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Corruption and FDI in Brazil: Contesting the "Sand" or "Grease" Hypotheses

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Abstract: Foreign Direct Investment (FDI) is seen as a significant driver of economic growth and a potential ally in the struggle against poverty and inequality, making emerging countries focus on attracting this type of investment. Thus, understanding factors that impact the concentration of regional FDI is essential to verifying which characteristics encourage or deter foreign investment. Likewise, the literature has explored institutional factors such as corruption as determining factors for the concentration of FDI. Within this framework, this study aims to empirically examine the sensitivity of multinational enterprises (MNEs) to corruption. Few studies have been carried out on this subject, mainly in Latin American economies. We employ a unique Brazilian municipality-level FDI database to investigate whether corruption hinders (i.e., corruption acting as "sand") or promotes the concentration of foreign investment (i.e., corruption acting like "grease"). Additionally, we believe that analyzing different economic sectors is essential to deepening the knowledge about the impacts of corruption on FDI. Our results show that corruption acts as "grease" for both overall FDI and at the level of individual sectors. Finally, when taking a non-linear approach, our findings show that corruption acts as grease for FDI only in regions with intermediate (medium–low) levels of corruption.

Keywords: corruption; Foreign Direct Investment (FDI); Brazil; sand and grease

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1. Introduction

Recently, there has been a renewed interest in understanding how to achieve the Sustainable Development Goals (SDGs) established by the UN 2030 Agenda of Sustainable Development. In this context, Foreign Direct Investment (FDI) represents an essential ally for emerging economies, since it can help diminish poverty and hunger—SDG 1 and 2 [1], enhance economic growth—SDG 8 [2,3], control inequality—SDG 10 [4], and strengthen local institutions—SDG 16 [5].

However, several factors influence the presence of FDI in emerging economies. Among them, the institutional environment has been attracting increasing attention within the literature [6], as both formal and informal practices (i.e., legislation and corruption) can either deter or facilitate Multinational Enterprises (MNEs)' activities [7]. In other words, evidence suggests that corruption may, along with other aspects, explain the regional concentration of foreign companies [7,8].

The literature presents two opposing views on the role of corruption in the regional attraction and concentration of MNEs. The first, called "sand", presents corruption as a

constraining factor. Thus, according to Barassi and Zhou [6], corruption can be viewed as "sand in the wheels of commerce", as it creates costs, uncertainty, and distortion towards the activities of international enterprises. Wei [9] argues that corruption is costly for firms, as it is no different than an additional unofficial tax that directly reduces MNEs' profits. In addition, Kaufmann [10] states that the costs caused by corruption would not lie only in the bribe paid to the government in exchange for services, but also in the time and effort that MNEs have to spend dealing with corrupt public officials.

The second view is called "grease". Within this idea, corruption can attract foreign investors since it may serve as a "helping hand" to foreign investors, as bribes could circumvent restrictions and regulations [11]. It holds especially for emerging economies (e.g., Brazil, Latin American countries), since they tend to present extremely complex and inefficient legal, accounting, and taxes systems. Thus, corruption can be seen as an "efficient grease" that helps foreign firms to overcome rigid regulations and excessive government intervention within the host region [12].

Given the aforementioned literature, by employing regional Brazilian data, our study aims to challenge the dichotomous idea of "sand" or "grease" views within the scope of emerging economies. We argue that MNEs may tolerate some levels of corruption to gain location-specific advantages such as access to a consumer market, cheap labor, or tax heavens [13]. Thus, the main issue to be investigated here goes beyond the "sand" or "grease" hypotheses, lying instead in the investigation of which level of corruption marks the change from the grease to the sand effect, which is equivalent to answering the following question: To what extent are MNEs willing to tolerate corruption?

Regional-level research on FDI in Brazil and other emerging economies is still limited. To our knowledge, regional investigations on the effects of FDI on the host are almost nonexistent in Brazil, with only a few exceptions [14,15]. These exceptions, however, do not address the relationship between FDI and corruption. Thus, we try to deepen the knowledge about such connections within the most important Latin American economy.

Our results show that when employing a linear econometric model to evaluate the dichotomous approach of "Sand OR Grease", corruption tends to act as "grease" for FDI. In other words, FDI intensity should be higher in regions with higher levels of corruption. However, when we adopt a non-linear approach, our findings show that corruption acts as grease for FDI only in regions with intermediary (low–medium) levels of corruption. Our results are innovative for the theory that analyzes the effects of corruption on the local economy. Moreover, our findings can serve as a basis for the elaboration of Brazilian public policies aimed at combating corruption, encouraging FDI, and upgrading local bureaucracy.

This article is structured as follows. Section 2 discusses the theoretical background of corruption, FDI, and emerging countries. Section 3 presents the data and methods. In Section 4, we present the results. Finally, in Section 5, we discuss the results and implications of our findings for firms and policymakers.

2. Literature Review

2.1. FDI and Corruption in Emerging Economies

Stimulating economic development in emerging countries is one of the goals set by the UN 2030 Agenda. In this context, several studies identify FDI as a significant driver of economic growth both in emerging [3,16,17] and transition economies [18,19]. Some authors assume that the positive effects of FDI on the economy come from the increase in the capital stock of the host region [20]. In contrast, others postulate that this growth derives from positive externalities, such as knowledge spillovers [21] and its associated productivity gains from domestic firms [22].

FDI assumes an even more critical role, as it is identified as a potential ally in the fight against poverty, hunger, and inequality [1,4,23,24], which is an essential target of the UN sustainable development goals. Nevertheless, recent studies point out that the benefits of FDI for emerging countries must be analyzed with caution, as other variables, such as environmental ones, must be taken into account [25]. Additionally, the method

used to measure economic development must also be analyzed carefully, as econometric modeling is not always sufficient to capture the impact of a sector on economic growth [26]. Indeed, the country's economic context and the proxy used to measure poverty are among them [16,27,28].

Likewise, it is widely accepted that creating and promoting an attractive environment for FDI is complex and varies from one country to another [19]. Some authors point out that one of the main attractions for FDI entry into an emerging country is the abundance of natural resources in the host region [29,30], while others focus on market openness [31], financial factors [32], and social variables [33] as determinants of FDI. However, our study highlights the importance of institutional and policy factors. Hoang et al. [34] argue that the level of social security and legal institutions plays an important role in attracting FDI. Moreover, according to Wan [35], institutions can affect the probability of success of foreign firms, since MNEs tend to adapt their strategies according to the host institutional environment [36,37].

