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Does the size of the government increase corruption? An analysis for Brazilian municipalities

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The article analyzes the effects of government size on corruption in Brazilian municipalities between 2005 and 2016. An objective corruption measure is used, constructed from data provided by the Federal Comptroller General (CGU), using the panel data technique. The results revealed a significant and inverse relationship between government size and corruption in Brazilian municipalities. Therefore, corruption in Brazilian municipalities may not be related to the government's size. In this sense, the issue of good governance in conjunction with the effectiveness of legal rules is highlighted as a way of inhibiting activities related to corruption in Brazilian municipalities.

Keywords: corruption; government size; municipal spending.

O tamanho do governo aumenta a corrupção? Uma análise para os municípios brasileiros

O artigo analisa os efeitos do tamanho do governo na corrupção dos municípios brasileiros entre 2005 e 2016. Para tal, é utilizada uma medida de corrupção objetiva, construída com base em dados disponibilizados pela Controladoria-Geral da União (CGU) e na técnica de dados em painel. Os resultados revelaram uma relação significativa e inversa entre tamanho do governo e corrupção nos municípios brasileiros. Assim, a corrupção pode não estar relacionada ao tamanho do governo. A boa governança, em conjunto com a efetividade das normas legais, é uma forma de inibir atividades ligadas à corrupção nos municípios brasileiros.

Palavras-chave: corrupção; tamanho do governo; gastos municipais.

¿El tamaño del gobierno aumenta la corrupción? Un análisis para los municipios brasileños

El artículo analiza los efectos del tamaño del gobierno sobre la corrupción en los municipios brasileños entre 2005 y 2016. Para ello, se utiliza una medida objetiva de corrupción, construida a partir de los datos facilitados por la Contraloría General de la Unión (CGU) y sobre técnica de datos en panel. Los resultados revelaron una relación significativa e inversa entre el tamaño del gobierno y la corrupción en los municipios brasileños. Por tanto, la corrupción puede no estar relacionada con el tamaño del gobierno. La buena gobernanza, junto con la efectividad de las normas legales, es una forma de inhibir las actividades vinculadas a la corrupción en los municipios brasileños.

Palabras clave: corrupción; tamaño del gobierno; gasto municipal.

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1. INTRODUCTION

The intervention of the Government in the economy is seen as necessary due to the existence of market errors. This intervention, however, may imply a growth in the government size, which among other issues, may affect a country's corruption level (Kotera, Okada & Samreth, 2012).

Corruption is a problem found all over the world, even if it happens at different levels. The public opinion tends to associate corruption to the behavior of public employees and political leaders. This view that corruption is inherent to the State leads to the belief that the solution for this disease is the reduction of the Government size.

Filgueiras (2009) suggests that the approach to corruption in the general literature is mainly restricted to the political sector, due to the unavailability of data that allows for a broader analysis. However, it is important to remark that corruption is a multifaceted phenomenon, being considered in Brazil and many other countries as systemic, that is to say, present in all society sectors.

Brazil is a country that went through dictatorship periods and suffered from corruption since colonial times. From the 90's until the present days, two presidents suffered an *impeachment*, which suggests a deeper population involvement in public affairs in the sense of making political leaders responsible for their crimes against the public good. However, there is still much to be done with regards to fighting corruption, as the frequent corruption scandals exposed by the media and the figures below clearly show.

According to the World Bank (2019), Brazil reached a qualification of -0.42 in 2018 within a scale that goes from -2.5 to 2.5 in the Corruption Control component, according to the Worldwide Governance Indicators (WGI). In 2017, the country suffered its worst qualification since 1996, when the index started to be calculated, with 0.53 points while New Zealand, considered to be the least corrupt country reached 2.24 points.

As for the Corruption Perceptions Index (CPI) in 2018 and 2019 the country obtained its worst qualification since 2012, when data started to be yearly comparable, with 35 points out of 100, being well below the global average and 43 points behind African countries such as Rwanda and Ghana, which scored 53 and 41 points respectively. Brazil is currently in the 106th position among the 180 countries assessed in the International Transparency Ranking (2019) losing positions in comparison to 2017, when it stayed in the 96th place.

This information exposes the need for more governance effort against corruption, mainly considering that according to the *Trading Economics* platform (2019), the size of the Brazilian government is equivalent to developed countries' standards.

The 1988 constitution promoted different reforms in the Brazilian fiscal federalism, resulting in stronger states and municipalities in relation to the power of the central government as a means to strengthen democracy after its return in 1985. In that occasion, municipal governments were given the responsibility of managing a substantial amount of public services, in particular those related to education and health. With this fiscal decentralization, large amounts of federal resources started to be transferred to the municipalities (Guedes & Gasparini, 2007). The larger flow of federal funds transformed corruption at a municipal level in a major concern in Brazil (Ferraz & Finan, 2005).

Although corruption is a matter studied by several Brazilian researchers, the influence of the government size on the incidence of corrupt activities is not widely discussed in literature, which is a key motivation for this study. Another motivation comes from the importance of verifying if in fact a "big" government, which spends more in its economy, may result in a higher corruption level in the process.

The main hypotheses defended on this matter, according to Bergh et al. (2012), are on the one hand, that the higher availability of resources may increase potential profits from corrupt activities in such a way that there would be a direct relation between government size and corruption. On the other hand, according to the same authors, higher public spending may induce citizens to demand a higher government commitment with regards to the way in which tax revenues are used, as for example, in the services offered to the population, particularly health and education, thus resulting in a corruption reduction.

