EFFECT OF PUBLIC-PRIVATE PARTNERSHIP PROJECTS ON INEQUALITY IN DEVELOPING COUNTRIES

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ABSTRACT

This study examines the effect of public-private partnerships (PPPs) on income inequality, focusing on economic infrastructures. For that, we use a sample composed of data from 38 low- and middle-income countries over the period 2000-2018. The empirical findings suggest that inequality has not been reduced; by contrast, income inequality has increased in countries that have developed PPP projects to a greater extent. This study offers practical implications about the social cost that the PPP formula has in developing countries.

Keywords: Inequality; PPP; Public-Private Partnership; Developing Countries; Income.

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1. INTRODUCTION

Infrastructure services has long been viewed as an essential way for economic development and they may also impact on income inequality (Calderón and Servén, 2010a; 2010b; 2014). *Income* refers to household disposable income (earning, self-employment and capital income and public transfers, excluding income taxes and social security contributions); and, *inequality* is reflected in the share of income accruing to a portion of the population ranked by income levels, that is, the gap between rich and poor (OECD, 2011; 2015).

According to Estache (2003), infrastructure provision may have an effect on the income and welfare, especially affecting the poor, by raising the value of the assets they hold (land or human capital), or by lowering the transaction costs (like transport and logistical costs) they incur to access the markets for their inputs and outputs. Infrastructure facilitates the poor's access to productive opportunities (Calderón and Servén, 2014) and integrates individuals into social and economic life (World Bank, 2003) through access to telecommunications, electricity, roads, water, sanitation, etc. In addition, basic infrastructure positively affects health outcomes, especially through water and sanitary services (Galiani et al., 2005). For infrastructure development to reduce income inequality, the key ingredient is that it must help expand access and affordability by the poor (Estache, Gomez-Lobo, and Leipziger, 2001). Access refers to connection facilities and their affordability (Bagnoli et al., 2023).

One of the main advantages of PPPs is the efficiency gains[3] (Ruiz-Núñez, Dinthilac, and Wei, 2016; Trebilcock and Rosenstock, 2015), but the way in which these efficiency gains are shared with users may affect income distribution (World Bank, 2016). This issue has

[3] For further information about gains, please, check Estache and Saussier (2014).

been hardly investigated until now, since most of the literature is focused on the privatization reforms (Estache, Gomez-Lobo, and Leipziger, 2001).

To empirically check the effect of the use of the PPP model for infrastructure services on income inequality, several econometric models are estimated by using a sample from 38 low- and middle-income countries collected for the period 2000-2018. Our results suggest that, although income levels have increased across the population when PPP projects have been carried out, the gap between the richest and the poorest remains high because of the disproportionate income share held by the wealthiest 10%. Thus, income inequality has not been reduced after implementing PPP projects. These findings contribute towards filling one of the research gaps highlighted by Cui *et al*. (2018), which is the social impact assessment.

The rest of the document is structured as follows: section 2 reviews the PPP literature; section 3 focuses on theories and the research question; section 4 describes the methodological framework; the fifth section demonstrates the descriptive and empirical results; and the last section concludes the paper, as well as indicating the limitations and some ideas for future research.

2. THE CONCEPT OF PPP

The PPP model can be considered a governmental entrepreneurial movement (Bloomfield, 2006) in which a public partner shares responsibility with a private partner (Hodge, 2006). The antecedents of this model were the power purchase agreements (PPAs) used by the USA government to facilitate the independent projects of energy producers in the 1980s, as well as the private finance initiative (PFI), launched in 1992 in the UK (Yescombe, 2007). Since then, it has been a popular strategy across the world for

implementing infrastructure projects, especially in developing countries (Hodge and Greve, 2018).

Despite its popularity, there is no common definition of a PPP (Roehrich *et al.*, 2014). As Hodge and Greve (2007) summarise, ones see PPPs as a new public management tool that will replace the traditional method of contracting for public services through competitive tendering and involving private organisations in the delivery of public services (Linder, 1999).

This study uses the approach of Hodge and Greve (2007), who define PPPs as organisational and financial arrangements between the public and the private sector, which enable the public sector to make use of private finance capital in order to develop infrastructure projects. The core of this approach is "cooperation" between both sectors, which have different qualities, and if those qualities are combined, the result will be better for all of them (Vaillancourt Rosenau, 2000).

Concretely, data about PPP are retrieved from the Private Participation in Infrastructure (PPI) database[4], which is provided by the World Bank's Public Private Partnership Group. It covers contractual arrangements for public infrastructure projects that are owned or managed by a private company/investor. Projects are considered to have private participation if a private company/investor is (at least partially) responsible for operating cost and associated risks. This could be by either having the rights to operate alone or in association with a public entity or owning an equity share in the project. This represents the core of the PPP approach, that is "cooperation" and "risk sharing" between private and public sectors.

[4] Further information: https://ppi.worldbank.org/en/ppi

Regarding activity sectors, this study is focused on the waste collection and transport, waste treatment/disposal, utilities, treatment plant, airports, ports, railways, roads, electricity and ICT (infrastructure cable assets).

All these infrastructures are key means of raising living standards and so a determinant of income inequality (Trebilcock and Rosenstock, 2015; Calderón and Servén, 2010).

3. LITERATURE REVIEW ABOUT PPP

After an exhaustive literature review, de Castro e Silva Neto *et al*. (2016) and Cui *et al*. (2018) highlighted the most relevant issues in PPP literature: contract design, management and performance, risk management and success factors, the costs and benefits of the model, financial issues, value for money, and political and institutional issues. However, Cui *et al*. (2018) noted a research gap regarding the social impact assessment of PPPs. This study contributes towards filling this gap by analysing the impact in terms of income inequality.

The effect of PPP model on income inequality has been previously investigated in education and the health sector. The main conclusion is that public-private arrangements reinforce inequality, especially in developing countries, like Israel (Filc and Davidovitch, 2016), Sri Lanka (Kumar *et al*., 2022), Peru (Gianella, Gideon, and Romero, 2021), Mexico and India (Rodríguez and Rodríguez, 2017), but also in Europe (De Oliveira, 2020), UK and USA (Verger, Moschetti, and Fontdevil, 2021).

