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Keywords

Foreign direct investment, corruption, natural resources, grabbing hand, Latin America

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The Effect of Corruption on Foreign Direct Investment in Natural Resources: A Latin American Case Study

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This study looks at the relationship between corruption and foreign direct investment (FDI) in natural resources using a panel of 20 Latin American countries from 1995-2019. We find that lower levels of corruption have a positive and significant impact on resource FDI supporting the grabbing hand hypothesis. A one-point increase in the Corruption Perception Index (CPI) is associated with an increase between 52-57 million dollars across models with varying controls. Results also show a nonlinear relationship between CPI and resource FDI, suggesting that when a country becomes less corrupt and improves its economic, social and political performance, it usually attracts more resource FDI. The analysis is robust to alternate measures of corruption (CPI, ICRG, and WGI) and different specifications of the dynamic panel model. Finally, the study highlights significant precautions and pre-conditions required to increase economic development when attracting natural resource-based FDI.

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1. Introduction

Foreign direct investment (FDI) plays an important role, especially in developing countries. It brings economic dynamism to the host economy by creating jobs and boosting development, providing access to new technology, skills, sharing personal experiences within a country, and providing scarce capital resources. In addition, there have been studies examining the relationship between corruption and FDI with mixed evidence of positive and negative effects of corruption on overall FDI. However, as mentioned, much of the available literature has focused on the effects of corruption on overall FDI. As such, an understanding of the effect of corruption on FDI in natural resources is missing. A few studies have looked at FDI in natural resource-based sectors (resource FDI), but they have been either covered in a short time or are not focused on Latin America, a hotbed of natural resources.³ Resource FDI is different from other types of FDI because, generally, natural resources are exposed to various international price fluctuations. As a result, their global prices are more volatile than non-resource FDI, and their extractive costs and the technology implemented in their processes are

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³ The distinction between resource and non-resource based FDI comes from the idea that natural resources based FDI are meant to extract natural resources by foreign multinationals that bring in capital and knowledge. However, as resource FDI is very capital intensive, it leads to fewer spillover effects into the non-resource sectors of the host economy because it relies less on local subcontractors or suppliers (Poelhekke and van der Ploeg, 2013).

different (Carril-Caccia *et al.*, 2019). Therefore, even though some of its determinants may overlap with the total FDI's determinants, the effects and magnitudes of its explanatory variables could be different.

Resource FDI is an essential pillar for developing countries as it catalyzes natural resource-based activities to foster economic growth (Barbier, 2019). It is relevant especially for low – and middle-income economies which are highly dependent on the commercial exploitation of natural resources, mainly for exports (Barbier, 2019). In this study, we focus our attention on Latin American countries because this region is one of the most dependent on natural resources. The share of primary products in total exports in most of the 20 Latin American countries in our sample is above 50% of its dependence in the last decade. (See Appendix 1).

It is pertinent to stress that when foreign investors decide where to invest, they consider economic factors and social and political indicators. In that sense, the objective of this paper is to figure out how corruption impacts resource FDI since the former affects essential determinants of the latter, like economic growth, the productivity of public investment, quality of infrastructure, education, and health care. Also, corruption could create inefficiencies, raise transaction costs for foreign investors and undermine democracy, deterring equal opportunities for the population, with economic and social consequences. Unlike previous literature that has been focused on the impact of corruption on total FDI, the main contribution of this study is the focus on quantifying the effect of corruption on resource FDI.

The literature has two main hypotheses related to this topic: the grabbing hand hypothesis and the helping hand hypothesis. The former says that high levels of corruption make investment unfavorable. The latter tells the opposite; higher corruption attracts more investment. Therefore, if the region becomes less corrupt (more corrupt) and it has a positive effect on resource FDI, the grabbing hand (helping hand) hypothesis is supported. Our analysis tests which of the hypotheses holds for the Latin American region.

We built a panel data composed of 20 Latin American countries for the period is 1995-2019. We deal with endogeneity and simultaneity bias with the persistence of resource FDI over time in the baseline fixed effect panel model by using an Arellano-Bover/Blundell-Bond approach. It allows the inclusion of instruments generating a causal and robust estimation. The main findings are as follows. First, lower levels of corruption have a positive and significant impact on resource FDI supporting the grabbing hand hypothesis. Second, a one-point increase in corruption perception index from Transparency International increases resource FDI by US\$ 37 million to US\$ 51 million (depending on the model), *ceteris paribus*. It is because an increase in the corruption perception index means that the country is less corrupt. Third, a one-point increase in corruption perception from PRS Group increases resource FDI by US\$ 619 million to US\$ 771 million (depending on the model), on average and *ceteris paribus*. Similarly, this is because an increase in the corruption perception from PRS Group means that the country is becoming cleaner.

Our results also show evidence of a nonlinear relationship between corruption perception index and resource FDI. It suggests that when a country becomes less corrupt and improves its economic, social and political performance, it usually attracts more FDI and uses these resources for its development. However, when developing countries move towards a higher degree of development and become less corrupt, they tend to be less dependent on resource FDI, so that amount of resource FDI decreases in relative terms maybe because its economy is less resource-extractive intensive, and its economic growth is less based on highly polluting industries.