For these reasons, the goal of this study is to investigate the impact of government size on corruption in Brazilian municipalities between 2005 and 2016. For such purpose, an objective corruption measurement unit developed with data made available by the Office of the Controller General (OCG) was applied by using the panel data technique.

This study is composed of five sections. After the introduction, the following section offers a review on corruption literature, its concepts and assessment means, besides an analysis of the main empirical studies on the influence of government size on corruption. Data description and the methodological strategy are introduced in the third section. The fourth section discusses results and the fifth one deals with the final research considerations.

2. CORRUPTION CONCEPTS, TYPES AND MEASUREMENTS AND ITS RELATION WITH THE GOVERNMENT SIZE

A Transparency International definition states that corruption is the abuse of entrusted power for private gain. For the World Bank, corruption is the "inappropriate use of a public position for private gain" (Tafa, 2014) and for some authors such as Rose-Ackerman (2005), corruption represents the bad use of the public power to obtain private and political advantages.

According to Tafa (2014), there are different approaches to identify corruption types. One of them is related to the position an individual holds at a given institution. According to this approach, corruption can be divided into "high level" and "low level". When practiced by higher rank officials, we consider it to be of high level. On the other hand, if only public employees are involved, it is considered low level corruption. Besides, it may also be classified into political and bureaucratic corruption. Political corruption is the one practiced in the decision making process, while the bureaucratic one is related to the implementation of policies and decisions.

Another approach involves the transaction nature, making a distinction between "bribe" and "extortion". The first one is referred to an "extra" payment made by a general public individual to a public official in order to get something desired, thus jumping over certain regulations. Extortion is a situation in which the opposite case occurs: a public official demands payments for the rendering of a service (Tafa, 2014).

A classification often used by many experts divides corruption into small or large. Large corruption, sometimes called political corruption, is the one that happens at the highest governance level and involves high amounts of money whereas the small, or mean corruption, happens at the lowest levels, where there is direct contact between the public worker and the general population. These bribes, although involving lower amounts of money, tend to be cumulative (Scott, 1972).

Corruption is very hard to be measured due to its illegal nature and the different perspectives from which it is seen. However, international organizations such as the World Bank and International Transparency have created some indexes to measure it. Transparency International uses the Corruption Perceptions Index (CPI) while the World Bank applies the Corruption Control Index (CCI) from World Governance Indicators (WGI). On the other hand, the *Political Risk Services* (PRS) established a different index named *International Country Risk Guide* (ICRG), which is used by transnational corporations and portfolio managers in order to assess country risks. The three mentioned indexes are considered subjective corruption measurements, as they are based on perceived corruption.[1]

Most studies involving corruption consider these measurements to be subjective. Magtulius and Poquiz (2017), for example, use two measurements for corruption: the Control of Corruption Index developed through the World Bank's Worldwide Governance Index and the Economic Freedom's Freedom from Corruption Score based on the the Corruption Perceptions Index elaborated by Transparency International. Other authors, however, prefer to use more objective measurements, as in the case of Liu and Mikesell (2014) who apply the number of corruption-related crime sentences. Caldas, Costa and Pagliarussi (2016) created a corruption measurement based on the reports of audits made by the Office of the Comptroller General (OCG).

In general, in relation to empirical studies on corruption, Kotera et al. (2012) highlight that they basically follow two paths: one stream emphasizes the effects of corruption on economic growth or its implications on specific public spending whereas other researchers investigate corruption determinants. With regards to the last ones, although there may be some consensus on the impact of some corruption factors, this is still not very clearly defined. One of these factors is precisely the government size, which is the object of this research.

2.1 Social context and corruption

The corruption phenomenon is affected by the behavioral attitudes developed in the society. This affirmation may be implicitly noticed in studies such as those of Putnam (1993), who elucidates the blessings of civic tradition materialized as social capital and as empirically analyzed by Weber (2006) by performing a research through the analysis of the role of associations in public corruption.

In a study developed by Weber (2006), valid for small and medium sized Brazilian municipalities, a moderately strong relation between the associative density of municipalities and corruption events detected by the CGU auditors was found within the public administration, which suggests that a higher social capital stock tends to reduce corruption at a municipal level.

[1] Transparency International developed its index based on public opinion surveys, country analyst experiences and risk evaluations from people who do business in each specific country. The World Bank index is developed in a similar way, however with a different algorithm and involving fewer studies from individual countries (Nelson, 2013). The ICRG provides a classification of countries in terms of political, economic and financial risks. Although the corruption component responds for merely 6% of the political risk subcategory, it is possible to dissociate the indicator and extract only the component of interest (Melo, 2010). The ICC qualification goes from –2.5 to 2.5, while the CPI and the ICRG vary from 0 to 100, being that the highest values correspond to countries considered to be less corrupt (Magtulius & Poquiz, 2017).

In this sense, and considering trust as an important social capital attribute, a public opinion survey on corruption carried out in Brazil in February 2005 suggested that society distrust levels with regards to its politicians and public institutions is more evident in places with low social capital levels. These regions also suffer the most cases of irregularities in the management of public resources (Weber, 2006).