Therefore, institutional factors affect not only the performance of MNEs in the country but also how the concentration and the inflow of foreign capital impact the local economy. In this sense, Chaudhry et al. [38] suggest that the efficiency of local institutions affects economic development and reduces the ecological footprint of MNEs in the host region. Slesman, Abubakar, and Mitra [39] argue that depending on hosts' level of institutional capacity, FDI can be harmful (in lower levels) or beneficial (in higher levels) to domestic firms. Further, Chih, Kishan, and Ojede [40] show that the impact of FDI on economic growth is non-linear, and it also depends on the democratic level of the country, indicating the complexity of the relation between FDI and its impact on (or how it is affected by) the characteristics of the host region, especially on emerging economies. Among the emerging economies, Latin America stands out. Indeed, since 1980, these countries have been undergoing a major industrial reform, with the opening of their markets to foreign investment and the privatization of large companies in critical sectors of the economy [41]. Nevertheless, despite the complexity of this relationship, it is essential to explore it due to its potential to bring both economic and social benefits (or harm) to the host region.

Our study brings to light one of the factors that affect the complex relationship between FDI and its effect on emerging economies: corruption. The effects of corruption have been a topic of debate among economists and policymakers for at least 50 years [42], since it can impact the decision-making process, access to public resources, and information [43]. In this sense, understanding corruption in a deeper way is essential to exploring its regional economic impacts.

There are many definitions for the word "corruption". Tanzi and Davoodi [44] defined it as the acceptance or extortion of money for personal benefit by government officials; this perspective, although widely used, only addresses the public [45] or government corruption [46]. In the organizational sphere, other authors state that corruption occurs when someone misdirects resources or subverts organizational policies or routines to obtain personal gains [47,48]. Additionally, accepting a strong private–public dichotomy is essential to explaining the aforementioned concept of public and organizational corruption [49]. Here, we choose to use a broader definition: "corruption is any practice that violates important rules for personal or organizational gain" [50]. By choosing a broader definition of corruption, we accept that it happens whenever there is an abuse of power. This vision is aligned with Transparency International, a non-governmental organization responsible for estimating the Corruption Perception Index (CPI).

Although corruption may present different manifestations, bribery is the most common one according to Svensson [51]. Moreover, while scholars agree that the global monetary effects of bribes are significant [52], emerging markets such as Brazil are at the forefront of those bribing activities [53].

The literature has extensively investigated the problem of corruption in emerging countries. Kotabe, Jiang, and Murray [54] emphasize the political network's importance in reducing timing and uncertainty in highly bureaucratic and volatile emerging markets.

Krammer's [42] findings corroborate these results by showing that corruption and bribery enhance innovation levels in emerging economies. Nevertheless, Habiyaremye and Raymond [55] state that corruption has a contrary effect on innovation, since it undermines the foundations of institutional trust. Later, the same authors found that the relationship between corruption and innovation is not necessarily linear. The type of corruption (petty or grand) affects emerging markets firms' propensity to innovate [56].

Recently, Ojide and Agu [57] investigated the impact of corruption on the battle against the effects of COVID-19 in Nigeria, recommending measures to control corruption as an essential part of economic recovery policies in the country. On the other hand, Soh, Muhamad, and San [58] analyzed the relationship between corruption and public debt, noting that government efficiency can be an obstacle to reducing this debt in emerging countries. The authors state that a highly efficient country tends to have lesser levels of corruption. This reality was contrary to that found in developed economies, emphasizing the particularities of elaborating public policies in countries with different stages of economic development. Additionally, the results of Sadik-Zada, Gatto, and Niftiyev [59] point out that high levels of civil liberties and political rights have a positive relationship, with the decrease in petty corruption.

2.2. FDI and Corruption—The "Sand or Grease" Theory

Although the corruption impact on the economy is highly accepted in the literature [43,57,58,60,61], it remains a point of debate whether such illegal payments are harmful to economic activities [42] such as FDI inflows and their regional concentration [6–8,37,62,63].

According to Transparency International [60], corruption is not unusual in international business, especially in emerging economies. Meyer and Nguyen [7] show that formal and informal practices (i.e., legislation and corruption) may either deter or ease the investment incentives of foreign investors.

However, the literature on corruption is divided into two branches. The first one assumes that corruption acts as an agent that obstructs economic activities ("sand in the wheels") by (i) imposing additional costs on firms [9,61,64–66], (ii) increasing uncertainty [67,68], (iii) decreasing foreign investments [69] by dissuading potential foreign participation in joint ventures [70], and (iv) hindering the innovation of processes and products [43].

Thus, Qian and Sandoval-Hernandez [71] asserted that corruption is harmful and therefore configures a deterrent factor of FDI. For instance, Hakimi and Hamdi [72] found that corruption is a serious hurdle for 15 Middle East and North African (MENA) countries, since it disturbs investment activities and FDI inflows. Recently, Chewaka [62] found that corruption can be a trap for the smooth growth of firms, even in promising potential markets. Additionally, Bouzahzah's [60] findings show that high levels of corruption get in the way of environmental regulations on multinationals.

The second and opposite branch of the literature on corruption believes that it acts as an enabling agent ("grease the wheels") by (i) benefiting firms suffering from obstructive private monopolies and government practices [73,74], (ii) reducing the waiting time to obtain licenses [75], and (iii) increasing the speed of product innovation [76].

Urbina [11] states that corruption can act as a "helping hand" to foreign investors, as bribes could circumvent restrictions and regulations. Furthermore, Darendeli [77] found evidence that corruption can help MNEs circumvent political instabilities. Additionally, Helmy [78] did not find any evidence that corruption hinders FDI inflows and emphasizes that policies that aim to eradicate corruption should be cautious not to affect the economy's freedom and openness. Accordingly, the literature points out that there is indeed a relationship between foreign investment and local corruption, although there are disagreements about whether this effect is positive or negative. Thus, our first research hypothesis seeks to prove this relationship, which is the fundamental one for the "sand OR grease" theory.