Regarding economic infrastructures, literature is much more limited. The vast majority is focused on waste and water management, and the main conclusion is similar to the education and health sectors, that is, PPP results in an increase of inequalities, especially in developing countries. For instance, Makamté Kakeu-Tardy and Véron (2019) concluded that the use of PPPs for waste management services have contributed to

increasing socio-spatial inequalities in Cameroon. In Mozambique, Tvedten and Candiracci (2018) showed that, while PPPs may help to handle the complex issue of waste management in the informal areas, this model does not end spatial and social inequalities. Adama (2018) analysed the case of the Lagos Magacity Project (Nigeria), concluding that the PPP model reinforced socio-spatial exclusion and confirmed the persistent inequalities. Ioris (2012) determined that the use of the PPP model in the water sector in Peru, failed to address persistent water management problems, such as the discriminatory treatment of low-income residents. In the case of energy sector, Neusiedl (2017) investigated the effects of PPP in Bangladesh, concluding that this model had resulted in further inequality and poverty. On the contrary, Grogan (2018) found improvements in sanitation services and physical structure of dwelling, as well as a reduction in indicators of extreme poverty in Guatemala, thanks to the PPP created to provide electricity to households.

4. RESEARCH HYPOTHESIS

The PPP model is one of the reforms under the umbrella of the New Public Management (NPM), along with others like corporatisation, contracting-out, private finance initiatives, and the privatisation (Torres and Pina, 2002). NPM seeks to modernized public administrations by applying formulas derived from the private sector, by changing the organisational structure and the way in which services are provided (Hood 1995; Van Helden 2000). NPM has promoted the use, specifically in infrastructures, of public private partnerships (PPPs),—that is the arrangements between public administration and private firms for financing, building and operating infrastructures such as transportation, electricity, telecommunication, or water facilities (Kwak, Chih, and Ibbs, 2009). The aim is to achieve a market-oriented outlook in order to increase efficiency, effectiveness and productivity by the use of tools such as PPPs, among others (Diefenbach 2009).

In line with the NPM aim, there are also proponents of PPP projects who argue that these provide better efficiency in providing and running infrastructure services, especially in a developing country (Nwangwu, 2016). However, those efficiency gains do not always result into a reduction in tariffs due to initial prices below cost recovery (with subsidies not always well targeted to the poor), or with the private sector retaining part of the profit (World Bank, 2016). Other times, selling prices grow more than their unit costs in order to increase margins, which increase inflation rate, harming purchasing power. Indeed, Chisari et al. (2007, 2009) find negative short-term effects on the lowest income classes associated with price increases. Bagnoli et al (2023) found that the lowest quintiles of the income distribution need to spend much more than the higher-income classes on utilities. Furthermore, critics see PPPs as instruments which can lead to perverse incentive structures that allow opportunism and corruption (Gailmard, 2014). Bertelli et al. (2020) analyze the impact of PPPs in over 4,000 infrastructure PPPs funded by the World Bank between 1990 and 2015 in 89 low- and middle-income countries. They confirm the theoretical claim that PPPs are less likely to be cancelled in countries with more veto points among their political institutions to restrain politicians from intervening in policy implementation. This finding provides further evidence for the long-lasting hypothesis that in settings with more checks and balances on politicians, the chances that the "political Coase theorem" holds increase (Acemoglu, 2003).

Research on outcome evaluation and effectiveness often concludes that PPPs do not systematically deliver promised results. Some researchers (e.g., Wettenhall, 2003, Hodge and Greve, 2009) reveal the gap between rhetoric and reality and between policy and practice (Brinkerhoff, 2002) but there are no studies that analyse the effects of the PPP model in infrastructure on income inequality.

Following previous arguments, we propose the following hypothesis:

H0: PPP projects tend to increase income inequality.

5. METHODOLOGICAL FRAMEWORK

5.1. Sample and empirical model

To test the hypothesis, we use a panel dataset composed by 38 low- and middle-income countries (see Appendix A1) in the period 2000-2018. The selection of this sample is conditioned by the availability of data about PPPs and income inequality.

Regarding PPPs, this study uses data published on the PPI database[5], which is provided by the World Bank's Public Private Partnership Group. It fits with the definition of PPP previously provided, that is infrastructure projects that are owned or managed by a private company. Concretely, it considers that a private entity/investor participates in a project when it assumes at least 20% of the participation in the contract, except for divestitures which are included if at least 5% of the equity is held by private parties. The PPI Project Database records, amongst other data points: the basic project information (location, project name, project company name, sector and subsector, type of PPI), the sponsors and their equity shares/commitments, any direct and indirect government support, debt providers and amount of debt, multilateral and bilateral support, award type and bid criteria, government level of the contracting authority, and revenue sources. From all this information, this study uses two indicators to represent PPP projects, following Cuadrado-Ballesteros and Peña-Miguel (2022) and Peña-Miguel and Cuadrado-Ballesteros (2023):

- *PPP* is the number of contractual agreements (that meet the characteristics described above) for public infrastructure projects per year, counting only the closed legal agreements.

[5] Further information is described in more detail on the website: https://ppi.worldbank.org/en/ppi.

- *Proceeds* is the sum of two investments:

  (i) The investments in physical assets (millions of US dollars), that is, the total cost of developing or expanding the facility during the contract period. These data refer to the year of financial or contractual closure. For agreed further expansions, the investment commitments are recorded in the year the expansion was agreed.

  (ii) The commitments to the government for obtaining the rights to provide a public service, through divestiture revenues, licence or concession fees, or lease payments (millions of US dollars). These investments are recorded in the years in which the transactions take place. Where investments in acquiring government assets are due over the period of a concession, an estimate of their present value is recorded in the year of financial or contractual closure.

PPI Database has data on over 6,400 infrastructure projects in 137 low- and middle-income countries as classified by the World Bank. However, our sample covers only 38 countries because of the unavailability of data that represent the another key concept of this study, that is income inequality. Concretely, this study uses three indicators that have been obtained from the World Development Indicators (WDI) collection:

- *GINI* denotes the Gini index, which measures the dispersion of income inequality within an economy through a Lorenz Curve. A Gini coefficient of zero means perfect equality and a coefficient of 100 perfect inequality.
- *Richest* refers to the share of total national income that is in the hands of the richest 10% of the population. So, a greater value of *Richest* represents a higher level of income inequality.