The outline of the approach in this paper is as follows. Section 2 provides a brief literature review., section 3 presents the methodology, section 4 explains the measures used in this work. Section 5 tests what hypothesis is supported by the data and quantifies its effect. Also, it shows evidence of a nonlinear relationship between corruption and resource FDI. Section 6 concludes, and section 7 provides some ideas about possible future research.

2. Literature review and hypothesis

Literature related to the impact of corruption on foreign direct investment can be defined through two hypotheses: the grabbing hand hypothesis, motivated by Sheleifer and Vishny (1998), and Frye and Shleifer (1997), and the helping hand hypothesis inspired by Bardhan (1997) and Quazi *et al.* (2014).

The grabbing hand hypothesis assumes that the self-interest of public officials leads to the expropriation of shareholder wealth from firms and demands bribes by private agents to conduct transactions. It makes investments unprofitable due to distortions and higher transaction costs in the market, discouraging foreign investments (Bliss and Di Tella, 1997). In addition to the direct financial costs, corruption also affects democracy (Drapalova, 2019; Holmes, 2006; Jong-sung and Khagram, 2005; Warren, 2004), increases inequality in the society, lowers economic growth, decreases state capacity, and the efficient allocation of talent (Dimant and Tosato, 2018).

On the other hand, some studies show positive impacts of corruption on FDI, supporting the helping hand hypothesis (Gossel, 2018). For instance, Quazi *et al.* (2014), using panel data for 53 African countries over 1995-2012, conclude that corruption facilitates FDI inflows in Africa, maybe because the overall regulatory environment in Africa is weak. Houston (2007) finds that while corruption has restrictive and direct adverse effects, there tend to be expansionary economic effects in countries with weak institutions. Houston (2007) concludes that eliminating corruption in countries where it plays an expansionary role can be costly and should be resisted. Bardhan (1997), making a review of issues, also concludes a positive relationship between corruption and FDI.

There is no previous literature covering the impact of corruption on resource FDI, but some studies analyze related topics. For instance, Carril-Caccia *et al.* (2019) focus their work on the role of institutions on FDI in oil-abundant countries. They use a gravity equation covering 182 countries between 2003-2012, concluding that rule of law, lack of corruption, political stability, and democracy are relevant determinants of new greenfield investment projects. Epaphra and Massawe (2017), using panel data for five East African countries over 1996-2015, show that corruption level in the host country harms FDI inflows when eliminating GDP per capita in the regression as a control variable. Egger and Winner (2006), using a panel of bilateral outward FDI stocks of 21 OECD countries in 59 OECD and non-OECD economies between 1983 and 1999, find a negative impact of corruption on total FDI, suggesting the grabbing hand effect outweighs the helping hand effect of corruption. These authors also distinguished the effect of corruption between developed and less developed countries concluding that "*corruption is an important impediment of FDI in developed economies but not in less developed ones.*" Habib and Zurawicki (2002), using a sample of 89 countries for the period 1996-1998, find that foreign investors generally avoid corruption because it is considered wrong and can create operational inefficiencies.

Additionally, other studies have found ambiguous and not robust results, such as Al-Sadig (2009) 's work. This author, using data on 117 host countries over the period 1984-2004, finds that a host country's higher corruption level impacts FDI inflows negatively: "*a one-point increase in the corruption level leads to a reduction in per capita FDI inflows by about 11 percent*", supporting the grabbing hand hypothesis, but

after controlling for other characteristics of the host country, the adverse effects of corruption dissipate, and sometimes it becomes positive but not statistically significant, supporting the helping hand hypothesis partially. Udenze (2014) finds a negative and statistically significant relationship between corruption and FDI inflows in low and middle-income countries outside Sub-Saharan Africa and a positive but statistically significant association for 22 Sub-Saharan countries.

3. Methodology

We are interested in testing what hypothesis – the grabbing hand or helping hand- is supported by the data and want to quantify the effect of the three measures of control of corruption perception on resource FDI. Therefore, our dependent variable is resource FDI, and our independent variable of interest is corruption. The baseline econometric specification is a linear dynamic panel fixed effect estimation that allows control for omitted variables that vary across countries but not across time. In line with the empirical literature, the hypothesis gives rise to the following baseline econometric approach (Ahn and Schmidt, 1995):

$$FDI_NR_{it} = \rho_m FDI_NR_{i,t-m} + \beta C_{it} + \gamma X_{it} + \alpha_i + \varepsilon_{it}$$