Hypothesis 1 (H1). *Corruption at the regional level affects the concentration of FDI.*

However, we challenge the idea that the corruption impact can be measured only as positive or negative ("sand OR grease") to FDI. Instead, we ask: To what extent are MNEs willing to tolerate corruption?

The literature shows that the impact of corruption on FDI changes according to its type and the response of firms to this process. Sartor [68] found that different types of corruption have different effects on MNE responses. Further, Galang's [79] findings show heterogeneous results in the firm's performance according to their responses to public corruption.

Using firm-level data, Ghosh [59] states that the illegality of corrupt practices hinders any way of measuring it at an individual level in companies; for this reason, many studies choose to analyze corruption at a regional level. Additionally, Ketteni and Kottaridi [37] suggest that the FDI effects on the economic development of host economies can vary significantly in the same country over time. The authors further suggest that this variation strongly depends on the status of regional regulations.

In light of the arguments above, we believe that investigating the effect of FDI at microscales is fundamental to understanding the impact of corruption on these companies. We also believe in a non-linear model and a non-binary relationship between corruption and FDI performance. Accordingly, we propose the following hypothesis:

Hypothesis 2 (H2). *FDI regional intensity has a non-linear relationship with corruption.*

Moreover, the impact of corruption on FDI's regional concentration may vary depending on the sector analyzed [80], since MNEs inserted in highly corrupt sectors may be more indulgent to higher levels of regional corruption. One explanation for the variation in levels of corruption in different sectors is the type of regulation that each economic activity needs to function. Zhu and Wu [80] assume that the more a firm or sector needs government support or approval, the more likely it is to be involved in corrupt practices such as bribery.

The literature expands the field of economic sectors by analyzing foreign direct investment and corruption. For example, Phan and Nguyen [81] examined the effect of FDI and corruption on the development of public service in 10 ASEAN countries. They found that although FDI positively impacts the development of public sectors, this impact can be null in highly corrupt regions. Similarly, Rygh, Torgersen, and Benito [82] investigate the role of institutions in attracting FDI in agricultural and extractive activities, finding some evidence that corruption deters FDI in both primary subsectors. Additionally, some researchers argue that when anti-corruption policies are in place, foreign investors feel safer investing in highly corrupt sectors [83].

Corruption in different economic sectors can also hamper entrepreneurial activities. Berdiev and Saunoris [84] argue that corruption can harm or increase the propensity for entrepreneurial activities, and the determining factor for this is each sector's level of formality. They found that corruption deters formal sector entrepreneurship while boosting entrepreneurial activities in informal sectors. Even more, there is evidence that firms in corrupt sectors tend to mimic this behavior and naturalize corruption [85].

Kouneva-Loewenthal and Vojvodic [86] found that corruption can either deter or enhance FDI inflows depending on the economic sector. In other words, while corruption can damage ("sand") foreign investments in the manufacturing sector, it can also benefit ("grease") the energy sector. The authors also suggest that the analysis of the relationship between FDI and corruption ought to be contextualized and complemented by sectoral-level research. However, studies that analyze the FDI disaggregated by sectors are still scarce. Based on the literature mentioned, we believe that analyzing different economic sectors is essential to deepening knowledge about the impacts of corruption on FDI. Finally, the sectoral analysis can capture different effects of corruption on the attraction of FDI due to the particularities (e.g., regulation, formality) and tolerance of corruption in each

economic activity. Hence, our study also assesses aggregate FDI at the regional level by analyzing FDI disaggregated by economic sector and region.

3. Methods

3.1. Data Sources and Variables

Our study focuses on the state of São Paulo, in Brazil, between the years 2012 and 2016. This choice lies in the fact that it hosts almost 40% of all foreign investments according to the Brazilian Central Bank. Moreover, regional statistics on emerging economies such as Brazil are not readily available, which poses two main challenges.

First, regarding the corruption variable, corruption data were collected in 31 Judicial Subsections of the state of São Paulo from 2012 to 2016. The division of the state into 31 Judicial Subsections serves as a reference for the operation of the Brazilian Federal Public Ministry (MPF), which is, among others, responsible for combating corruption in Brazil. As a proxy for regional corruption levels, we followed the regional-level studies of Fredriksson, List, and Millimet [87] and Cole, Elliot and Zhang [88], which employed a normalized number of convictions of public officials to proxy regional corruption. Thus, we employed the number of lawsuits against Brazilian public servants each year within the microregion of the state of São Paulo at the "Judicial Subsections of the São Paulo State". Such data are made available by the MPF, which uses tools that allow citizens to view statistical data on judicial and extrajudicial actions in the fight against corruption. Thus, by using the aforementioned measure, we intend to proxy corruption as an institutional characteristic and its interplay with regional inward FDI.

The second challenge is concerned with the regional FDI intensity statistic. Thus, we employed a unique export-related FDI proxy available for Brazilian municipalities as presented in Equation (1) [14,15,89]. Specifically, the aforementioned municipal database was modified to match the "Judicial Subsections" by summing the "*r*" municipalities of every judicial subsection "*s*".

$$FDI_{st} = \sum_{r=1}^{n} \sum_{i=1}^{k} W_{ijt} \left(\frac{MNC_{jt}}{T_{jt}} \right), \text{ for each region } j. \quad (1)$$

where

MNC is the number of exporting multinational companies in the region "*j*";
T is the regional whole population of exporting companies (domestic and foreign) in the region *j*;
W is the adjustment weight (based on its exporting value) for each company "*i*";
k is the total number of companies in each region;
s represents each of the 31 regions Judicial Subsections of the São Paulo state.

Finally, our study also employs three sets of control variables to account for regional-level characteristics that may affect FDI regional intensity. The first set deals with economic characteristics such as per capita GDP and the GDP of economic activities in the municipality (industry, services, and agriculture). The second aims to capture the local education structure through the share between citizens with higher and primary education (Education H/P). Lastly, Firjan Fiscal Management Index (IFGF) is a proxy for local governance. This index is calculated to identify the challenge many municipalities face in allocating their resources. Our period of analysis is between the years 2012 and 2016 for all variables presented in the econometric modeling. Descriptive statistics are presented in Table 1.

Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
FDI	155	315.96	468.65	0.00	2339.33
Corruption	155	32.42	26.72	2.00	146.00
GDP PC	155	373.38	254.33	103.52	1574.48
Urbanization	155	1583.22	1139.27	391.76	6181.65
Industry GDP	155	794.68×10^4	812.80×10^4	109.17×10^4	4871.08×10^4
Agriculture GDP	155	80.23×10^4	70.27×10^4	0.75×10^4	369.71×10^4
Service GDP	155	1775.28×10^4	2115.03×10^4	229.08×10^4	$11{,}325.44 \times 10^4$
Education H/P	155	0.89	0.62	0.09	4.97
IFGF	155	5.87	7.06	0.00	36.65

3.2. Econometric Model and Estimation Strategy

Equation (2) was employed to test the regional "sand OR grease" effect (Hypothesis 1), while Equation (3) tests the non-linear relation between corruption and FDI concentration (Hypothesis 2). Specifically, Equation (2) presents a baseline linear model to be estimated by traditional fixed (FE) and random effects (RE), and also employed the Hausman test to determine which specification (i.e., random or fixed) was better suited for the model. Later we employed the Driskoll–Kraay (DK) method [90] to deal with non-spherical disturbances. Indeed, given the geographical nature of our study, the DK approach will be the main technique employed for our baseline analysis, since it deals with heteroscedasticity and autocorrelation problems, being also robust to general forms of cross-sectional (spatial) and temporal dependence.

Still, given that FE estimators tend to perform poorly when there is little within-subject variability [91], we also estimated Equation (2) through Feasible Generalized Least Squares (FGLS) to ensure robustness. Indeed, FGLS was employed considering the specific autocorrelation process of each specific entity along with controlling for heteroskedasticity. By extension, Fixed Effects Generalized Least Squares (FEGLS), a modified fixed-effects approach of FGLS was also applied to double-check our results [92,93].

Moreover, panel-corrected standard errors (PCSE) were also considered since FGLS variance–covariance estimates tend to be anticonservative [94]. Finally, corruption and all the controls are lagged to reduce possible endogeneity issues and for functional adequacy.

As previously mentioned, we challenge the binary concept of the sand or grease hypothesis, arguing that different regional levels of corruption may display distinct effects on FDI concentration. Thus, following Hansen's [95] non-linear approach, we employ a triple fixed-effects panel threshold model presented in Equation (3), where corruption is both the threshold and the regime-dependent variable. Finally, the baseline estimation of Equation (2) will support the threshold model of Equation (3) since such method splits the sample to calculate the threshold parameter, thus causing some subsets to exhibit low variability and resulting in insignificance parameters.

$$FDI_{st} = \beta_0 + \beta_1{}' X_{it-1} + \beta_2 C_{st-1} + a_i + \varepsilon_{it} \quad (2)$$

$$FDI_{st} = \beta_0 + \beta_1{}' X_{it-1} + \sum_{j=2}^{J} \beta_j C_{st-1} I(\gamma_{j-1} < C_{st} \leq \gamma_{j-1}) + a_i + \varepsilon_{it} \quad (3)$$

where

FDI: Foreign direct investment;
X: Regional-level controls;
C: Corruption proxy;
$I(.)$: Is an indicator function;
a_i: Regional time-invariant characteristics (Fixed Effects);
γ_i: Thresholds to be estimated;
ε: Stochastic disturbance.

4. Results

Before estimating the model, we discarded the 2% top and bottom values for corruption and FDI variables to ensure that outliers are not leading us to misguided conclusions. Moreover, the calculated variance inflation factor (VIF) was 6.71 for the baseline fixed-effects model, indicating that multicollinearity is not overinflating the estimated standard errors. Thus, according to Table 2, a reasonable number of controls were statistically significant, as the corruption variable is positive and statistically significant in all estimated models, therefore proving Hypothesis 1. Additionally, according to the sand or grease hypothesis within a linear model, corruption in Brazil acts as grease for FDI, which would lead us to infer that more corrupt regions will tend to concentrate more foreign companies.

Table 2. Main results—Dependent variable: FDI.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**FE**	**RE**	**DK FE**	**DK RE**	**FGLS**	**FEGLS**	**PCSE**
Corruption	0.0914 ***	0.122 **	0.0914 **	0.122 **	0.172 ***	0.0403 ***	0.249 ***
	(0.0309)	(0.0479)	(0.0191)	(0.0311)	(0.0277)	(0.0132)	(0.0660)
GDP PC	0.345	0.342	0.345 **	0.342 **	0.161 *	0.159 ***	0.0808
	(0.227)	(0.251)	(0.0665)	(0.0834)	(0.0950)	(0.0587)	(0.188)
Urbanization	0.0229	−0.514 ***	0.0229	−0.514 **	−0.524 ***	−0.903	−0.852 ***
	(2.509)	(0.196)	(1.118)	(0.135)	(0.0773)	(0.656)	(0.184)
Industry GDP	−0.127	0.0822	−0.127 **	0.0822	0.253 ***	−0.106 ***	0.638 ***
	(0.139)	(0.165)	(0.0229)	(0.0771)	(0.0773)	(0.0337)	(0.226)
Agriculture GDP	−0.344 ***	0.0296	−0.344 ***	0.0296	0.574 ***	−0.289 ***	0.570 ***
	(0.0959)	(0.183)	(0.0430)	(0.0248)	(0.0633)	(0.0494)	(0.0872)
Service GDP	−0.0406	−0.0149	−0.0406	−0.0149	0.116 ***	0.0219	0.107
	(0.148)	(0.0870)	(0.0712)	(0.0765)	(0.0351)	(0.0640)	(0.0946)
Education H/P	0.000629	-9.62×10^{-5}	0.000629	-9.62×10^{-5}	6.95×10^{-6}	0.000160	−0.00157
	(0.000537)	(0.00152)	(0.000372)	(0.000861)	(0.00238)	(0.000343)	(0.00525)
IFGF	0.0228	0.0489 ***	0.0228 **	0.0489 ***	0.0446 ***	0.00234	0.0794 *
	(0.0233)	(0.0161)	(0.00543)	(0.00530)	(0.0135)	(0.00546)	(0.0455)
Constant	0.0939	0.124 ***	0.0939	0.124 **	−0.00979	−0.000888	−0.000783
	(0.522)	(0.0413)	(0.223)	(0.0366)	(0.00788)	(0.000732)	(0.0198)
Observations	112	112	112	112	111	111	112
R-squared	0.206						0.671
Number of id	31	31	31	31	30	30	

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

To ensure robustness, Equation (2) was also estimated using the SYS-GMM method to ensure that lagged FDI is not violating strict exogeneity [96], thus finding insignificant values for it (p-value = 0.740). The Hausman test results (p-value = 0.000) pointed out that the fixed effects specifications are better suited to this model. However, we adopted both a random and a fixed effects model to compare the results.