Interpersonal trust may be consolidated through associations, which at the same time can induce a higher efficiency level in the performance of public services. In these terms, Putnam (1993) corroborated that in more financially developed regions public management is more efficient, as there is also a more active civic participation. Therefore, the deeper the regional civic involvement, the lower the corruption level found, which results in more efficient governments and higher economic development.

Finally, it is also important to highlight that for having direct consequences on both economic and governance-wise factors, corruption directly affects poverty levels. On this matter, Chetwynd et al. (2003) argue that low supply and inefficient basic public services resulting from corrupt practices largely affect the poorest, as they highly depend on such services, in particular those related to health and education. It is not by chance that the countries with the lowest Corruption Perception Index (CPI) in the world are also the richest and boast the lowest percentage of poor people[2].

There seems to be a causal relation between poverty and corruption. Two recent studies that expose such causality were developed by Bayar and Aytemiz (2019) and Castro and González (2019). In general, these studies suggest that both high income inequality and poverty trigger an increase in corruption levels. Likewise, massive corruption increases poverty and inequality.

2.2 Effects of Government Size on Corruption

There are different government size measurements but the most widely used consider government spending in relation to their Gross Domestic Product (GDP) and the population fraction employed in the civil service (Magtulius & Poquiz, 2017).

The State intervention in the economy through an increase in public spending – in other words, a larger government size – generates controversial effects. Although on the one hand, more spending may imply fostering development, a more fair income distribution and a better delivery of public goods and services (Mueller, 2003), on the other hand, it may generate more opportunities for public officials to become involved in corrupt activities (Goel & Nelson, 1998).

Common sense associates a higher corruption incidence to bigger governments, as a larger public sector size implies more bureaucracy, which generates more opportunities for bureaucrats to demand bribes (Arvate, Zaintune, Rocha & Sanches, 2010).

In this thinking logic, Goel and Nelson (1998) suggest that with "larger governments" it is reasonable to expect more political trickery, besides the fact that a larger public sector results in more bureaucracy, thus inducing citizens to offer higher bribes to public workers in order to fool bureaucratic barriers. The concept proposed by these authors that a bigger government generates incentives for illegal practices such as corruption is partly inspired by Becker's crime and punishment model (1968)[3].

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[2] The world ranking of countries with the lowest Corruption Perception Index (CPI), as published by Transparency International, is led by Denmark, New Zealand, Finland and Sweden.

[3] In general terms, this model predicts that corruption incidence is directly proportional to potential gains in corrupt activities and inversely proportional to the probability of being caught and the severity of the punishment.

In this sense, Goel and Nelson (1998) examined the correlation between government size and corruption in the United States by using a set of data at a state level for the 1983 – 1987 period. Two regression models were estimated, one using panel data and the other through a states cross sectional study. Results suggest a strong positive influence of government size on corruption, especially when analyzing state government spending. However, there were contrasts between federal and state results in some states, which points at a a non-linear relation in such variables.

Arvate et al. (2010) applied a dynamic specification suggested by Arellano and Bond (1991) using data from 1996 to 2003. They verified that there is a different standard for the government size – corruption relation between developed and developing countries. These authors discovered that government size provokes corruption in both samples. In the developing sample, the statistical relation between the two variables suggests that throughout the analyzed period of time, Brazil and Colombia for example, proved to have higher corruption levels linked to bigger size governments.

On the other hand, some experts such as La Porta et al. (1999 as cited in Kotera et al., 2012) and Billger and Goel (2009) advocate that "larger governments" promote a corruption reduction. They sustain this point of view based on the fact that some developed countries have larger public sectors, however they suffer from lower corruption levels than developing countries.

In this same path, there are some other studies such as those of Kotera et al. (2012). Seeking to explain ambiguous results with regards to the relation between government size and corruption, these authors investigated the effect of the first variable on the second one considering the role that democracy exerts. With data from 82 countries from 1995 o 2008, results suggest that democracy strongly affects this relation.

The Kotera et al. (2012) research revealed that in countries where democracy is sufficiently consolidated, an increase in the government size leads to a corruption reduction. This happens because in countries with free elections and free press, monitoring and controlling politicians and bureaucrats activities is easier, thus making illegal practices such as corruption less attractive. In countries with a deficient democracy however, due to the fact that these monitoring and control mechanisms are not very efficient, a growth in the government size aggravates corruption.

Also contradicting common sense, Bergh Bergh et al. (2012) findings reveal a negative relation between corruption and public spending. Using data from a research on corruption performed in 2007 with the main politicians and public officials in Sweden as a base for the development of corruption measurements means, together with administrative data taken from municipalities, these authors investigated the effects of government size in corruption in Swedish municipalities. Results pointed at a strong negative relation between total public spending and corruption.

Another research that converged to the same result was that of Magtulius and Poquiz (2017), who studied the relation between government size and public corruption in the Philippines through a vector autoregressive model (VAR). Contrary to theoretical expectations, results revealed that more spending improves the perception of public corruption, which means that bigger governments contribute to reduce corruption in that country. Results did not evidence bidirectional causality in the relation between the two variables.

As exposed, empirical research developed by several countries suggest mixed results with regards to the effects of government size on corruption. In this sense, the question is: which is the impact of a "large government" considering as a measurement variable the government spending in relation to its GDP in Brazil's corruption? The following section introduces the methodological strategy applied to answer this question.

