**	**0.0207**	−0.0092	−0.0011	**0.0263**
RQ	**0.1132**	**−0.0668**	**0.1075**	0.0123	0.0047	0.0133	**−0.0284**	**−0.0187**	**−0.0506**	**−0.0228**
RL	**0.125**	**−0.1534**	**0.163**	**0.1146**	**0.092**	**0.0642**	**−0.1047**	**−0.0383**	**−0.0446**	**−0.1037**
VA	**0.1735**	**−0.0496**	**0.207**	**−0.0336**	**−0.0587**	0.0094	**0.0479**	0.0007	**0.0243**	**0.0343**
D_1997	**−0.1416**	**0.0307**	**−0.177**	**−0.1784**	**−0.1101**	**−0.132**	**0.0478**	**0.0448**	**0.0207**	**0.0428**
D_2004	−0.0092	**0.0549**	**0.0767**	**−0.1945**	**−0.0896**	**−0.1722**	0.0064	**0.0252**	0.0071	−0.0012
D_Asia	**−0.0366**	**−0.1006**	**−0.0634**	**0.1896**	**0.1827**	**0.0782**	**−0.1543**	**−0.054**	**−0.0431**	**−0.1619**
D_America	**0.0488**	**−0.1376**	**0.1581**	**−0.0825**	**−0.0756**	**−0.038**	**0.0589**	**−0.018**	0.0001	**0.0603**
D_Africa	−0.0126	**0.1384**	**−0.051**	**−0.0889**	**−0.0882**	**−0.0341**	**0.1041**	−0.0012	**0.1046**	**0.1178**
D_Water	**−0.2059**	**−0.2572**	**0.151**	**0.0812**	**0.0999**	0.0123	**−0.0892**	**−0.0542**	**−0.0447**	**−0.0763**
D_Energy	**−0.0381**	**−0.0631**	**0.0437**	**0.1839**	**−0.0216**	**0.2608**	**−0.0401**	**−0.0845**	−0.0114	**−0.0342**
D_ICT	**0.0668**	**0.5478**	**−0.3259**	**−0.3117**	**−0.1986**	**−0.2243**	**0.1657**	**0.1601**	**0.0758**	**0.1367**
Log_GDP	**0.1564**	**−0.3429**	**0.2182**	**0.2223**	**0.2343**	**0.0721**	**−0.2565**	**−0.1247**	**−0.0762**	**−0.2694**
Income	**0.055**	**−0.1464**	**0.0766**	0.004	**0.0192**	−0.0114	**−0.1116**	**−0.0549**	**−0.0843**	**−0.1187**
Rel	**−0.1451**	**−0.0979**	−0.0125	**−0.0339**	**−0.0279**	**−0.0199**	**−0.0625**	**−0.0464**	**0.0488**	**−0.072**

* The correlations significant at 10% are highlighted in bold.