$$\alpha_i = \beta_0 + \delta W_i$$

Where FDI_NR_{it} is resource FDI for country i at time t . $FDI_NR_{i,t-m}$ are the lags of the dependent variable, where m its number of lags. C_{it} are the several measures of control of corruption used in this study for country i at time t . CPI is from Transparency International (Index C.P., 2019), the ICRG index comes from the PRS Group's ICRG corruption index, and the WGI index is obtained from World Governance Indicators. CPI index ranges from 0 to 100, where 0 is highly corrupt, and 100 is a very clean country in terms of corruption. ICRG rating is an index that includes 22 variables from various risk categories. From ICRG ratings, we use the corruption variable, which ranges between 0 and 6 (we have coded this so higher numbers indicate less corruption). WGI index ranges from -2.5 to 2.5, where -2.5 reflects more corruption perception and 2.5 means that the country is very clean. X_{it} is a vector of control variables that vary across countries and time t . The controls are per capita real GDP, economic openness, the country's population in millions, indices for freedom of trade, political freedom, law and order, and property rights. α_i is an individual effect that varies across countries but not across time, ε_{it} is the error term of the baseline model, β_0 is an intercept, and W_i represents unobserved explanatory variables that vary across countries but not across time. If corruption positively affects the dependent variable, the results imply that the helping hand hypothesis holds. By the same analogy, if the effect of corruption is negative, then the grabbing hand hypothesis holds.

The inclusion of lags of the dependent variable, $FDI_NR_{i,t-m}$, is critical in the specification of this approach. Since resource FDI is mostly tangible long-term and long-lived investments, their planning and implementation require the inputs of multiple stakeholders. Capital withdrawal post-investment is not as straightforward as finance-capital. The decision to invest in the host country's natural resources is not instantaneously a reaction to the economic performance of the host country. Sponsoring companies decide to invest depending on the previous levels of investment in natural resources. Once an investment decision is realized, it is assumed to be a sunk cost by the investor because long-run contracts might make it unlikely to redirect the use of the funds. Third, adjustments in the market do not always respond immediately to technological innovations. We do not restrict the lag covariate to any number of lags; instead, we test the point estimates for robustness for the dependent variables' 1, 2, and 3 lags.

But the inclusion of lags of the dependent variable in the baseline regression violates strict exogeneity making the fixed effect estimator inconsistent. The baseline model would suffer endogeneity bias since the lags of the dependent variable are correlated with the unobserved panel-level effects by construction. The error term of the lagged variable could be strongly correlated with the level of FDI in the current period. From an economic standpoint, the previous period's investment in a heavily capital-intensive project is predicted to substantially affect the current period's investments.

To avoid the issue of endogeneity, we use the Arellano-Bover/Blundell-Bond (ABBB) generalized method of moments (GMM), which is an extension of the Arellano-Bond (AB) estimation approach, is used in this study. Since the AB estimator is inefficient -lagged-level instruments are weak- when the autoregressive process is too persistent -too large- or the ratio of the variance of the panel-level effect to the variance of the idiosyncratic error is too large, it is necessary to implement the ABBB estimator. The ABBB approach augments the AB by assuming that the first observable first-differences of the dependent variable are orthogonal to levels of the disturbances, allowing the introduction of more instruments improving the efficiency. ABBB uses the AB moment conditions and additional moment conditions in which lagged first differences of the dependent variable are used as instruments (Engblom and Oikarinen, 2015).

Additionally, the ABBB estimator is applicable in this context because the baseline specification is a linear functional form, the baseline specification is fixed country effects, the dependent variable depends on its own lags, there would exist autocorrelation and heteroskedasticity within countries but not across them, and the independent variables are not strictly exogenous meaning that they are correlated with past and possible realizations of the error term.

4. Measures

This work uses panel data from 20 Latin American countries for the 1995-2019 period. The dependent variable is resource FDI. It represents the net inflows of foreign direct investment in natural resources into a country, its unit is million US\$, and the dataset is obtained from the annual reports *Foreign Direct Investment in Latin America and the Caribbean* (ECLAC, 2020). The independent variable of interest is corruption perception which is used as a proxy for actual corruption. We use three measures for corruption perception, the corruption perception index, Corruption (CPI), from Transparency International (2021), the corruption perception, Corruption (ICRG), from PRS Group (2021), and the corruption perception index, Corruption (WGI), from World Governance Indicators.

Since the market size in host countries is a relevant variable in attracting resource FDI, following previous studies, e.g., Quazi (2007) and Jaspersen *et al.* (2000), we choose per capita real GDP as a proxy for the market size from World Bank (2021). Another economic variable that plays a vital role in attracting investment is economic openness. In general, if a country is more open to the rest of the world, it is more likely to seem interesting for foreign investors. Following past literature, e.g., Malefane and Odhiambo (2018), Hye and Lau (2015), and Karras (2003), we use exports plus imports divided by GDP as a proxy for economic openness from World Bank (2021). Another control variable that plays an essential role in attracting foreign investment is the scale of the internal market (Petrovic-Randelovic *et al.*, 2017; Jaumotte, 2004). So, we use population (in a million people) as a proxy for the size of the host economy, from World Bank (2021).

Additionally, we use three covariates to check the robustness of the corruption coefficient: trade freedom, political freedom, and law and order. We show six different models for every case using various combinations of these last three covariates to see whether there are essential changes in our independent variable of interest when using these additional controls. Trade freedom is used as a control because a foreign investor would be interested in investing in a host country to sell in the domestic market and investing in a host country and trade with the rest of the world. This covariate's scale is between 0 to 100, where 0 to 49.9 is "repressed," 50 to 59.9 is "mostly unfree," 60 to 69.9 is "moderately free," 70 to 79.9 is "mostly free," and 80 to 100 is "free," from The Heritage Foundation (2021).