3. METHODOLOGY

This section is dedicated to the description of data used in this study and the specification of econometric models applied to analyze government size impact on corruption in Brazilian municipalities.

3.1 Data Introduction

The database used in this research was developed considering the combination of different sources, based on data provided by the National Treasury Secretariat Accountings and Tax information system for the brazilian public sector (Finbra/Siconfi), the national treasury secretariat (STN), the health public budgets information system (Siops - Datasus), the Brazilian Institute of Geography and Statistics (IBGE), the Rio de Janeiro Federation of Industries (Firjan) and the office of the comptroller general (CGU).

Based on these databases, information on total spending, population, investments, expenses with public workers and social security, health-related expenses, GDP, the Firjan Index of Municipal Development (IFDM) and the number of lawsuits related (or not) to corruption (CGU, 2019; Firjan, 2018; IBGE, 2016; Secretaria do Tesouro Nacional, 2017; Siops, 2017) was included for the period between 2005 and 2016.

As Caldas et al. (2016) suggest, there is no existent direct data on corruption levels in Brazilian municipalities, so the use of a *proxy* is necessary to measure this variable.

For this purpose, the occurrence of irregularities obtained from reports produced by the Corruption Prevention Program by Public Drawing (PFSP) which as from 2015 was renamed Control Program for Federative Entities, managed by the Office of the Comptroller General (CGU). Data from the same program had been already used by other authors in research involving corruption, such as in the case of Albuquerque and Ramos (2006), Bologna and Ross (2015), Caldas et al. (2016), Ferraz and Finan (2008), Ferraz, Finan and Moreira (2012) e Sodré and Alves (2010).

The Control Program for Federative Entities is carried out through public drawing, so that the municipalities selected in each drawing are random expressions of a population that comprises all Brazilian municipalities with up to 500 thousand dwellers (Brasil, 2019). Variables included in this analysis are summarized in Box 1, which includes a short description and the source from where they were extracted.

The *corruption* variable was obtained by adding the number of lawsuits that have been filed, investigated and judged per year for each municipality included in the sample. Among these legal actions we considered: unlawful use of resources by public officials; irregular concession of benefits granted by themselves; acceptance of bribes or commissions and irregularities in specific careers in state companies.

BOX 1 DESCRIPTION OF VARIABLES AND DATA SOURCE

Variable	Description	Data Source
Corruption	Legal processes started, investigated and judged by the relevant municipality.	CGU
Government Size	Developed based on the percentage of expenses in comparison to the municipal GDP.	Finbra/IBGE
IFDM	Firjan Index of Municipal Development.	Firjan
Spending Productivity	Developed based on the health expenses variable divided by the GDP.	Siops/IBGE
PIB *per capita*	Municipality GDP *per capita*.	IBGE
Expenses	Expenses with public workers and social security.	Finbra
Investments	Municipal investments.	Finbra

Source: Elaborated by the authors.

The corruption variable was obtained by adding the number of open, investigated and tried cases for each municipality in the sample. Among such cases we included the inadequate use of resources by public agents, irregular concession of benefits by agents, bribes or commissions received and irregularities on specific careers in state corporations.

With regards to the GDP *per capita*, this is a recurrent variable in analyses involving corruption and government size. Its inclusion to explain corruption, according to Svensson (2005 as cited in Hessami, 2011), results from the general finding in literature that lower income and economic development levels imply a higher probability of corruption cases. Besides, several studies associate public corruption to the increase in income inequality and poverty[4], which also justifies the inclusion of the *IFDM* variable.

As for the *expenses* variable, it was included due to indications that there might be a direct relation between this variable and corruption. According to Liu and Mikeshell (2014) expenses with public workers and social security tend to be higher with growing corruption levels.

Table 1 introduces descriptive statistics for the different variables. It may be verified that the mean value of the corruption indicator – which here consists of the sum of the number of investigated and judged cases per year for each municipality included in the sample– was approximately nine. The maximum value of 1,074 investigated cases was found in the Federal District in 2016 while the mean size of the government in that period was approximately 20% of the GDP, with a minimum value of -481.89% and a maximum of 15,457.56%, which was found in the Minas Gerais municipality of Belmiro Braga, also in 2016.

The IFDM in the analyzed period was nearly 0.63 (in a scale from 0 to 1), a moderate development level considering that the minimum was 0.18, obtained by the Bahian municipality of Santa Luzia in 2006 and the maximum, 0.93 reached in the same year by São Paulo's São Caetano do Sul. In terms of spending productivity, the mean was 3.92 %. At the same time, the GDP *per capita* of municipalities

[4] Mauro (1995), Rose-Ackerman (2005) and Tanzi and Davoodi (1997) are some examples.

reached around 12,357.79 Brazilian reais, being that the minimum amount was 1,459.79 reais for the Rio Grande do Norte municipality of Guamaré in 2012. As for the highest GDP of all municipalities included in the sample, it was 815,697.80 reais, registered in 2014 in the Espirito Santo municipality of Presidente Kennedy.

TABLE 1 VARIABLES DESCRIPTIVE STATISTICS

Variable	Mean	Standard-Deviation	Minimum	Maximum
Corruption	8.96	43.62	0	1,074
Government Size	19.91	77.57	-481.89	15,457.56
IFDM	0.63	0.12	0.18	0.93
Spending Productivity	3.92	3.31	-150.67	664.82
GDP *per capita*	12.357,79	15,800.12	-1,459.79	815,697.80
Expenses	2.56e+07	2.00e+08	0	2.03e+10
Investments	5,055.41	4.94e+07	0	4.93e+09

Source: Elaborated based on research data.