- *Poorest* represents the mean income deficit from the poverty line of $5.50 per day (based on 2011 purchasing power parity). Thus, the higher the value of *Poorest*, the greater the income inequality.

In addition, empirical results consider different factors that may also affect income inequality, along with PPPs. These factors have been selected on the evidence obtained previously in the literature (e.g., Roine *et al*., 2009; Salti, 2015). These factors have also been taken from the WDI database:

- The stability of the economy is characterised by the inflation rate (*Inflation*) and the balance situation of public accounts (*Balance*), which is the difference between total general government revenue and expenditure (% of GDP).
- The openness of the economy (*Openness*) is represented by the sum of imports and exports of goods and services (% of GDP) and the rents obtained extracted from natural resources (*Rents_natural*), considering oil, natural gas, coal (hard and soft), mineral, and forest rents (% of GDP).
- The size of the demand for public services is represented by the annual population growth rate (*Pop_growth*), the proportion of the total population living in rural areas (*Pop_rural*) and the unemployment rate (*Unemployment*).
- The economic growth is represented by the annual growth rate of GDP at market prices (*Growth*).
- The institutional context is represented by the *Democratisation* variable, which considers the electoral success of smaller parties and the voting turnout in each election. It has been obtained from the Quality of Government (QoG) database.

Considering all these variables, the following equations are estimated to test for the effect of PPPs on income inequality.

$$Inequality_{it} = \beta_0 + \beta_1 PPP_{it-s} + \beta_2 Inflation_{it} + \beta_3 Pop\_growth_{it} + \beta_4 Balance_{it} + \beta_5 Openness_{it} + \beta_6 Pop\_rural_{it} + \beta_7 Unemployment_{it} + \beta_8 Democratization_{it} + \beta_9 Rents\_natural_{it} + \beta_{10} Growth_{it} + \eta_i + \varepsilon_{it} \quad \textbf{(1)}$$

$$Inequality_{it} = \beta_0 + \beta_1 Proceeds_{it-s} + \beta_2 Inflation_{it} + \beta_3 Pop\_growth_{it} + \beta_4 Balance_{it} + \beta_5 Openness_{it} + \beta_6 Pop\_rural_{it} + \beta_7 Unemployment_{it} + \beta_8 Democratization_{it} + \beta_9 Rents\_natural_{it} + \beta_{10} Growth_{it} + \eta_i + \varepsilon_{it} \quad \textbf{(2)}$$

In the two equations, subindex *i* represents each country and subindex *t* refers to each year of the sample. Subindex *s* refers to temporal moment as well, in order to consider the lag of PPP variables. As PPPs take several years to complete and implement, the effect on income inequality would take a long time, so models include the *s*-order lag of the two independent variables (*PPP* and *Proceeds*). Concretely, *s* is between one and five because the lag distribution is effectively zero beyond the fifth period. *Inequality* refers to the three indicators that represent income inequality, which have been previously describes. The rest of variables have been also previously defined. Finally, the error term has two components: ε_{it} is the classical disturbance term, and η_i is the unobservable heterogeneity, which represents all characteristics that differ between countries but are invariant over the period of analysis.

5.2. Technique of analysis

The four equations could be estimated by using the fixed-effects (FE) or random-effects (RE) estimators, but they both require homoscedastic and non-serial correlated errors. So, firstly we calculated the Modified Wald and Wooldridge tests, for checking heteroscedasticity and autocorrelation problems, respectively. All p-values are lower than 0.05, so we must reject the null hypothesis of "homoscedastic errors" and the null hypothesis of "non-serial correlated errors" at a 95% confidence level. This means that

models (1) to (4) suffer heteroscedasticity and autocorrelation problems and, accordingly, we cannot use FE and RE in this case.

Another additional problem in the four models is endogeneity, which may appear because of three reasons (Wooldridge, 2010): (i) the use of proxy variables to represent unobservable concepts that are difficult to represent, such as inequality; (ii) additional control variables that could be entered into the four models (e.g., public debt, life expectation, education, regulation quality, economic freedom, corruption[6], etc.), but have been omitted because they are highly correlated with other variables, introducing multicollinearity problems; and (iii) the existence of reverse causality between PPP indicators and some variables, like GDP, debt, and inequality. These three variables may affect PPP arrangements, but such arrangements may also impact on economic development, the level of indebtedness and the inequality as well.

Endogeneity may be solved by using instrumental variables (IV) techniques. In the presence of heteroscedasticity (as here), the traditional IV estimator is consistent but inefficient (Baum *et al*., 2003). Thus, we use the dynamic panel estimator (Arellano and Bond, 1991) that overcomes such a limitation through the generalised method of moments (GMM). To ensure the instrument validity in the four models, two tests are performed: the Arellano-Bond test for AR(2) of first differences and the Hansen test of overidentification restriction. The null hypothesis in the first case is: "no serial correlation between the error terms"; and the null hypothesis in the second test is: "over-identifying restrictions are valid".

[6] Corruption is especially relevant in this case. It is highly correlated with many control variables, like inflation, economic growth, balance, openness, unemployment, and especially with the democratization index. In addition, according to Cuadrado-Ballesteros and Peña-Miguel (2021), corruption (which would be an explanatory variable in our model) would be highly correlated with PPP variables (which are currently explanatory variables). Then, our model would have several multicollinearity problems if corruption had been included.

RESULTS OF ANALYSES

5.3. Descriptive analysis

Table 1 displays some descriptive statistics of the variables described previously. For instance, the Gini index takes the mean value of 41.33, although there are large differences between the sample countries. The maximum value (lowest inequality) is observed for South Africa, and the minimum value (highest inequality) is observed for Ukraine. The other two variables that represent inequality, namely *Richest* and *Poorest*, have a mean value of 32.14 and 38.29, respectively. The former suggests that 32.14% of income is held by the highest 10% population; the latter indicates that 38.29% live on less than $5.50 a day. We could conclude that there are large levels of inequality in the sample countries, although these indicators have been reduced during the period of analysis, as Figure 1 shows (additionally, the mean value of the three variables for each country is shown in Appendix A1).