A relevant concern lies in the possible endogeneity between FDI and corruption variables within the proposed models due to potential reverse causality. Therefore, shocks may affect both covariates simultaneously, especially in the context of developing economies, which are constantly prone to instabilities and institutional weaknesses.

The chosen method to evaluate endogeneity was the LIML (Limited Information Maximum Likelihood) instrumental variables model, as it tends to perform better with small samples and weak instruments [97]. De facto, external instruments are considered desirable to deal with reverse causality. However, the literature recognizes the difficulties in finding adequate exogenous instruments [98], with several studies using lagged values of the independent variable as an internal instrument [13,99,100].

Likewise, by employing the aforementioned strategy, C-statistic (inference of two Sargan–Hansen statistics) points out that corruption is indeed exogenous (p-value = 0.771).

To verify the non-linear effect of corruption on FDI concentration (Hypothesis 2), thus challenging the "sand" or "grease" dichotomic view, the fixed-effects triple threshold model accounted for four regimes: low corruption, medium–low corruption, medium–high corruption, high corruption. Therefore, Table 3, presents that only the second regime (medium-low) is significant, while threshold 2 is not significant, implying that the four-regime threshold model may collapse into a three-regime one (low corruption, medium corruption, high corruption). Thus, Figure 1 presents the three-regime results (delimited by the 1st and 3rd thresholds), indicating that only medium-level corruption regions will tend to concentrate foreign enterprises.

Table 3. Fixed-Effects panel threshold regression.

Variables	FE Panel Threshold
Low corruption	−0.0995
	(0.111)
Medium–low corruption	0.305 ***
	(0.106)
Medium–high corruption	0.0456
	(0.0529)
High corruption	−0.0731
	(0.0803)
GDP PC	0.447
	(0.278)
Urbanization	−0.903
	(3.394)
Industry GDP	−0.120
	(0.167)
Agriculture GDP	−0.354 ***
	(0.0793)
Service GDP	−0.253
	(0.300)
Education H/P	0.000392
	(0.000634)
IFGF	−0.0136
	(0.0371)
Constant	0.365
	(0.652)
Threshold 1 (λ1)	0.298 *
Threshold 2 (λ2)	0.305
Threshold 3 (λ3)	0.597 ***
Observations	124
Number of id	31
R-squared	0.431

Robust standard error in parentheses. *** $p < 0.01$, * $p < 0.1$.

However, these results should be interpreted with caution, since the fixed-effects threshold method employs a bootstrap to calculate the threshold parameters. In addition, the small sample size can also induce low variability that affects the threshold parameters. Likewise, we argue that although Table 3 indicates three regimes, given the statistical insignificance of threshold 2, we can suspect that the same results may be pointing to the concentration of FDI in regions with medium–low corruption levels. Therefore, Figure 2 presents the four-regime corruption levels, where it is possible to observe the medium–low corruption regions, i.e., the ones where there is evidence that corruption can act as grease to FDI.

As previously mentioned, our study deepens the analysis of the effect of corruption on the regional concentration of FDI by identifying the behavior patterns of this relationship in different economic sectors. To this end, we divided the FDI concentration into 21 groups of economic activities according to the Brazilian CNAE (National Classification of Economic Activities) sectoral classification. Table 4 shows the sectoral divisions of the CNAE and the

name of the FDI variables for each sector. Then, we developed several econometric models to verify the effect of corruption in each economic sector.

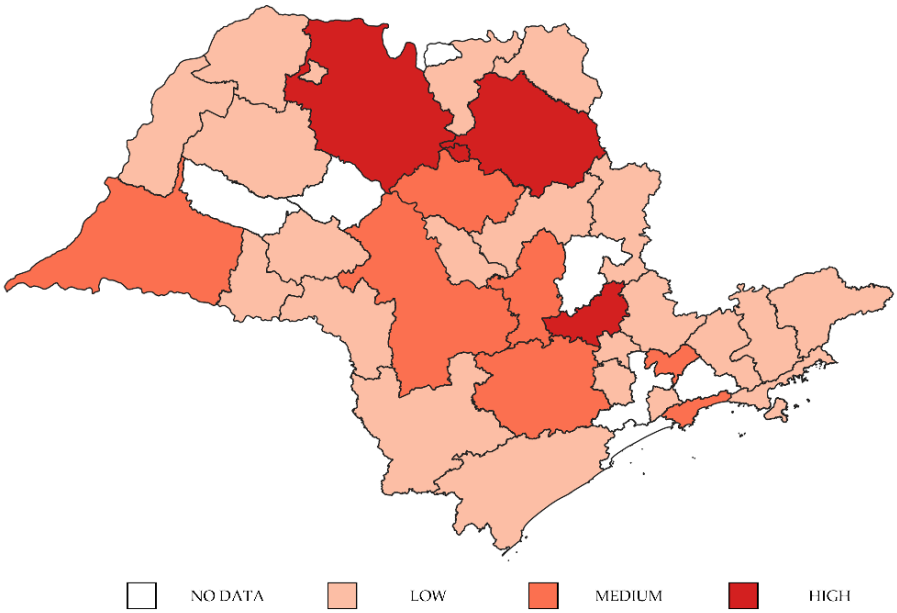

Figure 1. Regional corruption level in 2016—divided in three regimes.