In the analyzed period the mean spending of municipalities with public workers and social security (expenses variable) was approximately 25.6 million reais, reaching a maximum of 20.3 billion reais. The mean investment made by municipalities was around 5.05 million reais, reaching a maximum of 4.93 billion.

3.2 Econometric Model

Considering Cameron and Trivedi (2013) as a reference we initially estimated the POLS (*Pooled Ordinary Least Squares*) model or, in a simpler way, the *pooled* model. Then, fixed and random effects models were estimated. Considering *Corrup* as the dependent variable used as proxy for corruption, we have a *pooled* model given by:

$$Corrup_{it} = \alpha + \beta_2 TGov_{it} + \beta_3 IFDM_{it} + \beta_4 ProdG_{it} + \beta_5 PIBpc_{it} + \beta_6 DesPes_{it} + \beta_7 Invest_{it} + \beta_8 DTemp_{it} + \mu_{it} \quad (1)$$

As for the fixed and random effects models, they have their specifications given by the following expressions:

$$Corrup_{it} = (\alpha + \varepsilon_{it}) + \beta_2 TGov_{it} + \beta_3 IFDM_{it} + \beta_4 ProdG_{it} + \beta_5 PIBpc_{it} + \beta_6 DesPes_{it} + \beta_7 Invest_{it} + \beta_8 DTemp_{it} + \mu_{it} \quad (2)$$

$$Corrup_{it} = \alpha + \beta_2 TGov_{it} + \beta_3 IFDM_{it} + \beta_4 ProdG_{it} + \beta_5 PIBpc_{it} + \beta_6 DesPes_{it} + \beta_7 Invest_{it} + \beta_8 DTemp_{it} + (\varepsilon_{it} + \mu_{it}) \quad (3)$$

Whereas *i* represents *the i-th* cross sectional unit and *t* represents the *t-th* unit of period of time. The terms *TGov*, *IFDM*, *ProdG*, *PIBpc*, *DesPes* and *Invest* i, respectively represent the explicative variables "government size", "municipal development index", "spending productivity", "GDP *per capita*", "expenses with public workers and social security" and "investments". *Dummies* variables for each year were considered, represented by *DTemp*, seeking to control the effect of time on corruption.

One aspect of the panel data analysis is related to the statistical tests used to detect the presence of autocorrelation and heteroskedasticity in the panel and to help in the search for the most adequate model.

Once the fixed effects estimation was made, a Chow test (or restricted F test) was applied to verify if the intercepts were the same for all cross sectional units. In other words, if the specific effect for each individual in equation (2) was equal to 0.

As a test result, we observed a Ho rejection, which leads us to conclude that the fixed effects model is more desirable than the *pooled* one. This means that the unobserved heterogeneity is important in the analysis and may not be discarded in the model.

It is worth mentioning that unobserved effects may be modeled through fixed or random effects. The Hausman test, which is an independence test between the error term and the regressors, helps in the choice between the two models. The null hypothesis subjacent to the Hausman test is that there is no systematic difference between fixed and random effect estimators. In other words, we are testing the consistency of random effect estimators (Wooldridge, 2002).

Rejecting the null hypothesis of this test means saying that the random effects model is not adequate (unobserved effects are probably correlated to one or more regressors) and therefore, the fixed effects model is preferable (Gujarati & Porter, 2011; Kennedy, 2009).

The result obtained by this test was the H_0 rejection and the consequent inadequacy of random effects models so again, preference is given to the fixed effects model.

The Lagrange Multiplier Test developed by Breusch and Pagan in 1980 was also applied to equation (3). According to Gujarati and Porter (2011), this test is used to check that there are no random effects at an individual level, being that the null hypothesis rejection in this case implies that the *pooled* model is inadequate and the random effects model is desirable.

The result obtained by this test, however, was the non-rejection of H_0, which means that the *pooled* model is better than the random effects model. From a different perspective, the Breusch and Pagan LM test reinforced the Hausman test, through which it was also corroborated that the random effects model is not the most suitable in this case.

As for the presence/absence of autocorrelation and heteroskedasticity, the Wooldridge tests for panel autocorrelation and the Wald test for group heteroskedasticity (fixed effects) were performed. Their results were absence of autocorrelation (1st order) and presence of heteroskedasticity. For this reason, an estimate with robust standard errors for heteroskedasticity was carried out.

3.3 Heckman's sample selection model

Although there are random draws to control municipalities with regards to their management of resources transferred by the Union for decentralized use, the number of corruption cases measured through the quantity of open and investigated cases by the CGU does not permit to infer the real corruption size. However, due to the inexistence of a concrete measurement tool at a municipal level, it is necessary to use alternative information that can provide us with basic evidence on such phenomenon.