<Insert Table 1 about here>

<Insert Figure 1 about here>

Meanwhile, in the same period, the number of PPP projects tends to increase (see Figure 2), although with several ups and downs. The number of PPPs has gone up in recent years, especially since 2015, likely given the size of the infrastructure gap in developing countries. However, that growth has been accompanied by a reduction in payment commitments to the government. This suggests that it is important to use different variables for representing the use of PPP projects. The mean values in Table 1 suggest the existence of five or six PPP commitments on average, which led to an income on average of around 1,532.95 million US dollars from payments to the government and investment in physical assets. China displays the maximum value of PPPs, namely 116

in 2018, resulting in an investment of 32,744.38 million US dollars, but the payment to the government was zero. Indeed, Brazil displays the maximum value of *Proceeds*, that is, 62,375.77 million US dollars, from the 66 PPP projects developed in 2012.

Regarding the rest of variables, we can see that the financial situation in the sample countries is worrying, given that the *Balance* variable shows a negative mean value (-2.06), especially in Bolivia, where the deficit was 12.76% of GDP in 2006. Venezuela shows very large increases and decreases in the GDP growth rate, displaying the minimum (-19.62% in 2018) and the maximum (18.29% in 2004) values of the sample countries.

The rural population averages about 41.49% in the sample countries, rising to 85.21% in Uganda, while Argentina displays the minimum value (8.13% in 2018). The democratisation index is relatively low in the sample, displaying a mean value of 17.32. The largest value is observed for Argentina, while China is rated as the least democratic country in the sample.

<Insert Figure 2 about here>

Table 2 displays the bivariate correlations between independent and control variables. We can see that PPP indicators (*PPP*, *Proceeds*, *Investment*, and *Payment*) are highly correlated, but the rest of variables are weakly correlated, that is, the coefficients are lower than 0.5 (Wooldridge, 2010). Only *Pop_rural* is highly correlated with *Democratisation*, so we calculated the variance inflation factor (VIF) to check multicollinearity, and the results suggest that it is not an issue with the models.

<Insert Table 2 about here>

5.4. Empirical analysis

Table 3 shows the results of the two models by using *GINI* as dependent variable. The results indicate that all lags of the *PPP* and *Proceeds* variables are statistically relevant and positive, suggesting the existence of a positive link between income inequality and PPP projects. These findings indicate that income inequality increases as PPP projects are implemented.

<Insert Table 3 about here>

Table 4 shows the results of the two models by using *Richest* as dependent variable. Findings here are like those obtained in Table 3 for the *GINI* variable, i.e., the lags of *PPP* and *Proceeds* are statistically relevant and have positive coefficients. These results suggest that countries that have developed PPP projects to a greater extent tend to show a larger percentage of income in hands of the richest 10% of the population. This means that income inequality tends to be higher as PPP projects are implemented.

<Insert Table 4 about here>

Similarly, Table 5 shows the results of the two models by using *Poorest* as the dependent variable. In this case, the coefficients of the lags of *PPP* and *Proceeds* are statistically relevant but negative. This means that the proportion of population that survive with less than $5.50 per day is lower in countries that have developed PPP projects to a greater extent. These findings are interesting because they suggest that the entire population improves its income situation, but that the inequality continues to exist. In other words, the poor are not that poor, but the rich are even richer; so, inequality has not been resolved through PPP projects.

<Insert Table 5 about here>

Concerning control variables, *Inflation* and *Pop_growth* have positive coefficients in most of the equations, suggesting that income inequality goes up as inflation and

population growth rates increase. However, *Openness* and *Rents_natural* have generally negative coefficients, which means that income inequality tends to be lower when the economy is more open to the external market and the country may extract a larger amount of rent from natural resources. *Balance* has negative coefficients in most cases, indicating that countries with large deficits tend to show more inequality. In Table 5, *Unemployment* and *Pop_rural* are statistically relevant, and all the coefficients are positive, indicating that countries with large unemployment rates and larger percentage of rural population tend to show more inequality. Finally, *Democratisation* is also statistically relevant in the last table, and its coefficients are negative, suggesting that democratisation tends to reduce income inequality

5.5. Robustness checks

Table 6 displays the most salient results of the robustness analysis, which estimates all the models after replacing the *Proceeds* variable with *Investment* and *Payment*. In fact, *Proceeds* is the sum of these two variables that represent the investment commitments in physical assets and the payment commitments to the government, respectively.

Regarding *Investments*, all the coefficients are negative. This result is interesting because it suggests that inequality tends to be reduced if the payment to the investment commitments in physical assets increases. So, the investment in physical assets seems to be effective in reducing the inequality.

However, the coefficients of *Payments* are positive in explaining the *GINI* and *Richest* variables, but negative in explaining the *Poorest* variable. These results are similar to those obtained previously for the *Proceeds* variable, i.e., although the number surviving on less than $5.50 per day is reduced after the development of PPP projects, the inequality rates increase, suggesting that the population (in general) is not as poor as previously, but

income inequality remains high since the income share held by the highest 10% is larger. Income levels have increased in the entire population, but the gap between the richest and the poorest remains, despite the development of PPP projects.

<Insert Table 6 about here>

6. DISCUSSION AND CONCLUSION

PPPs have attracted attention in academia for several years (de Castro e Silva Neto *et al.*, 2016). However, Cui *et al*. (2018) highlighted a research gap in literature regarding the social impact of PPPs. This investigation contributes towards filling this gap by analysing the effect of using the PPP model in infrastructure projects on the income inequality of the population who can use those infrastructures, since very few studies have focused on this issue.

With this aim in mind, we use a sample composed of data from 38 low- and middle-income economies over the period 2000-2018. Our findings suggest that, although income levels have increased across the population when PPP projects have been carried out, the gap between the richest and the poorest remains high because of the disproportionate income share held by the wealthiest 10%. So, income inequality has not been reduced through PPP projects; by contrast, empirical results show that countries that have developed PPP projects to a greater extent tend to show higher levels of income inequality. These results may be explained when fostering by NPM, PPPs use measures such as increasing prices in order to increase margins, harming purchasing power and causing income inequality.