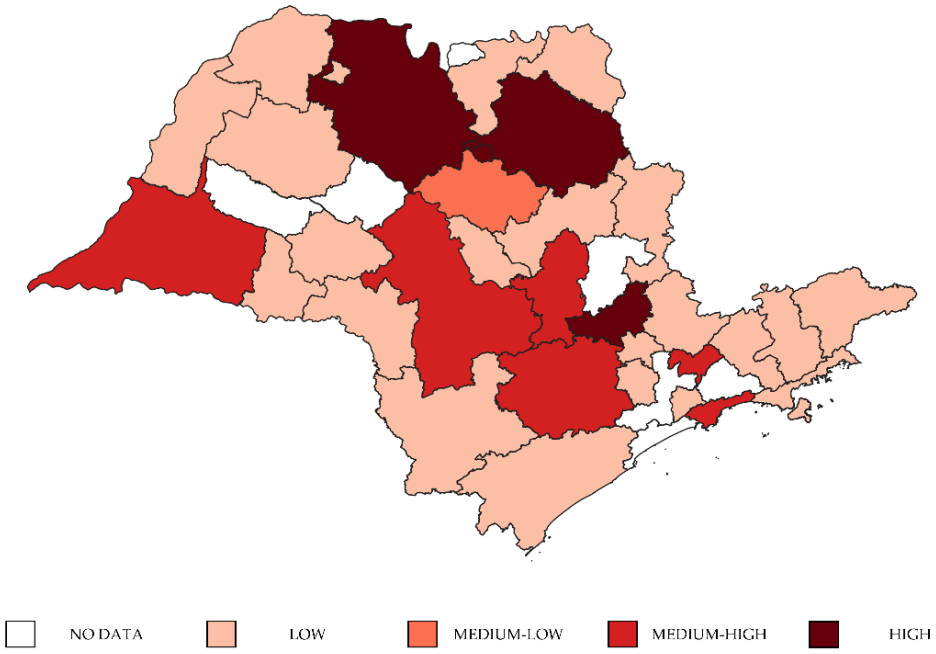

Figure 2. Regional corruption level in 2016—divided in four regimes.

In Table 5, we can see the results of the econometric analysis. Corruption acts as a "grease" for FDI in all statistically significant models. This result corroborates our previous analysis. Additionally, several sectors were omitted from the analysis due to collinearity. This behavior occurs due to the large volume of regions without the presence of FDI in several sectors. In Figure 3, we can see the sectoral distribution of FDI by region, where a high concentration of foreign investment can be seen in specific economic activities, such as transformation industries (Sector C), agriculture, livestock, forest production, fisheries and aquaculture (Sector A) and trade, repair of motor vehicles and motorcycles (Sector G).

Table 4. CNAE Economic Sectors.

Sector	Activity
A	Agriculture, livestock, forest production, fisheries, and aquaculture
B	Extractive industries
C	Transformation industries
D	Electricity and gas
E	Water, sanitation, waste management and decontamination activities
F	Construction
G	Trade; repair of motor vehicles and motorcycles
H	Transport, storage, and mail
I	Accommodation and meals
J	Information and communication
K	Financial, insurance, and related services activities
L	Real estate activities
M	Professional, scientific, and technical activities
N	Administrative activities and complementary services
O	Public administration, defense, and social security
P	Education
Q	Human health and social services
R	Arts, culture, sports, and recreation
S	Other service activities
T	Domestic services
U	International organizations and other extraterritorial institutions

Table 5. Sectoral Analysis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**FE**	**RE**	**DK FE**	**DK RE**	**FGLS**	**FEGLS**	**PCSE**
Corruption	0.0454 **	−0.000530	0.0454 **	−0.000530	0.0145 ***	0.00665 *	−0.0422
	(0.0170)	(0.0423)	(0.00960)	(0.0256)	(0.00461)	(0.00356)	(0.0446)
GDP PC	0.260 *	−0.171	0.260 **	−0.171	0.0291 ***	0.0218	−0.259 **
	(0.129)	(0.187)	(0.0739)	(0.110)	(0.0112)	(0.0156)	(0.101)
Urbanization	−0.382	0.0896	−0.382	0.0896	−0.0343 ***	0.0431	0.130
	(0.900)	(0.151)	(0.377)	(0.0778)	(0.0108)	(0.155)	(0.110)
Industry GDP	−0.107	0.0457	−0.107 *	0.0457	0.0112	−0.00716	0.0848
	(0.0887)	(0.0746)	(0.0416)	(0.0417)	(0.00943)	(0.0135)	(0.115)
Agriculture GDP	−0.156 **	0.142	−0.156 **	0.142 **	0.0328 ***	−0.0721 ***	0.185 ***
	(0.0636)	(0.127)	(0.0351)	(0.0260)	(0.00535)	(0.0241)	(0.0438)
Service GDP	0.0427	0.0182	0.0427	0.0182	0.00712	0.0117	0.0204
	(0.0785)	(0.0240)	(0.0319)	(0.00809)	(0.00469)	(0.0221)	(0.0447)
Education H/P	0.000463 *	0.00212	0.000463 **	0.00212 *	0.000351	7.33×10^{-5}	0.00211
	(0.000252)	(0.00204)	(9.71×10^{-5})	(0.000872)	(0.000285)	(0.000224)	(0.00262)
IFGF	0.0106	−0.00689	0.0106 ***	−0.00689	0.00504 ***	0.00143	−0.00700
	(0.00900)	(0.0161)	(0.00134)	(0.00948)	(0.00183)	(0.00286)	(0.0231)
FDI Sector A	0.143 ***	0.130 ***	0.143 ***	0.130 ***	0.134 ***	0.152 ***	0.125 ***
	(0.00410)	(0.00542)	(0.00597)	(0.00523)	(0.00271)	(0.0108)	(0.0189)
FDI Sector B	0.157 ***	0.186 ***	0.157 ***	0.186 ***	0.175 ***	0.182 ***	0.206 ***
	(0.0483)	(0.0309)	(0.0134)	(0.0201)	(0.0110)	(0.0220)	(0.0261)
FDI Sector C	0.120 ***	0.143 ***	0.120 ***	0.143 ***	0.141 ***	0.129 ***	0.148 ***
	(0.00868)	(0.0128)	(0.00627)	(0.00962)	(0.00213)	(0.00400)	(0.00688)
FDI Sector D	-	-	-	-	-	-	-
FDI Sector E	-	−2.756	-	−2.756	−0.307	13.40 ***	−5.328
		(4.050)		(1.579)	(0.700)	(1.469)	(3.334)
FDI Sector F	-	-	-	-	-	-	-
FDI Sector G	0.0202	0.0651 **	0.0202	0.0651 **	0.0886 ***	0.0739 ***	0.0692 ***
	(0.0608)	(0.0314)	(0.0347)	(0.0145)	(0.00426)	(0.0151)	(0.0229)