Political rights are also an aspect that a foreign investor considers in her decision. We use that variable as a proxy for political freedom. Its scale is from 1 to 7, where 1 is "highest degree of freedom," and 7 is "the lowest degree of freedom," from Freedom House (2021). Finally, we take law and order as a covariate. This control includes two aspects: law as the strength and impartiality of the legal system and order as an assessment of widespread observance of the law. Both components, law, and order are rated from 0 to 3, where 0 means that the country suffers from a very high crime rate if the law is routinely ignored without effective sanctions, and 3 means that the country enjoys a better judicial system. Law and order are a single component scored from 0 to 6, where a higher score represents higher respect to laws in the country. This covariate is obtained from PRS Group (2021). A summary statistic of all these measures is provided in Appendix 2.

5. Results

5.1. Arellano-Bover/Blundell-Bond estimation

The dynamic panel estimations for both variables of interest using the Arellano-Bover/Blundell-Bond estimation (Arellano and Bover, 1995; Blundell and Bond, 1998) are presented in Table 1 and Table 2. The regression that includes corruption (CPI) in Table 1 shows this index's positive and statistically significant impact on resource FDI. This coefficient in model 1 suggests that a one-point increase in corruption perception index -more clean- attracts US\$ 57.09 million more of resource FDI on average. This amount is around 5.2% of the mean of resource FDI (see Appendix 2). That result remains significant after controlling for trade freedom. Still, it decreases slightly when political freedom is included as a control and reduces considerably when law and order are included in models 5 and 6.

The effect of resource FDI in previous years on current resource FDI is positive and significant in all cases, showing persistence over time as expected. That dependence on the past is still significant after controlling for relevant economic, social, and political variables in all models. In general, market size, economic openness, and the size of the host economy have a positive and significant impact on resource FDI in all cases. When trade freedom is included in models 2, 3, and 6, the coefficient of economic openness decreases, but it is still significant. A possible reason is that trade freedom would be considered a proxy for economic openness.

Political freedom has a negative and considerable effect on resource FDI as expected. The reason is that the scale of this control is from 1 to 7, where 1 means "highest degree of freedom" and 7 "lowest degree of freedom." Since the scale of political freedom is small, a one-point increase represents a big shrink in political freedom. Similarly, law and order positively impact resource FDI as expected because its scale is

from 0 to 6. Still, their coefficients are positives because a higher score implies a stronger and impartial legal system and lower crime rates if the law is routinely ignored without effective sanction.

Regarding Table 2, where the variable of interest is corruption perception (ICRG), which is one of the ICRG index components, it is shown that the results are consistent with those found in Table 1. Since the scale of corruption (ICRG) is between 0 to 6, a one-point increase in this variable will have a more considerable effect on resource FDI than corruption (CPI), between 0 to 100. For instance, in Appendix 2, the mean of corruption (CPI) is 36.63, and the mean of corruption (ICRG) is 2.53, a relationship of 14.5 to 1. When the coefficient of corruption (ICRG) in model 1 in Table 2 is compared to the coefficient of corruption (CPI) in model 1 in Table 1, the ratio is 13.1 to 1 (746.0/57.1), showing that when the scales are considered, both results are very similar. The signs of the control variables are as expected, the coefficients of Table 2 are similar to those obtained in Table 1, and law and order positively impact resource FDI. Still, it is not statistically significant at 10% significance -its p -values for models 5 and 6 are 0.117 and 0.188, respectively (not reported). Overall, these results support the grabbing hand hypothesis. Table 3 displays the results when we use corruption (WGI) as a variable of interest.