Consequently, the corruption variable applied for the estimation of Pooled panel models and random and fixed effects may involve biases, as a significant number of municipalities have latent information on the existence or not of corruption cases, besides the impossibility for municipalities to be able to measure the real size of corruption and its operating mechanisms. It is also possible that a corruption case in a given municipality may become more relevant than in another one. Besides, as the CGU randomly selects no more than 60[5] municipalities to be supervised per year, the corruption phenomenon remains unknown in most of them, thus leading to a bias that results from the sample selected for the estimation of the key factors that trigger this phenomenon. As highlighted by Baltagi (2005), if we consider solely the balanced panel with the information available, the inference based on it is inefficient, even if based on randomly left out data, as we would be discarding information. Therefore, considering non-randomly missing data we would have a misleading inference because it wouldn't be representing the population sample anymore.

The distinction between ignorable and non-ignorable data selection rules, in other words, between missing and non-missing data in a given research, was analyzed by Verbeek and Nijman (1996). This is important because if the selection rule is ignorable for interest parameters, standard panel data methods may apply for a consistent estimation. When the selection rule is not ignorable, we must take into account the mechanism that causes missing observations in order to obtain consistent estimations of interest parameters.

Therefore, Heckman (1979) proposed a simple estimator to treat the bias resulting from the selection of a non-random sample, that is to say, a truncated sample that intends to estimate behavioral relations. The problem of estimations through fixed and random effects is that corruption processes are only noticed in the municipalities inspected by the CGU. Consequently, data omission for the other municipalities is not randomly selected.

The model to be adopted is therefore given as follows:

$$y_{it}^{*} = x_{it}\beta + \alpha_{1i} + \varepsilon_{1it} \tag{4}$$

In which y_{it} is the dependent variable with information omission; x_{it} are the variables used to model the result; α_{1i} is the individual effect of the main equation and ε_{1it} is the error term. The selection equation is given by S_{it}, which determines which y_{it} represents missing data, such that:

$$S_{it} = 1(Z_{it}\gamma + \alpha_{2i} + \varepsilon_{2it} > 0) \tag{5}$$

[5] Data available at the CGU website for 2020.

In which S_{it} is a *dummy* variable that takes value 1 if an observation is selected and 0 when the opposite occurs. 1[.] is an indicator function equal to 1 if its inner argument is true and zero in the opposite case; Z_{it} is a vector of variables used to model a selection associated to a parameter γ; α_{2i} is the individual effect and ε_{2it} is the error term of the equation selection.

$$\begin{pmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \end{pmatrix} \sim Normal\ Bivariada \left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_1^2 & \rho\sigma_1 \\ \rho\sigma_1 & 1 \end{bmatrix} \right)$$

As there is no parametric estimation for fixed effects estimators in the case of endogenous sample selections, we used the Heckman estimator for random effects.

For the selection equation, we used the IFDM variable, which belongs to the main equation, together with financial management indicators, as recommended by Macedo and Corbari (2009). The purpose of including such indicators is to detect the influence of financial imbalances resulting from corrupt practices carried out by the municipalities. Besides these ones, other variables such as *population* were included, seeking to find the increase level in the probability of the existence of corrupt events considering the size of the municipality population. Financial management indicators are described in Box 2.

The dependency level of municipalities on their own revenues reflects the low fiscal effort, which may be related to two main factors: the first one is given by the disincentive provoked by the guarantee of funds transfers from the Union and states. The second one may be related to an inefficient tax collection structure, which at the same time, allows for debt remissions in exchange for political support.

BOX 2 DESCRIPTION OF SELECTION EQUATION VARIABLES – FINANCIAL MANAGEMENT INDICATORS

Variable	Description	Data Source
Dependency level	Compares the dependency level of municipal entities with regards to transfers received from federal authorities. It is given by the relation between transfer-related revenues and the total municipality revenues.	Finbra/Siconfi
Public agent expenditure indicator	Indicates the amount of current net revenues that are compromised with spending on public agents. It is given by the relation between costs and public agents' expenditure and the current net revenues.	Finbra/Siconfi
Expenditure on Investments	Indicator of investment expenditure in relation to the current net revenue.	Finbra/Siconfi
Population	Municipality population.	Finbra/Siconfi

Source: Elaborated by the authors.

Likewise, for the public agents' expenditure indicator, we expect to discover the impact of excessive hiring with no public tender, which instead, occurs as a mere payment for the support received during election campaigns.

Finally, the investment expenditure indicator not only reflects the level of concern with local development, it may also be applied as a mechanism to promote informal agreements between local governors and corporate service providers.

4. RESULTS ANALYSIS

Table 2 introduces estimates obtained through two *pooled* models for random and fixed effects. As Fávero advocates (2013) in the stacked data, inference requires a control of the *within* correlation in the disturbance term for a given individual. Therefore, robust standard errors must be grouped at an individual level (clustered).

The first aspect to be noticed is that coefficients estimated by random effects *pooled* models are identical. This happens due to the fact that the error term variance specific to an individual is equal to zero in the random effects model, such that the GLS estimator is equivalent to the OLS estimator applied to the *pooled* model, once identical weigh is given to the variations *within* and *between*[6], as Marques (2000) clarifies. Fixed effects estimates, instead, show substantial differences in comparison to the other two models. However, it is important to highlight that regardless of the model adopted, the impact on corruption generated by the government size is always negative and this is the main point of analysis in this case.