Table 5. *Cont.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	**FE**	**RE**	**DK FE**	**DK RE**	**FGLS**	**FEGLS**	**PCSE**
FDI Sector H	0.877 ***	0.407	0.877 **	0.407	0.627	0.840	1.451
	(0.312)	(1.226)	(0.167)	(0.684)	(0.440)	(0.559)	(2.120)
FDI Sector I	0.368 **	0.0690	0.368 **	0.0690	0.455 ***	0.0937	−0.0155
	(0.137)	(0.403)	(0.0767)	(0.140)	(0.0552)	(0.125)	(0.422)
FDI Sector J	−0.0250	−0.815	−0.0250	−0.815	−0.0884	−0.0261	−1.224 **
	(0.263)	(1.093)	(0.0470)	(0.443)	(0.0785)	(0.114)	(0.489)
FDI Sector K	0.171	−0.699	0.171 **	−0.699	0.287	−0.323	−0.271
	(0.197)	(1.967)	(0.0484)	(1.194)	(0.388)	(0.298)	(1.907)
FDI Sector L	-	-	-	-	-	-	-
FDI Sector M	0.894	2.952 *	0.894 ***	2.952	2.494 ***	1.090 ***	4.052 ***
	(0.580)	(1.722)	(0.0261)	(1.306)	(0.412)	(0.243)	(1.184)
FDI Sector N	0.184 ***	0.0774	0.184 ***	0.0774	−0.582 ***	0.219 ***	0.336
	(0.0475)	(0.510)	(0.0216)	(0.591)	(0.0747)	(0.0276)	(0.315)
FDI Sector O	-	-	-	-	-	-	-
FDI Sector P	-	-	-	-	-	-	-
FDI Sector Q	-	-	-	-	-	-	-
FDI Sector R	−7.081 **	9.323	−7.081 **	9.323	1.887	0.545	5.584
	(3.068)	(13.75)	(2.190)	(5.633)	(2.956)	(3.907)	(16.07)
FDI Sector S	−0.0430	0.381	−0.0430	0.381 **	0.132	0.106	0.731
	(0.0395)	(0.407)	(0.0860)	(0.0872)	(0.0890)	(0.0836)	(0.465)
FDI Sector T	-	-	-	-	-	-	-
FDI Sector U	-	-	-	-	-	-	-
Constant	0.0824	−0.00758	0.0824	−0.00758 **	−0.00331 ***	−0.000190	-
	(0.189)	(0.00616)	(0.0737)	(0.00151)	(0.000895)	(0.000260)	
Observations	112	112	112	112	111	111	112
R-squared	0.914						0.962
Number of id	31	31	31	31	30	30	

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

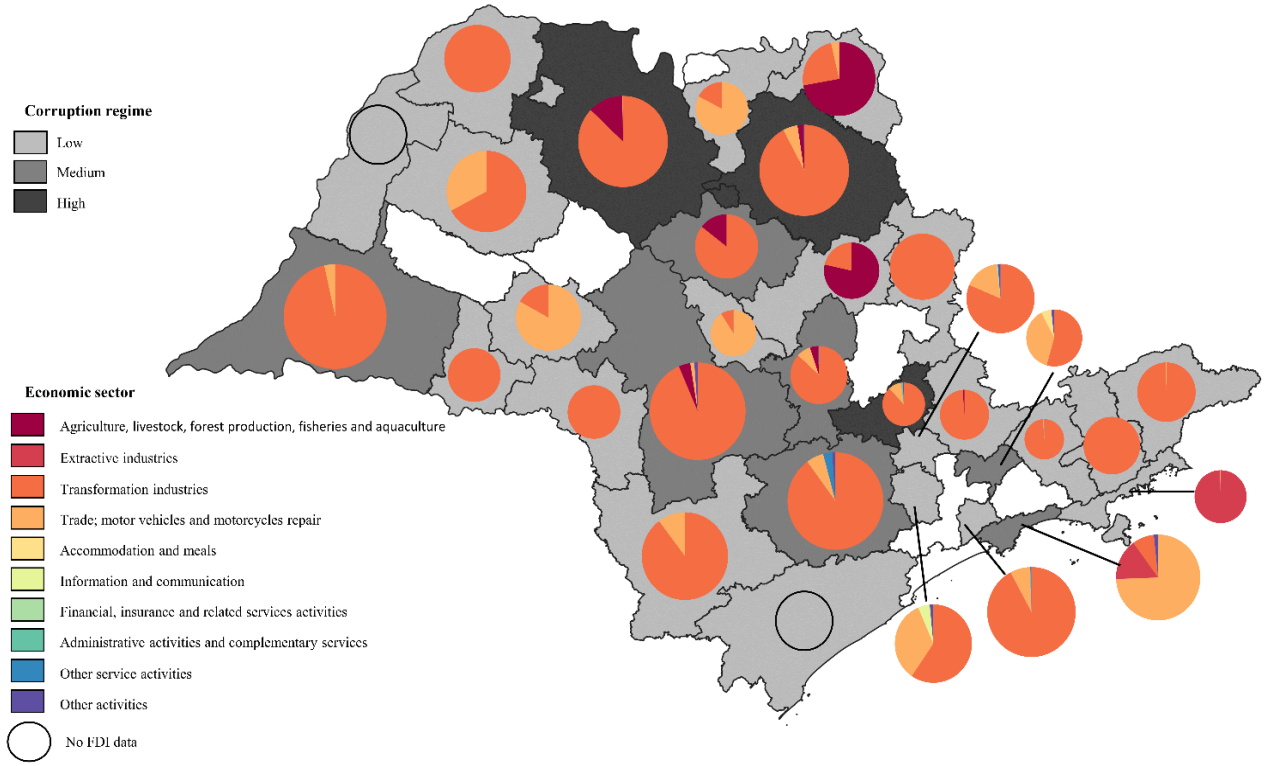

Figure 3. Sectoral distribution of FDI—2012 to 2016.