De Castro e Silva Neto *et al*. (2016) and Cui et al. (2018) encourage researchers to make assessments of PPPs from a social point of view. The few studies that have been previously analysed this issue are focused on education and the health sectors, concluding

that PPPs reinforce inequality (Filc and Davidovitch, 2016; Kumar *et al*., 2022; De Oliveira, 2020; Verger *et al*., 2021). Our empirical findings are according to them, expanding this conclusion to economic infrastructures (energy, ICT, transport, water and sewerage and municipal solid waste). There are some studies that have previously found a similar evidence (i.e., effects of PPPs on income inequality) in economic sectors as well, but they are focused on specific contexts/countries and specific activities, especially water and waste management and treatment (Makamté Kakeu-Tardy and Véron, 2019; Tvedten and Candiracci, 2018; Adama, 2018; Ioris, 2012). Our study uses an international sample and it considers several economic sectors, so empirical findings are more robust than evidence from previous research.

Despite this contribution, this study is not free from limitations that could be addressed in future studies. First, although PPI Database considers four categories of projects (management and lease contracts, greenfields, brownfields, and divestitures), our analyses have been developed without considering this classification, so it could be interesting that future studies check the robustness of our findings for the wide spectrum of PPPs. Second, PPP indicators are based on closed contractual agreements but do not refer to the actual completion of the project, which is a measure of success. Future studies may expand our findings by using different measures of success (Hodge and Greve, 2018), not only the narrow view of performance, but also a broader view that includes the long-term relationship or benefits to citizens.

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APPENDIX A1. Sample countries

Country	GINI	Richest	Poorest
Albania	31.96	24.66	40.88
Argentina	45.81	33.29	17.33
Armenia	32.16	26.58	61.70
Belarus	27.68	22.38	14.61
Bolivia	51.09	38.60	38.76
Brazil	54.64	43.15	28.58
Bulgaria	36.57	27.88	11.01
China	41.02	30.87	47.75
Colombia	53.64	42.53	40.06
Costa Rica	48.99	37.51	16.43
Dominican Republic	48.06	37.72	29.71
Ecuador	49.06	37.85	36.70
Egypt, Arab Rep.	30.78	26.65	69.42
El Salvador	44.99	34.49	39.47
Georgia	37.95	28.58	57.57
Honduras	54.38	41.52	54.78
Indonesia	37.23	30.12	78.80
Iran	40.86	31.28	11.68
Kazakhstan	30.17	24.30	27.56
Kyrgyz Republic	30.11	24.62	74.02
Malaysia	43.98	33.32	9.73
Mexico	48.90	38.87	34.01
Mongolia	33.31	25.96	35.58
Pakistan	31.51	27.09	84.71
Peru	47.21	35.73	36.97
Romania	36.35	25.61	28.23
Russia	39.34	30.48	9.76
Serbia	39.23	27.93	24.03
South Africa	62.40	50.44	61.90
Sri Lanka	39.34	32.20	54.68
Tajikistan	32.66	25.56	72.62
Thailand	39.09	30.53	19.84
Turkey	40.71	30.99	18.12
Uganda	43.22	35.10	90.16
Ukraine	26.45	21.92	13.42
Venezuela	49.72	36.05	50.97
Vietnam	36.21	28.26	56.73
Zambia	52.74	41.84	89.68

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
GINI	41.33	9.03	24.00	64.80
Richest	32.14	6.79	20.60	54.20
Poorest	38.29	24.55	0.40	95.70
PPP	5.87	14.70	0.00	116.00
Proceeds	1532.95	4684.22	0.00	62375.77
Investment	1240.97	3625.79	0.00	44073.25
Payment	273.02	1556.93	0.00	29900.70
Inflation	8.89	15.56	-1.71	254.95
Pop_growth	0.99	1.13	-9.08	7.79
Balance	-2.06	3.17	-12.76	12.16
Openness	75.12	36.54	21.85	220.41
Pop_rural	41.49	18.49	8.13	85.21
Unemployment	8.20	5.47	0.40	33.47
Democratization	17.32	8.99	0.00	38.51
Rents_natural	7.00	7.74	0.11	45.57
Growth	4.48	3.94	-19.62	18.29

Table 2. Bivariate correlations

	PPP	*Proceeds*	*Investment*	*Payment*	*Inflation*	*Pop_growth*
Proceeds	0.6334***	1				
Investment	0.6848***	0.952***	1			
Payment	0.2702***	0.7***	0.4501***	1		
Inflation	-0.098*	-0.0617	-0.0703†	-0.0195	1	
Pop_growth	-0.0525	-0.0071	-0.0047	-0.0101	-0.0688†	1
Balance	-0.0649	0.0181	-0.0059	0.0677	0.126**	-0.1623***
Openness	-0.2155***	-0.2109***	-0.2138***	-0.1218**	0.0129	-0.1439***
Pop_rural	-0.0701†	-0.1912***	-0.1945***	-0.108**	-0.0925*	0.2665***
Unemployment	-0.1101**	-0.0644†	-0.0808*	-0.0053	0.0489	-0.2374***
Democratization	-0.0886*	0.125***	0.1259***	0.0676†	-0.0173	-0.2962***
Rents_natural	-0.1225**	-0.0864*	-0.0835*	-0.0635†	0.0941*	0.2771***
Growth	0.1004**	-0.0016	-0.0164	0.0389	-0.2088***	0.0873*

	Balance	*Openness*	*Pop_rural*	*Unemployment*	*Democratization*	*Rents_natural*
Openness	0.1039*	1				
Pop_rural	-0.2228***	0.1767***	1			
Unemployment	-0.0985*	-0.1505***	-0.1374***	1		
Democratization	-0.1205**	-0.1175**	-0.4239***	0.0695†	1	
Rents_natural	0.2712***	-0.0091	-0.0967*	-0.0814*	-0.2807***	1
Growth	0.3144***	0.1283***	0.266***	-0.0832*	-0.2115***	0.1462***

Notes:
†, *, **, ***significant at 10, 5, 1, and 0.1 percent level, respectively.