Table 1: Arellano-Bover/Blundell-Bond linear dynamic panel estimation using corruption (CPI)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (CPI)	57.09*** (17.64)	56.80*** (17.67)	54.01*** (17.54)	54.27*** (17.51)	53.44*** (18.67)	52.44*** (18.62)
Market size	0.277*** (0.0762)	0.231*** (0.0851)	0.182** (0.0864)	0.230*** (0.0778)	0.294*** (0.0804)	0.191** (0.0909)
Economic openness	19.72*** (7.389)	17.78** (7.589)	17.13** (7.513)	19.14*** (7.314)	21.34*** (7.598)	18.10** (7.727)
Size of the host economy	27.25*** (3.952)	28.22*** (4.043)	30.19*** (4.080)	29.19*** (3.990)	30.09*** (4.464)	32.40*** (4.617)
Trade freedom		22.07 (18.15)	22.47 (17.98)			26.10 (18.68)
Political freedom			-544.5** (216.4)	-539.3** (216.0)		-483.8** (231.5)
Law and order					334.1* (201.9)	273.7 (214.7)
FDI_NR _{t-1}	0.198*** (0.0355)	0.198*** (0.0356)	0.175*** (0.0363)	0.176*** (0.0362)	0.179*** (0.0378)	0.162*** (0.0383)
FDI_NR _{t-2}	0.131*** (0.0367)	0.128*** (0.0369)	0.131*** (0.0366)	0.135*** (0.0364)	0.123*** (0.0379)	0.126*** (0.0383)
FDI_NR _{t-3}	0.165*** (0.0388)	0.163*** (0.0390)	0.170*** (0.0387)	0.172*** (0.0386)	0.166*** (0.0394)	0.170*** (0.0392)
Constant	-5,482*** (925.3)	-6,698*** (1,369)	-4,997*** (1,514)	-3,775*** (1,143)	-6,474*** (1,066)	-6,219*** (1,812)
Observations	338	338	338	338	319	319
Number of countries	20	20	20	20	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2: Arellano-Bover/Blundell-Bond linear dynamic panel estimation using corruption (ICRG)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (ICRG)	746.0*** (188.8)	793.1*** (191.1)	734.7*** (189.3)	687.6*** (187.1)	667.6*** (193.7)	678.2*** (193.0)
Market size	0.312*** (0.0721)	0.240*** (0.0822)	0.195** (0.0835)	0.270*** (0.0737)	0.329*** (0.0723)	0.207** (0.0836)
Economic openness	19.04*** (7.189)	16.76** (7.322)	14.82** (7.258)	17.19** (7.127)	19.91*** (7.140)	15.52** (7.233)
Size of the host economy	25.77*** (3.882)	27.61*** (4.022)	29.15*** (4.041)	27.24*** (3.902)	28.71*** (4.279)	31.74*** (4.473)
Trade freedom		33.76* (18.17)	34.63* (17.99)			39.46** (18.25)
Political freedom			-516.5** (220.8)	-508.5** (219.8)		-425.0* (230.1)
Law and order					300.9 (191.9)	269.0 (204.3)
FDI_NR _{t-1}	0.183*** (0.0362)	0.180*** (0.0364)	0.159*** (0.0371)	0.164*** (0.0369)	0.167*** (0.0374)	0.148*** (0.0379)
FDI_NR _{t-2}	0.134*** (0.0366)	0.129*** (0.0369)	0.132*** (0.0365)	0.138*** (0.0362)	0.121*** (0.0373)	0.119*** (0.0378)
FDI_NR _{t-3}	0.165*** (0.0389)	0.163*** (0.0391)	0.169*** (0.0388)	0.171*** (0.0386)	0.172*** (0.0389)	0.174*** (0.0388)
Constant	-5,348*** (889.5)	-7,367*** (1,407)	-5,659*** (1,558)	-3,615*** (1,135)	-6,154*** (1,020)	-6,965*** (1,834)
Observations	326	326	326	326	326	326
Number of countries	19	19	19	19	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3: Arellano-Bover/Blundell-Bond linear dynamic panel estimation using corruption (WGI)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (WGI)	2,343*** (409.2)	2,387*** (413.9)	2,383*** (427.6)	2,344*** (423.9)	2,362*** (480.5)	2,403*** (485.9)
Market size	0.139* (0.0845)	0.102 (0.0954)	0.101 (0.0969)	0.140 (0.0858)	0.126 (0.0922)	0.0848 (0.106)
Economic openness	9.816 (7.382)	9.026 (7.462)	8.797 (7.464)	9.593 (7.385)	9.435 (7.842)	8.294 (7.928)
Size of the host economy	28.58*** (4.068)	29.49*** (4.218)	29.40*** (4.264)	28.47*** (4.108)	29.24*** (4.553)	30.63*** (4.809)
Trade freedom		16.61 (19.48)	16.60 (19.54)			21.45 (20.84)
Political freedom			2.727 (261.7)	17.14 (260.8)		112.7 (290.3)
Law and order					238.6	316.7

					(248.8)	(266.5)
FDI_NR _{t-1}	0.168*** (0.0396)	0.170*** (0.0398)	0.170*** (0.0402)	0.169*** (0.0401)	0.162*** (0.0426)	0.164*** (0.0430)
FDI_NR _{t-2}	0.196*** (0.0455)	0.194*** (0.0457)	0.194*** (0.0458)	0.196*** (0.0456)	0.213*** (0.0474)	0.211*** (0.0477)
FDI_NR _{t-3}	0.152*** (0.0408)	0.153*** (0.0409)	0.153*** (0.0412)	0.152*** (0.0411)	0.144*** (0.0423)	0.143*** (0.0428)
Constant	-1,223 (907.1)	-2,165 (1,432)	-2,152 (1,561)	-1,248 (1,131)	-1,735 (1,216)	-3,470* (2,056)
Observations	337	337	337	337	308	308
Number of countries	20	20	20	20	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

5.2. Arellano-Bond estimation

The AB estimation (Arellano and Bond, 1991), using the three corruption perception indexes as independent variables, are shown in Appendices 3, 4, and 5. As mentioned above, this estimation is not efficient when the lagged-level instruments become too persistent or when the ratio of the variance of the panel-level effect to the variance of the idiosyncratic error is too large. That explains why even though the signs of the controls of corruption have the expected signs and their coefficients, they are similar to the ABBB estimations. Corruption CPI in Appendix 3 is statistically significant at a 10% level from models 3 to 6, and their impact on resourcing FDI is a little smaller than the ABBB estimation. Corruption ICRG in Appendix 4 is significant at a 1% level in all models, but their coefficients are smaller than the ABBB approach. Corruption WGI in Appendix 5 is significant at a 1% level in all models, like the corruption IRCG case. However, contrary to the other controls of corruption, their coefficients are greater than the ABBB estimation.