5. Discussion

This study empirically examines the relationship between corruption and FDI intensity at the regional level in Brazil. This analysis is aligned with the "sand or grease" theory, where corruption can either enhance or deter economic activities. However, we do not limit our analysis to a linear or dichotomous approach; instead, we advance the discussion through a non-linear analysis using different levels of corruption.

The first stage of our empirical results shows that corruption does have a statistically significant relationship with FDI (Hypothesis 1), and acts as a "grease" for FDI intensity at the regional level. This result goes against Wellalage's [43] findings, which found that corruption acts as "sand in the wheels" when analyzing innovation at the firm level in other Latin American countries. However, our results are not surprising when considering Brazil's institutional characteristics, such as regulatory inconsistency and lack of transparency [101]. According to Lakshmi [102], markets that have weak institutional practices harm investor confidence. This loss of confidence increases uncertainty and risk when investing in the country. Thus, it is common for MNEs to pay bribes to circumvent political uncertainties and instabilities [77].

This result holds when we disaggregate FDI into different sectors. Our sectoral analysis shows that corruption acts as a "grease" in attracting FDI in all statistically significant relationships. This result shows that, although at different levels, the analyzed sectors have a certain tolerance to corruption.

Regarding the control variables, our models show multiple non-significant coefficients. However, we still find some interesting results. We see a positive and significant relationship between GDPPC and FDI intensity in almost all models. This result corroborates the findings by Sabir, Rafique, and Abbas [103], which show that higher levels of GDPPC favor FDI inflows in emerging countries, contrary to developed countries.

Concerning the urbanization variable, we noticed a negative and significant relationship between urbanization and FDI intensity, similar to the results obtained by Erdogan and Unver [104]. This may be due to the preference of MNEs to invest in medium-sized cities with lower rates of urbanization.

Not surprisingly, there is a positive relationship between local governance (measured by the variable IFGF) and FDI intensity. This relationship can be explained by the relationship between better local governance and firms' productivity [105] and supports the theory that MNEs prefer locations with higher productivity rates, especially in emerging countries.

Although the result of the first stage of our empirical analysis points out that corruption has a positive and significant relationship with FDI, there are indications that it is especially significant in regions with intermediate (low–medium) levels of corruption. This result confirms Hypothesis 2, since the level of regional corruption affects FDI intensity in different ways, and can be partially explained by investors' ability to identify different types and levels of corruption—and, in this case, adjust their corporate strategies according to the institutional reality of each region [68]. In other words, investors may be indifferent to very low levels of corruption. In the same way, investors may avoid regions with high levels of corruption. However, the question remains: why does only an intermediate level of corruption attract foreign investment?

Emerging countries' local institutional characteristics can hinder foreign companies' development due to their underdeveloped legal environments and deficient resource allocation [106]. According to Goedhuys, Mohnen, and Taha [73], corruption can be the tool to overcoming those institutional obstacles. In addition, the bureaucracy present in Brazilian institutions makes obtaining licenses often lengthy. In this case, it is not uncommon to speed up this process by paying bribes [40,74], which certainly helps reduce the operating costs of these firms. In addition, bureaucratic processes in emerging countries tend to be less efficient because of corruption [59], making it even more difficult for MNEs to work in the region. This creates a vicious cycle in which corruption can both hinder the performance of foreign companies and is necessary for them to develop locally. Then,

we argue that certain levels of corruption can be not only accepted but also desired by local MNEs.

Nevertheless, higher levels of corruption negatively affect the concentration of FDI by increasing firms' production costs [61], which may undermine the regional attractiveness for FDI. This indicates that corruption levels are only tolerated to a certain extent, which explains why the relationship between corruption and the intensity of FDI has not been confirmed in regions with high levels of corruption.

Our results are valuable but limited, since our sample only points to the reality of the state of São Paulo. Furthermore, our corruption proxy only counts the number of lawsuits against Brazilian public servants, which means the judicial system's effectiveness can influence it and even harm the predictor variable's accuracy. If the region has a highly effective legal system, the number of lawsuits can be higher than in a more corrupt region but with a less effective legal system. Additionally, the number of lawsuits cannot measure the financial corruption costs to firms, although it can be used to understand the level of local corruption superficially. We suggest reproducing this study with a larger sample, perhaps analyzing the entire national territory, and using an alternative corruption proxy to verify whether the results are maintained.

However, in our case, the desirability of intermediate levels of corruption may be an indication that legislation that regulates foreign firms may be outdated or has become an obstacle to these firms. Furthermore, Sadik-Zada et al. [59] found that the modernization of bureaucratic processes could be an ally in the fight against petty corruption. Nevertheless, the changes in the legal and institutional framework need to be based on procedures that are able to guarantee the maintenance of the freedom of investment and future FDI as well as fighting corruption [78]. Further, Delgado, McCloud, and Kumbhakar [107] found that the impact of FDI on economic growth can be moderated by the levels of corruption. The author states that a lower level of corruption enhances FDI's effectiveness in improving growth rates. A reduction in the high level of legislative complexity would aid the economy [108]. Finally, it is necessary to analyze the impacts of Brazilian regulations on MNEs in a deeper and at the same time broader way to propose legislative flexibility. Therefore, we believe that governance improvement in Brazil is necessary to attract FDI, reduce political corruption, and boost economic growth.

6. Conclusions

This study adds to the existing literature by deepening the comprehension of corruption FDI intensity at the regional level of a developing region (especially the understudied region of Latin America). The first stage of our empirical results shows that corruption does have a statistically significant relationship with FDI (Hypothesis 1) and acts as a "grease" for FDI intensity at the regional level. Our results also confirm Hypothesis 2, since the level of regional corruption affects FDI intensity in different ways, considering that investors may be indifferent to very low levels of corruption. In the same way, investors may avoid regions with high levels of corruption.

Despite some limitations, especially regarding the sample size, our results are in agreement with the previous literature, but we believe that caution in the database construction can yield robust results.

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