Table 3. Effect of PPP projects on GINI index

Panel A. Using variable *PPP*					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
PPPt-1	0.1573** (0.0452)				
PPPt-2		0.1383** (0.0468)			
PPPt-3			0.1084† (0.0601)		
PPPt-4				0.1032* (0.0436)	
PPPt-5					-0.0488 (0.0818)
Inflation	0.1675** (0.0533)	0.0842* (0.0365)	0.1295* (0.0486)	0.1139** (0.0397)	0.0414 (0.0325)
Pop_growth	0.2681** (0.0763)	0.7412* (0.3520)	0.4541† (0.2517)	1.6999** (0.5632)	4.2254** (1.2642)
Balance	-0.1635* (0.0673)	-0.1484** (0.0500)	-0.2126*** (0.0544)	-0.2366*** (0.0461)	-0.4671*** (0.1064)
Openness	-0.2000** (0.0527)	-0.2245*** (0.0493)	-0.2108** (0.0645)	-0.1581** (0.0483)	-0.0766† (0.0388)
Pop_rural	0.3893* (0.1550)	0.1039 (0.1241)	0.1532 (0.1051)	0.1422 (0.1437)	-0.1229 (0.1581)
Unemployment	-0.0153 (0.2117)	0.2128 (0.1795)	0.0673 (0.2174)	0.1978 (0.1753)	0.2747 (0.1754)
Democratization	0.0863 (0.0679)	-0.0665 (0.0891)	0.096 (0.0829)	0.0635 (0.0692)	0.0725 (0.079)
Rents_natural	-0.3469* (0.1358)	-0.3348** (0.0910)	-0.1906 (0.114)	-0.2137† (0.1188)	-0.4202*** (0.0928)
Growth	-0.1522* (0.0603)	-0.1006 (0.0593)	-0.1314 (0.0786)	-0.0739 (0.047)	-0.0644 (0.0451)
_cons	12.3805 (7.8374)	19.0330** (6.6465)	17.8891** (6.2904)	22.6807** (7.9052)	36.8442*** (6.5113)
Arellano-Bond test for AR (2)	Pr > z = 0.705	Pr > z = 0.229	Pr > z = 0.196	Pr > z = 0.453	Pr > z = 0.184
Hansen test	Pr > chi2 = 0.619	Pr > chi2 = 0.777	Pr > chi2 = 0.749	Pr > chi2 = 0.856	Pr > chi2 = 0.712
Panel B. Using variable *Proceeds*					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
Proceedst-1	0.0051 (0.0118)				
Proceedst-2		0.1957* (0.0734)			
Proceedst-3			0.3989** (0.1274)		
Proceedst-4				0.1625† (0.091)	
Proceedst-5					0.0776† (0.0383)
Inflation	0.1532** (0.0538)	0.0593* (0.0287)	0.1487** (0.0429)	0.0904† (0.0451)	0.006 (0.0447)
Pop_growth	0.2129** (0.0614)	0.7172* (0.3395)	0.7038* (0.345)	1.4026* (0.5733)	7.694*** (1.4539)
Balance	-0.1341† (0.0685)	-0.2324*** (0.0517)	-0.309*** (0.0465)	-0.2267*** (0.0407)	-0.5013*** (0.1037)
Openness	-0.1654** (0.0505)	-0.1881*** (0.0485)	-0.2403*** (0.0612)	-0.1352** (0.048)	-0.038† (0.0214)

Pop_rural	0.3717* (0.1501)	0.096 (0.1312)	0.2000 (0.1555)	0.1675 (0.1233)	-0.0674 (0.1001)
Unemployment	0.0676 (0.1729)	0.0067 (0.1567)	-0.0492 (0.0913)	0.2768† (0.1452)	0.4289* (0.1799)
Democratization	-0.1131 (0.0765)	0.0274 (0.0663)	-0.1181* (0.057)	0.0635 (0.0789)	0.0912 (0.0754)
Rents_natural	-0.3213* (0.1551)	-0.3275** (0.1077)	-0.2185* (0.0987)	-0.2829** (0.0928)	-0.3739*** (0.0679)
Growth	0.1187† (0.0659)	-0.0757 (0.0484)	0.1879* (0.0883)	0.006 (0.0507)	0.0845* (0.0336)
_cons	14.9013† (7.9532)	22.4785*** (5.3604)	16.1929* (6.94)	21.8404** (7.6455)	37.6272*** (4.4941)
Arellano-Bond test for AR (2)	Pr > z = 0.429	Pr > z = 0.440	Pr > z = 0.094	Pr > z = 0.177	Pr > z = 0.927
Hansen test	Pr > chi2 = 0.767	Pr > chi2 = 0.471	Pr > chi2 = 0.526	Pr > chi2 = 0.847	Pr > chi2 = 0.457

Notes:
†, *, **, ***significant at 10, 5, 1, and 0.1 percent level, respectively.
The dependent variable is *GINI* in all equations.