5.3. Nonlinearity between corruption and resource FDI

Next, we test the nonlinearity between the corruption perception index and resource FDI. Table 4 shows a statistically significant nonlinearity between corruption and the dependent variable in a dynamic panel fixed effect taking the logarithm of the dependent variable. The coefficients of corruption and corruption squared are robust to different control variables. This concave relationship would be interpreted as when a country is becoming less corrupt and is improving its economic, social, and political performance, usually attracts more resource FDI and uses these resources for its development, but when that developing country moves towards a higher degree of development and becomes less corrupt, tends to be less dependent on resource FDI, so that amount of resource FDI decreases in relative terms maybe because its economy is less resource-extractive intensive, and its economic growth is less based on highly polluting industries.

Since this regression is a fixed effect dynamic panel estimation, it would bring the complication of endogeneity bias because of the lagged dependent variable, making the coefficients estimated inconsistent. The controls market size, economic openness, size of the host economy, and law and order have the expected signs even when most of them are not statistically significant at 10% level. But trade freedom's magnitude is small with the sign opposite to expected but not statistically significant. Political freedom also has small coefficients and opposite signs to the expected, but statistically significant at 10% level in

models 3 and 4. One possible explanation for the flipped signs in trade freedom and political would be collinearity between these two measures of freedom. Another reason is that when the dependent variable is logged, it drops the negative values of resource FDI leaving only the positives. A third reason is the smaller sample negative values are dropped, eliminating approximately one-quarter of the sample, from 338 in Table 1 to 251 in Table 4.

Table 4: Nonlinearity between corruption (CPI) and resource FDI

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (CPI)	0.219** (0.0784)	0.219** (0.0788)	0.240*** (0.0802)	0.241*** (0.0798)	0.213** (0.0788)	0.229*** (0.0791)
Corruption squared	-0.00199** (0.000704)	-0.00200** (0.000707)	-0.00216*** (0.000720)	-0.00216*** (0.000718)	-0.00194** (0.000706)	-0.00206*** (0.000709)
Log Market size	0.811 (0.810)	0.912 (0.796)	1.363* (0.779)	1.346* (0.773)	0.569 (0.856)	1.235 (0.819)
Economic openness	0.00666 (0.00749)	0.00670 (0.00757)	0.00222 (0.00765)	0.00214 (0.00751)	0.00498 (0.00781)	0.000480 (0.00787)
Size of the host economy	0.0391 (0.0238)	0.0395 (0.0240)	0.0482** (0.0229)	0.0483** (0.0228)	0.0344 (0.0237)	0.0437* (0.0223)
Trade freedom		-0.00802 (0.00711)	-0.00194 (0.00724)			-0.00188 (0.00795)
Political freedom			0.318* (0.181)	0.322* (0.180)		0.324 (0.191)
Law and order					0.00548 (0.137)	0.0295 (0.146)
Log FDI_NR _{t-1}	0.525*** (0.101)	0.524*** (0.100)	0.540*** (0.100)	0.540*** (0.100)	0.520*** (0.104)	0.532*** (0.103)
Log FDI_NR _{t-2}	-0.140 (0.0940)	-0.138 (0.0943)	-0.144 (0.0926)	-0.145 (0.0926)	-0.154 (0.102)	-0.160 (0.101)
Log FDI_NR _{t-3}	0.200*** (0.0439)	0.202*** (0.0450)	0.199*** (0.0455)	0.199*** (0.0451)	0.230*** (0.0402)	0.231*** (0.0404)
Constant	-7.505 (7.082)	-7.848 (7.010)	-12.87* (7.062)	-12.86* (7.030)	-5.241 (7.581)	-11.64 (7.631)
Observations	251	251	251	251	239	239
R-squared	0.496	0.496	0.506	0.506	0.504	0.515
Number of countries	20	20	20	20	19	19

Dependent variable: Log Resource FDI.

Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

6. Conclusion

The findings indicate a positive and statistically significant relationship between both corruption measures (CPI and ICRG) and resource FDI in Latin American countries. This study uses an ABBB linear dynamic panel estimation. The estimated results suggest that a one-point increase in corruption perception index (CPI) leads to a rise in resource FDI between US\$37 to US\$51 million depending on the econometric specification, on average and *ceteris paribus*, taking Latin America as a region. A similar

result is found using the corruption (ICRG) measure, where a one-point increase in this index leads to a rise in resource FDI between US\$619 to US\$771 million depending on the econometric specification, on average and *ceteris paribus*. The results using both measures of corruption are consistent considering the scales of corruption perception indexes. These results support the grabbing hand hypothesis, which states that high (low) levels of corruption make investment unfavorable (favorable). The grabbing hand hypothesis is robust after controlling for market size, economic openness, size of the host country, trade freedom, political freedom, law and order, and lags of the dependent variable.