Results analysis shall be based on the equation estimation (4), given by the Heckman model, once the selection equation estimation (5) was made through the *probit* model in the first stage and interpreted as if corruption data was observed for all municipalities included in the sample. Considering that the coefficient related to Mills' inverse ratio resulted statistically significant at a 1% level, we may infer that the sample was randomly selected. Therefore, in the main estimation we consider the bias of the missing variable in this model. As we can observe in Table 2, the coefficient for the *government size* variable TGov presented statistical significance at a 5% level, whereas the significance of the variables IFDM and *PIBpc*, as well as variables for expenditures with public agents and social security costs *DesPes*, and investments, *Invest*, respectively remained at a 1% level. The coefficient for the variable *ProdG,* instead, did not show any statistical significance neither for fixed effects nor for the Heckman model.

As the table below demonstrates, the effect of the main variable of interest *TGov* on corruption suggests that an increase in the government size reduces corruption levels in the municipality. In both analyzed models, the coefficient for this variable suggests that a 1% growth in the government size, keeping all other factors constant, reduces corruption incidence in about 0,05 unit.

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[6] While the fixed effects model considers only the *within variance* and the variation through time for a given individual, the random effects model may be seen as an optimal combination of the within and *between* variances. This last model refers to the variation between individuals (Fávero, 2013; Kennedy, 2009; Marques, 2000).

TABLE 2 ESTIMATED REGRESSION MODEL RESULTS

Dependant Variable I:				
$Corrup_{it}$	*Pooled* Model	Random effects	Fixed effects	Heckman
$TGov_{it}$	-0,043***	-0,043***	-0,038**	-0,0582**
$IFDM_{it}$	-0,322	-0,322	-13,465**	-18,759***
$ProdG_{it}$	-0,475*	-0,475**	0,080	0,018
$PIBpc_{it}$	-0,00009***	-0,00009***	-0,00004	-0,00008***
$DesPes_{it}$	2,074e-08**	2,074e-08***	1,426e-08***	1,791e-08***
$Invest_{it}$	9,006e-08***	9,006e-08***	9,507e-08***	9,547e-08***
D2006	5,748***	5,748**	14,563***	7,068**
D2007	7,918***	7,918***	17,895***	10,090***
D2008	8,178***	8,178***	19,030***	10,944***
D2009	9,190***	9,190***	21,045***	12,080***
D2010	9,268***	9,268***	21,681***	12,691***
D2011	8,767***	8,767***	21,092***	12,252***
D2012	7,943***	7,943***	20,177***	11,258***
D2013	11,098***	11,098***	24,137***	14,536***
D2014	10,063***	10,063***	22,844***	13,405***
D2015	9,523***	9,523***	22,052***	12,220***
D2016	9,367***	9,367***	22,241***	12,141***
Constant	-3,098	-3,098	-7,515	15,314***
Selection equation				
Dependent variable:				
Dummy $Corrup_{it}$				
IDP_{it}				1,523***
GD_{it}				1,732***
Inv_Rec_{it}				-0,795***
$ifdm\_geral_{it}$				0,518***
pop_{it}				6,660e-06***
Constant				-1,149***
Mills ratio:				
Lambda				- 6,617***

Continue

Statistics				
	Pooled model	Random effects	Fixed effects	Heckman
N	6.193	6.193	6.193	60.039
R^2	0,682		0,502	
R^2 *Overall*		0,682	0,673	
R^2 *Within*		0,487	0,502	
R^2 *Between*		0,721	0,694	
F(17,1750)	8,823 (p-value = 0,000)		32,945 (p-value = 0,000)	
chi2(17)		13.272,032 (p-value = 0,000)		9273,5724 (p-value = 0,000)
sigma_u		0	9,5864	
sigma_e		13,3587	13,3587	
Rho		0	0,3399	-0,3067
Sigma		13,3587	16,4424	21,5740

Interpretation: * p<0.10; ** p<0.05; *** p<0.01
Source: Elaborated based on research data.

Such result contradicts Goel and Nelson (1998) studies for the United States, as well as those of Arvate et al. (2010) for Latin American countries in which it was found that Brazil had higher corruption levels associated to larger governments. On the other hand, however, this finding converges with results obtained by Bergh et al. (2012) for Sweden and by Magtulius and Poquiz (2017) for the Philippines, as they discovered a negative effect of government size on corruption.

With regards to Arvate et al. (2010) findings for Brazil, it is important to remark that unlike the present research, these authors used a subjective indicator given by the corruption perceptions index, besides the fact that they use sample data from an earlier period of time than this research, which may naturally justify different results for both studies.

Another connection may be made with Kotera et al. (2012). These authors affirm that the effect of government size on corruption depends on the country's democracy level, which means that a larger government tends to aggravate corruption if democracy is not sufficiently consolidated but if it is, an increase in the government size may result in a corruption reduction. If compared to other Latin-American countries such as Venezuela and Bolivia, Brazil may be considered a country with a relatively strong democracy, however incomplete. This may partly explain the negative relation between government size and corruption obtained by the estimated regression.

In regards to the IFDM variable, the municipal development index, an increase of 1% implies a reduction of 18,76 in the corruption indicator. The result suggested by the IFDM – which includes employment and income, health and education dimensions – agrees with previous studies, which associated public corruption to the increase in poverty and inequality. Among such studies we should mention those of Mauro (1995), Rose-Ackerman (2005) and Tanzi and Davoodi (1997).