Table 4. Effect of PPP projects on income share held by highest 10%

Panel A. Using variable *PPP*					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
PPPt-1	0.1164*** (0.0298)				
PPPt-2		0.0993** (0.0355)			
PPPt-3			0.0934* (0.0376)		
PPPt-4				0.0713* (0.0312)	
PPPt-5					-0.0298 (0.0718)
Inflation	0.1457** (0.0394)	0.0713* (0.0264)	0.117** (0.0331)	0.0887** (0.0316)	0.0265 (0.0237)
Pop_growth	0.1966*** (0.0498)	0.5361* (0.2505)	0.4095* (0.1865)	1.3634*** (0.3402)	3.5692*** (0.7139)
Balance	-0.126* (0.0497)	-0.0884* (0.0401)	-0.117* (0.0435)	-0.1572** (0.0448)	-0.3523*** (0.0773)
Openness	-0.1739*** (0.0359)	-0.184*** (0.036)	-0.1844*** (0.0434)	-0.1321*** (0.0301)	-0.0431 (0.0297)
Pop_rural	0.3654** (0.1103)	0.1228 (0.0886)	0.0934 (0.0806)	0.1557 (0.0998)	-0.0955 (0.1214)
Unemployment	-0.0300 (0.1781)	0.0534 (0.1473)	0.0407 (0.1657)	0.1208 (0.1421)	0.1728 (0.1276)
Democratization	-0.1026* (0.0439)	-0.0552 (0.0656)	0.0247 (0.0652)	0.089† (0.0505)	0.0345 (0.0624)
Rents_natural	-0.3045** (0.0934)	-0.2484** (0.0749)	-0.1787* (0.085)	-0.18* (0.0878)	-0.3064*** (0.0679)
Growth	0.145** (0.0474)	0.0949† (0.0502)	0.1297* (0.0575)	0.0483 (0.0436)	0.0613† (0.0343)
_cons	5.7205 (5.398)	13.6939** (4.7203)	14.6568** (4.5897)	14.912* (5.5984)	30.3631*** (5.173)
Arellano-Bond test for AR (2)	Pr > z = 0.716	Pr > z = 0.380	Pr > z = 0.707	Pr > z = 0.591	Pr > z = 0.466
Hansen test	Prob > chi2 = 0.348	Prob > chi2 = 0.660	Prob > chi2 = 0.739	Prob > chi2 = 0.739	Prob > chi2 = 0.662
Panel B. Using variable *Proceeds*					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
Proceedst-1	-0.0061 (0.0096)				
Proceedst-2		0.1564** (0.0532)			
Proceedst-3			0.3483** (0.0946)		
Proceedst-4				0.1408* (0.0644)	
Proceedst-5					0.063* (0.0301)
Inflation	0.1415** (0.0378)	0.0456* (0.0207)	0.1218** (0.0333)	0.0707† (0.0362)	0.0028 (0.0384)
Pop_growth	0.1586** (0.042)	0.5466* (0.2402)	0.4994† (0.2596)	1.2513** (0.3746)	6.374*** (0.9495)
Balance	-0.0884† (0.0475)	-0.1665*** (0.032)	-0.2195*** (0.0397)	-0.1621*** (0.0413)	-0.4008*** (0.0823)
Openness	-0.1518*** (0.0331)	-0.1496*** (0.0347)	-0.1991*** (0.0433)	-0.119** (0.0319)	-0.0209 (0.0134)

Pop_rural	0.3224**	0.1224	0.1939	0.2178*	-0.095
	(0.1093)	(0.0881)	(0.1172)	(0.0858)	(0.0733)
Unemployment	0.0142	-0.0995	-0.1201	0.1628	0.296†
	(0.128)	(0.1499)	(0.0779)	(0.1278)	(0.1559)
Democratization	0.1007†	0.0421	0.0614	0.0957†	0.0633
	(0.0548)	(0.0374)	(0.0396)	(0.0531)	(0.0472)
Rents_natural	-0.2918**	-0.2331*	-0.1874*	-0.2216**	-0.2576***
	(0.1042)	(0.0887)	(0.075)	(0.0748)	(0.0437)
Growth	0.1218*	-0.0694	0.1748*	0.0104	0.0465
	(0.053)	(0.0417)	(0.0658)	(0.045)	(0.0318)
_cons	9.538	16.1711***	11.227*	12.2466*	30.6078***
	(5.8515)	(3.7851)	(5.3736)	(5.0653)	(2.8597)
Arellano-Bond test for AR (2)	Pr > z = 0.389	Pr > z = 0.476	Pr > z = 0.260	Pr > z = 0.179	Pr > z = 0.912
Hansen test	Prob > chi2 = 0.508	Prob > chi2 = 0.331	Prob > chi2 = 0.415	Prob > chi2 = 0.692	Prob > chi2 = 0.174

Notes:
†, *, **, ***significant at 10, 5, 1, and 0.1 percent level, respectively.
The dependent variable is *Richest* in all equations.

Table 5. Effect of PPP projects on poverty headcount ratio at $5.50 a day

Panel A. Using variable PPP					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
PPPt-1	-0.5494** (0.1587)				
PPPt-2		-0.2443* (0.1107)			
PPPt-3			-0.3901*** (0.0821)		
PPPt-4				-0.8168*** (0.1559)	
PPPt-5					-0.5576*** (0.1006)
Inflation	0.3195*** (0.0487)	0.2014*** (0.0391)	0.2873*** (0.0468)	0.2077† (0.1176)	-0.0202 (0.0969)
Pop_growth	-0.3327 (0.5111)	0.0022 (0.3176)	2.9237* (1.3824)	0.7942 (0.5687)	2.5681 (2.4802)
Balance	-1.2823*** (0.1938)	0.1063 (0.1137)	0.1397 (0.2009)	0.272 (0.1822)	0.3587 (0.3545)
Openness	-0.0679 (0.0562)	0.062 (0.0632)	0.0833† (0.0453)	-0.0039 (0.0642)	0.0201 (0.0959)
Pop_rural	1.6147*** (0.2148)	1.7950*** (0.2367)	1.0824*** (0.2503)	1.3422*** (0.2676)	1.1541*** (0.2506)
Unemployment	1.6546** (0.4501)	2.1712*** (0.2503)	1.6681*** (0.2618)	1.5327*** (0.2713)	1.7124*** (0.3568)
Democratization	-0.7471*** (0.1344)	-0.5004** (0.1387)	-0.3995** (0.1321)	-0.6774*** (0.1393)	-0.4474* (0.201)
Rents_natural	-0.2446 (0.1931)	0.3301* (0.1462)	0.0417 (0.1606)	0.2653* (0.1082)	0.2446 (0.1699)
Growth	0.0327 (0.2391)	0.4277*** (0.0577)	0.5058*** (0.1265)	0.2435 (0.1788)	0.225 (0.1589)
_cons	-38.0025** (11.1453)	-70.5968*** (11.2616)	-36.0204** (11.4574)	-40.6548** (10.8938)	-36.5276*** (8.382)
Arellano-Bond test for AR (2)	Pr > z = 0.322	Pr > z = 0.569	Pr > z = 0.313	Pr > z = 0.321	Pr > z = 0.460
Hansen test	Prob > chi2 = 0.843	Prob > chi2 = 0.337	Prob > chi2 = 0.445	Prob > chi2 = 0.656	Prob > chi2 = 0.575
Panel B. Using variable Proceeds					
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
Proceedst-1	-0.4694** (0.1611)				
Proceedst-2		-0.0634*** (0.013)			
Proceedst-3			-0.3227*** (0.0776)		
Proceedst-4				-0.0919* (0.0415)	
Proceedst-5					-0.3104*** (0.0652)
Inflation	0.3301*** (0.0432)	0.1159** (0.0331)	0.2301*** (0.0481)	0.2377* (0.0952)	-0.0799 (0.1102)
Pop_growth	1.9884** (0.5301)	-0.182 (0.3839)	1.6377 (1.3838)	-0.2504 (0.3836)	1.8255 (2.8597)
Balance	-0.6963*** (0.1577)	-0.2854* (0.1228)	-0.0834 (0.1575)	0.1846 (0.1874)	0.0285 (0.2328)
Openness	-0.0064 (0.0526)	0.088 (0.0605)	0.1007 (0.062)	-0.0427 (0.062)	-0.1243* (0.0513)