Additionally, we find a significant nonlinear relationship between corruption (CPI) and resource FDI. It would be interpreted as when a country is a less developed or a developing country, improving its economic, social, and political performance attracts more resource FDI, and the country uses these resources to its development. But as that country achieves a higher level of development becomes less dependent on resource-extractive industries in relative terms and tends to attract more other types of FDI.

Regarding policy implications, Latin American countries, in order to attract more resource FDI to use for their development, should consider identifying the areas where corruption is more extended -public and/or private sector- and reform legal and tax systems to reduce actual corruption and corruption perception. These policies should be implemented considering each country's institutions and specificities, especially in a very heterogeneous region like Latin America. Also, open their economies more to trade responsibly and make an effort to strengthen political stability since corruption, economic openness, trade freedom, and political environment has a significant impact on the amounts of resource FDI received by host economies.

7. Future research

This study can be used for future research in different ways. For instance, countries from other regions - Asia, Africa, Europe- can be added to the sample, making the results more robust. In the same line, a similar idea would be to add more countries to the sample to compare regions. The grabbing hand or the helping hand hypothesis applied to resource FDI would be supported or not in other economies or regions. Future research also would include additional control variables such as a proxy for infrastructure, government effectiveness, or an overall economic freedom index which are relevant variables that a foreign investor considers when deciding to invest in natural resources or another type of investment.

Another alternative is to apply a similar econometric approach to a specific natural resource (e.g., oil, minerals). Natural resources are exposed to different international price fluctuations; they have different extractive costs and technology due to varying types of investments. Taking total resource FDI has the advantage of giving a broad perspective, but the behavior of a specific commodity is missed. In that sense, future research can also be focused on a country or group of countries with a common, abundant natural resource (e.g., oil exporters). Finally, future research can use the methodology of this paper to compare resource FDI and non-resource FDI and test whether the grabbing hand hypothesis or the helping hand hypothesis applies for both types of FDI and among different regions.

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Appendix

Appendix 1: Primary exports^a as a percentage of merchandise exports

	1970-1979	1980-1989	1990-1999	2000-2009	2011-2019
Argentina	78.0	77.5	67.5	67.0	64.3
Belize	74.0	99.1	80.6	79.6	92.1
Bolivia	97.0	97.9	72.5	82.9	89.4
Brazil	75.0	55.5	44.0	47.7	62.6
Chile	92.7	91.6	82.4	83.0	85.3
Colombia	80.3	79.3	67.1	62.5	75.9
Costa Rica	75.5	73.0	58.0	34.8	42.3
Dominican Republic	81.4	69.0	11.0	24.8	29.4
Ecuador	97.8	98.0	92.4	91.0	91.5
El Salvador	71.8	70.8	56.6	21.1	25.4
Guatemala	75.5	76.3	68.8	57.5	57.9
Guyana	92.1	95.0	64.7	62.2	48.5
Honduras	91.8	92.4	81.1	64.8	59.7
Jamaica	46.4	42.9	78.5	90.3	93.0
Mexico	67.8	73.9	27.4	20.4	19.3
Nicaragua	84.2	91.1	79.5	80.8	55.0
Panama	93.8	87.7	80.5	88.8	14.6
Paraguay	88.8	91.3	84.5	93.0	90.0
Trinidad and Tobago	91.4	84.9	62.3	71.6	62.5
Uruguay	69.5	64.6	60.4	66.7	77.0
Average	81.2	80.6	66.0	64.5	61.8

Source: Own elaboration based on World Development Indicators.

^a Primary export includes agricultural raw materials, food, fuel, and ores and metals.

Appendix 2: Summary statistics

Variable	Observations	Mean	Standard deviation
FDI_NR	415	1105.41	2613.94
FDI_NR _{t-1}	399	1085.54	2596.25
FDI_NR _{t-2}	381	1088.63	2594.85
FDI_NR _{t-3}	362	1099.58	2638.17
Corruption (CPI)	428	36.63	13.32
Corruption (ICRG)	456	2.53	0.83
Corruption (WGI)	420	-0.26	0.65
Market size	500	6230.36	3785.89
Economic openness	500	71.50	34.73
Size of the host country	500	24.32	45.15
Trade freedom	499	71.20	10.11
Political freedom	500	2.29	0.99
Law and order	456	2.71	0.95