As for the expenses with public workers and social security, the *DesPes* variable contributes to an increase in the municipality corruption level. This was expected considering that such variable is in direct relation with corrupt activities in the sense that there are managers who use the power they are entitled to in order to obtain private gains. In general, this happens due to having too many commissioned positions – as it is frequently the case in Brazil – or because of entering financial resources in the payroll expenses that should not be part of it, not to mention frauds with ghost employees. These acts increase spending with public workers and oftentimes result in non-compliance with the Fiscal Responsibility Law (LRF) that sets a limit for this kind of public expense.

Therefore, it is common that public workers' salaries represent expenses that are beyond the amount necessary to meet the population demands. This result is in agreement with Liu and Mikesell's affirmation (2014) that expenses with the entire payroll and wages in the public sector tend to be higher in scenarios of high corruption levels.

Likewise, the investments variable coefficient, *Invest* is positive, which suggests that an increase in amounts invested by municipalities tends to corroborate higher corruption levels. In fact, it's no surprise that such resources are often deviated for corrupt activities through the over-invoicing of works, contract and public bidding frauds and other related corrupt practices.

One consideration to be made is that the low values found in the *DesPes* and *Invest* variable coefficients don´t necessarily mean that they exert a reduced impact on corruption, once these models capture corruption variations per BRL unit and these regressors have wide amplitude.

Even if the variable coefficients related to spending productivity *ProdG,* and GDP per capita *PIBpc* have not presented any statistical significance for the fixed effects model, it is worth making a brief analysis of their effects on corruption considering the significances of these variables captured by two other models introduced in Table 2.

In this sense, with respect to the variable *ProdG*, results obtained through the random model suggest a reduction of a 0.47 unit in the corruption indicator for every 1% growth in the health/product expenses used as proxy for productivity. In fact, Liu and Mikesell (2014) state that inefficiency of public spending is directly related to a bigger corruption scenario. Therefore, an increase in health expenses with regards to the GDP tends to result in lower corruption levels.

As for the *PIBpc*, coefficients for these variable for the *pooled* and random effects models suggest a negative impact on corruption, converging with results reached by Kotera et al. (2012) and Svensson (2005 quoted in Hessami, 2011). This is not difficult to infer: with a simple corruption perceptions index analysis for different countries as published by international organizations such as CPI and WGI, it is possible to conclude that more developed countries have in general lower corruption levels.

Finally, the *dummies* variables related to the same years also presented a positive effect on corruption throughout the analyzed period. As per the results exposed on Table 2, it is evident that 2013 was the year with the highest growth in corruption levels. As from that year, the effect started to decrease in the following years.

This corroboration is in agreement with operations aimed at fighting corruption crimes developed in that period and the wider independence granted to the judiciary power to judge this type of crime, besides the growing attention given by the media and the population. Still in 2013, the Anti-corruption Law made companies responsible for harmful acts against the public administration.

This assertion is coherent with Becker's crime and punishment model (1968) and with results found by Goel and Nelson (1998), through which it was found that a tighter control and a higher chance of punishment discourage illegal activities such as corruption. Besides, we should also consider the economic crisis that started in 2014, not necessarily for leading to a reduction in corruption levels but rather, for limiting the availability of financial resources.

Summarizing the produced evidence, we may conclude that the problem is not in the government size –contrary to expectations, a bigger size government proved to be a factor that helps reducing corruption – but rather, the way in which public resources are used. We must highlight the relevance of good governance together with the effectiveness of the law as a means to inhibit corruption-related activities in Brazilian municipalities.

5. FINAL CONSIDERATIONS

This article investigated through panel data analysis, the impact of the government size on corruption in Brazilian municipalities from 2005 to 2016, using a corruption measurement unit developed through data made available by CGU.

Results revealed a significant inverse relation between government size and corruption in Brazilian municipalities. They also suggest that the larger the State size, the lower the corruption incidence in the municipality. Although this disagrees with theoretical expectations and common sense, this corroboration is not absurd considering that Brazil has a reasonable level of democracy and press freedom, which works both as a break and counterweight system.

As for the influence of other variables, parameters suggest that "expenses with public workers and social security" and "investments" induce a growth in municipal corruption, whereas "municipal development index", "spending productivity" and "GDP per capita" tend to contribute to a reduction in corruption incidence. It was also corroborated through the time factor that there was a corruption growth throughout the analyzed period. However, after 2013, this effect started to decrease until 2015, with a slight increase in 2016.

Before the evidence produced, we infer that the matter of corruption in Brazilian municipalities is not related to how large the government is. The problem may be in the way in which public resources are applied, highlighting the low law enforcement levels. It is worth mentioning the importance of good governance, with a transparent and responsible management, together with the effectiveness of the legal system as a means to prevent corrupt activities in Brazilian municipalities.

Social complexity is another factor that affects municipal corruption levels. A more active civil society and regions with higher economic development tend to have fewer irregularities in the management of public resources, as empirical evidence suggests.

It is important to remark that despite the unquestionable advantages brought to countries by economic liberalism with the Minimal State prerogative, given the intrinsic characteristics of the Brazilian nation –where corruption is considered to be systemic and there is a huge income inequality – the State intervention in the economy through public policies that grant access to all basic services such as health and education becomes necessary. In any case, the application of stricter measures in anti-corruption governance is advisable. For this purpose, it is crucial to apply sanctions foreseen by the law to those who use public resources in an unlawful way in order to satisfy personal interests.

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