Pop_rural	1.7493***	1.925***	1.3079***	0.9729***	1.0748***
	(0.1746)	(0.1935)	(0.1603)	(0.1613)	(0.2724)
Unemployment	1.1687**	2.344***	1.631***	1.4504***	1.9274***
	(0.3047)	(0.2253)	(0.3334)	(0.26)	(0.3896)
Democratization	-0.4531***	-0.5945***	-0.4261**	0.238	-0.2687**
	(0.1045)	(0.1069)	(0.1304)	(0.1526)	(0.0857)
Rents_natural	-0.0034	0.1846	-0.1646	0.0564	0.1056
	(0.2182)	(0.1489)	(0.1176)	(0.1332)	(0.1403)
Growth	0.1815*	0.4602***	0.5275***	0.6888***	0.5387***
	(0.0849)	(0.0743)	(0.0897)	(0.0869)	(0.1282)
_cons	-46.1485***	-80.0767***	-46.9091***	-18.5945*	-40.8759***
	(9.1582)	(7.8698)	(10.7606)	(7.3648)	(9.2012)
Arellano-Bond test for AR (2)	Pr > z = 0.262	Pr > z = 0.444	Pr > z = 0.453	Pr > z = 0.154	Pr > z = 0.229
Hansen test	Prob > chi2 = 0.551	Prob > chi2 = 0.630	Prob > chi2 = 0.495	Prob > chi2 = 0.668	Prob > chi2 = 0.649

Notes:
†, *, **, ***significant at 10, 5, 1, and 0.1 percent level, respectively.
The dependent variable is *Poorest* in all equations.

Table 6. Summary of robustness checking analysis

	Dependent variable = *GINI*	**Dependent variable = *Richest***	**Dependent variable = *Poorest***
	Coef. (Std. Err.)	**Coef. (Std. Err.)**	**Coef. (Std. Err.)**
Investment $_{t-1}$	-0.2189***	-0.2029***	-0.1571
	(0.0498)	(0.039)	(0.0956)
Investment $_{t-2}$	-0.1675**	-0.1193**	-0.1996***
	(0.0529)	(0.0397)	(0.048)
Investment $_{t-3}$	-0.5778**	-0.5059**	-0.5643***
	(0.2006)	(0.1465)	(0.0711)
Investment $_{t-4}$	-0.7401***	-0.6138***	-0.3783***
	(0.1661)	(0.123)	(0.0585)
Investment $_{t-5}$	-0.1219*	0.1115	-0.1762†
	(0.0553)	(0.0502)	(0.0987)
Payment $_{t-1}$	0.1761†	0.1680*	0.1571**
	(0.0871)	(0.0742)	(0.0956)
Payment $_{t-2}$	0.1201***	0.0803***	-0.2669*
	(0.0225)	(0.0121)	(0.1029)
Payment $_{t-3}$	0.574**	0.5513***	-0.2534***
	(0.2014)	(0.1374)	(0.0641)
Payment $_{t-4}$	0.0177*	0.0443	-0.1067***
	(0.319)	(0.2200)	(0.0213)
Payment $_{t-5}$	0.0714†	0.1078**	-0.0057***
	(0.0444)	(0.0368)	(0.0011)

Notes:
†, *, **, ***significant at 10, 5, 1, and 0.1 percent level, respectively.

Figure 1. Evolution of inequality indicators (2000-2018)

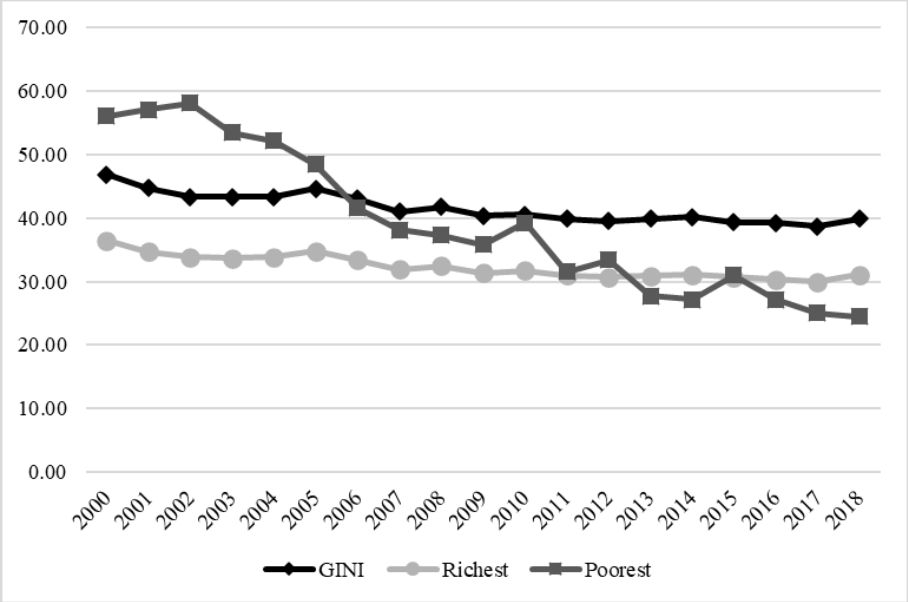

Figure 2. Evolution of PPP projects (2000-2018)