Appendix 3: Arellano-Bond linear dynamic panel estimation using corruption (CPI)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (CPI)	36.74 (24.94)	36.57 (24.94)	41.66* (24.84)	41.90* (24.85)	43.42* (26.32)	48.56* (26.31)
Market size	0.136 (0.0908)	0.0947 (0.104)	0.0761 (0.103)	0.108 (0.0909)	0.168* (0.102)	0.0932 (0.116)
Economic openness	8.946 (8.618)	8.940 (8.636)	8.812 (8.555)	8.817 (8.539)	10.37 (8.939)	10.30 (8.894)
Size of the host economy	93.07*** (27.82)	88.06*** (28.61)	96.12*** (28.60)	100.3*** (27.75)	92.13*** (30.61)	92.42*** (31.52)
Trade freedom		17.67 (22.04)	14.20 (21.92)			14.76 (22.79)
Political freedom			-501.4** (242.7)	-512.4** (241.6)		-486.8* (254.4)
Law and order					274.1 (269.2)	195.7 (271.1)
FDI_NR _{t-1}	0.220*** (0.0465)	0.219*** (0.0467)	0.198*** (0.0474)	0.198*** (0.0473)	0.212*** (0.0497)	0.194*** (0.0503)
FDI_NR _{t-2}	0.148*** (0.0483)	0.146*** (0.0485)	0.148*** (0.0481)	0.151*** (0.0479)	0.144*** (0.0502)	0.148*** (0.0502)
FDI_NR _{t-3}	0.129*** (0.0483)	0.132*** (0.0486)	0.134*** (0.0481)	0.132*** (0.0479)	0.130*** (0.0489)	0.137*** (0.0489)
Constant	-5,005*** (1,403)	-5,885*** (1,789)	-4,705** (1,861)	-3,976*** (1,470)	-6,245*** (1,884)	-5,664*** (2,289)
Observations	318	318	318	318	300	300
Number of countries	20	20	20	20	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Appendix 4: Arellano-Bond linear dynamic panel estimation using corruption (ICRG)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (ICRG)	640.5*** (226.1)	645.6*** (226.4)	636.2*** (223.8)	632.9*** (223.6)	629.5*** (226.0)	629.4*** (224.3)
Market size	0.108 (0.0896)	0.0589 (0.103)	0.0457 (0.103)	0.0870 (0.0895)	0.133 (0.0980)	0.0573 (0.110)
Economic openness	6.273 (8.286)	6.828 (8.322)	5.201 (8.256)	4.713 (8.219)	6.322 (8.250)	5.311 (8.242)
Size of the host economy	117.6*** (32.12)	109.3*** (33.31)	119.0*** (33.41)	126.4*** (32.16)	120.1*** (32.30)	119.8*** (33.52)
Trade freedom		21.73 (22.44)	18.48 (22.33)			19.05 (22.31)
Political freedom			-451.2* (248.8)	-467.2* (247.7)		-435.6* (252.8)
Law and order					156.5 (256.2)	79.25 (259.4)
FDI_NR _{t-1}	0.206*** (0.0479)	0.204*** (0.0481)	0.185*** (0.0488)	0.187*** (0.0487)	0.199*** (0.0494)	0.182*** (0.0500)
FDI_NR _{t-2}	0.143*** (0.0489)	0.140*** (0.0490)	0.142*** (0.0487)	0.145*** (0.0485)	0.137*** (0.0497)	0.139*** (0.0498)
FDI_NR _{t-3}	0.125*** (0.0484)	0.129*** (0.0487)	0.130*** (0.0484)	0.127*** (0.0481)	0.126*** (0.0483)	0.131*** (0.0484)
Constant	-5,508*** (1,308)	-6,596*** (1,726)	-5,328*** (1,839)	-4,369*** (1,424)	-6,108*** (1,632)	-5,695*** (2,166)
Observations	307	307	307	307	307	307
Number of countries	19	19	19	19	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.

Appendix 5: Arellano-Bond linear dynamic panel estimation using corruption (WGI)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Corruption (WGI)	3,777*** (779.3)	3,768*** (780.5)	3,805*** (779.6)	3,812*** (778.3)	4,343*** (865.7)	4,396*** (868.7)
Market size	0.0853 (0.1000)	0.0577 (0.114)	0.0445 (0.114)	0.0651 (0.101)	0.122 (0.111)	0.0664 (0.127)
Economic openness	5.238 (8.190)	5.341 (8.206)	3.959 (8.213)	3.857 (8.195)	5.536 (8.755)	4.399 (8.787)
Size of the host economy	154.5*** (38.81)	151.6*** (39.35)	166.3*** (40.79)	168.8*** (40.12)	162.3*** (44.59)	172.6*** (47.25)
Trade freedom		11.32 (22.76)	8.644 (22.80)			11.80 (24.57)
Political freedom			-374.9 (289.2)	-383.0 (287.9)		-338.3 (315.7)
Law and order					511.0 (313.6)	459.8 (317.9)
FDI_NR _{t-1}	0.175*** (0.0558)	0.174*** (0.0559)	0.167*** (0.0561)	0.167*** (0.0560)	0.176*** (0.0594)	0.170*** (0.0597)
FDI_NR _{t-2}	0.195*** (0.0573)	0.195*** (0.0574)	0.190*** (0.0574)	0.190*** (0.0573)	0.199*** (0.0606)	0.194*** (0.0608)
FDI_NR _{t-3}	0.113** (0.0497)	0.115** (0.0499)	0.117** (0.0499)	0.115** (0.0497)	0.111** (0.0518)	0.115** (0.0520)
Constant	-3,627*** (1,188)	-4,212** (1,675)	-3,339* (1,796)	-2,876** (1,309)	-5,409*** (1,715)	-5,180** (2,293)
Observations	305	305	305	305	277	277
Number of countries	20	20	20	20	19	19

Dependent variable: Resource FDI.

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.