Table A.1
Matrix Correlation (Part II)*

	Heritage_EF	Heritage_PR	Heritage_BF	Heritage_IF	G	F	CC	GE	PS	RQ	RL	VA
Heritage_PR	**0.5263**											
Heritage_BF	**0.6528**	**0.2758**										
Heritage_IF	**0.6692**	**0.4351**	**0.4673**									
G	**0.5717**	**0.6488**	**0.36**	**0.456**								
F	**0.5616**	**0.6231**	**0.3678**	**0.3825**	**0.9486**							
CC	**0.4695**	**0.5352**	**0.3409**	**0.3395**	**0.8713**	**0.9412**						
GE	**0.4569**	**0.4323**	**0.3146**	**0.1714**	**0.7377**	**0.849**	**0.7194**					
PS	**0.203**	**0.1183**	**0.1777**	**0.1693**	**0.5896**	**0.4388**	**0.4514**	**0.2655**				
RQ	**0.7319**	**0.5124**	**0.5077**	**0.5484**	**0.8141**	**0.8233**	**0.7057**	**0.6978**	**0.3623**			
RL	**0.4061**	**0.6616**	**0.1922**	**0.2665**	**0.8305**	**0.8835**	**0.7615**	**0.7214**	**0.2914**	**0.6125**		
VA	**0.3882**	**0.6588**	**0.1717**	**0.4776**	**0.6978**	**0.5417**	**0.4767**	**0.257**	**0.1598**	**0.4523**	**0.5361**	
D_1997	**0.0317**	**0.2673**	**0.1397**	**0.2605**	**0.0843**	**0.0612**	**0.0519**	**0.0199**	**0.1343**	**0.0924**	**0.0443**	**0.0209**
D_2004	**−0.0838**	**−0.1323**	−0.0139	**−0.1738**	**−0.1373**	**−0.1322**	**−0.0807**	**−0.1193**	**−0.102**	**−0.1365**	**−0.1605**	**−0.0477**
D_Asia	**−0.2117**	**−0.1057**	**−0.2508**	**−0.4156**	**−0.2222**	**−0.0402**	**−0.1235**	**0.2137**	**−0.3499**	**−0.211**	**0.1714**	**−0.3868**
D_America	**0.3208**	**0.2713**	**0.2528**	**0.4007**	**0.3791**	**0.2654**	**0.3385**	**0.0928**	**0.273**	**0.344**	0.0063	**0.4686**
D_Africa	**−0.0472**	**−0.0676**	**−0.0312**	**0.0525**	**−0.1693**	**−0.1939**	**−0.128**	**−0.293**	**0.019**	**−0.217**	**−0.1361**	**−0.0945**
D_Water	**−0.0698**	**−0.127**	**−0.0829**	**−0.1291**	**−0.0486**	0.0145	0.0142	**0.1278**	**0.0473**	**0.0177**	**−0.0293**	**−0.2555**
D_Energy	**0.0779**	**0.0487**	**0.018**	0.0057	**0.1681**	**0.1809**	**0.1716**	**0.1699**	**0.0653**	**0.1388**	**0.1537**	**0.0995**
D_ICT	**−0.036**	**−0.0806**	**0.0826**	**0.0625**	**−0.1978**	**−0.2587**	**−0.2327**	**−0.3154**	**−0.029**	**−0.1732**	**−0.2338**	**−0.0448**
Log_GDP	**−0.1247**	**0.1181**	**−0.1867**	**−0.2516**	**0.2038**	**0.3136**	**0.2642**	**0.4898**	**−0.0603**	**0.1811**	**0.2751**	0.0017
Income	**0.2406**	**0.0957**	**0.3297**	**0.1567**	**0.3777**	**0.3987**	**0.3994**	**0.4485**	**0.34**	**0.4639**	**0.144**	**0.0377**
Rel	**−0.2202**	**−0.1657**	**−0.1817**	**−0.2924**	**0.0218**	0.011	**0.0748**	−0.0008	**0.3329**	**−0.044**	**−0.0561**	**−0.1987**

*The correlations significant at 10% are highlighted in bold.

Table A.1
Matrix Correlation (Part III)*

	D_1997	D_2004	D_Asia	D_America	D_Africa	D_Water	D_Energy	D_ICT	Log_GDP	Income
D_2004	**−0.4373**									
D_Asia	**−0.0405**	−0.0079								
D_America	**0.0729**	**−0.0376**	**−0.6248**							
D_Africa	**−0.0304**	**0.0327**	**−0.3365**	**−0.2711**						
D_Water	−0.0145	**0.0462**	**0.1332**	**−0.037**	**−0.0828**					
D_Energy	**−0.0896**	**−0.1254**	**0.0499**	**0.111**	**−0.1823**	**−0.2425**				
D_ICT	**0.1074**	**0.0949**	**−0.1975**	**−0.109**	**0.2898**	**−0.2073**	**−0.6299**			
Log_GDP	**−0.1564**	**−0.1045**	**0.2605**	**0.1171**	**−0.4396**	**0.2353**	**0.2189**	**−0.4739**		
Income	**0.0546**	**−0.0537**	**−0.1887**	**0.4253**	**−0.471**	**0.1696**	**0.1422**	**−0.229**	**0.4967**	
Rel	0.0022	−0.0055	**−0.1086**	**−0.0739**	**0.2219**	**0.1541**	**0.0303**	**−0.0825**	**0.148**	**0.0913**

* The correlations significant at 10% are highlighted in bold.

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