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DOES CORRUPTION AFFECT HOMICIDE? THE BRAZILIAN CASE

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ABSTRACT

This article empirically assesses the determinants of homicide rates based on panel data by states for the period 1998-2008. The main contribution of this paper is to test whether corruption affects homicide rates in Brazil. It is worth noting that the relationship between corruption and homicide is very little explored in the literature. Based on different empirical specifications, the results attest to the hypothesis that corruption impacts, and show a directly proportional relationship with the total homicide rate, even controlling the results for other variables associated with socioeconomic aspects.

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INTRODUCTION

Homicide and corruption are two serious problems faced by a society that needs effective and efficient public policies to solve these problems. In this context, both generate collective losses, as different sectors of society lose productivity, effectiveness, and efficiency due to homicides that destroy human capital, as well as the illegal use of resources resulting from corruption. Thus, both phenomena imply a reduction in the well-being of the community. However, despite these harmful effects on society, the literature has not given the necessary attention to the interaction between these two phenomena. This paper discusses the impacts of corruption on total homicide rates in the period of 1998-2008, using panel data from Brazilian Federation Units. It should be noted that the General Corruption Index (ICG), built from data related to the registry of irregular accounts of the TCU (Union Court of Auditors), is the explanatory variable of interest in this study, however other control variables are considered. The IGC was created by Boll (2010). The objective of this research is, therefore, to analyze whether corruption affects the total homicide rates in Brazil, considering the period of 1998-2008, using panel data by Federation Units, that is, the 26 States and the Federal District. The main contribution of this work is to test whether corruption affects homicide rates in Brazil. It is worth noting that the relationship between corruption and homicide is very little explored in the literature. In view of the above, we show a short literature review as follows. Sobral (2014), using the Ordinary Least Squares Method in two panel stages, analyzed the impacts of corruption on the growth of federal units (FUs) in Brazil, concluding that positive and negative correlations were present, evidencing that corruption stimulates growth in the least corrupt Federation Units and reduces it in the most corrupt. Baugarten (2017), studying the impact of corruption on entrepreneurship, in a fixed-effect panel modeling, found a negative effect between these variables. The result is highlighted due to the importance of entrepreneurship for economic growth. Silva, Santos, and Ribeiro (2019), in a random effect panel regression test, estimated the impact of corruption control on GDP, and the result pointed to a positive relationship between these two variables, with a significance of 10%. Thus, mitigating non-collective interests, due to the control of corruption, resources are allocated more efficiently, providing a reduction in inequality. According to Lambsdorff (2005), low GDP, income inequality, and increased crime are accompanied by the variable corruption, which is a cause, or simultaneously, a consequence of the first variables, and a vicious circle can occur where corruption impacts and is then impacted by the other variables.

Boll (2010) points out that, analyzing the Federation Units, corruption occurs in a heterogeneous way in Brazil. In his study, the author developed the Government Corruption Index (GCI), adopting the Registry of Irregular Accounts of the Federal Court of Auditors (Cadirreg) as the main database. Besides, an article in this same line is developed by Carraro et al (2015). Azevedo et al (2018) using multiple linear regression, considering the Human Development Index (HDI) 2010 and the average for the period 1998-2008 of the Government Corruption Index (GCI), created by Boll (2010), obtained an inverse and significant relationship between these variables. Melo, Sampaio, and Oliveira (2015) used the GCI, created by Boll (2010), to estimate the effect of corruption on business opening, obtaining an inverse relationship between these variables. Also, according to Ferreira (2018), in general, the social performance of Brazilian municipalities is affected by the impacts of corruption, producing negative effects in the educational area, among others. Teixeira (2019) cites the perpetuation of poverty, the decrease in the efficiency of the public sector, and the reduction of incentives for company innovations, among others, as negative impacts of corruption. Using Boll's (2010) GCI dependent variable in a panel data analysis with the 27 Federation Units, Oliveira (2017) found that the explanatory variables, years of schooling, poverty, and Gini coefficient are statistically significant and impact with signs negative to corruption. In addition, the results presented by the research by Fraiha (2014) suggest that higher scholarity, greater interest in politics, and credibility in the media are factors that provide greater probabilities of perception of corruption. Mendonça, Loureiro, and Sachsida (2003) suggest that different crime prevention strategies can be developed for each type of crime. In the case of violent crimes, the authors indicate that bringing the individual closer to the family, the community environment where he lived, and devotion to God seems to be adequate actions to promote the reduction of this type of crime. Violence and homicides represent serious problems in numerous locations and in various sectors of society, whether social, educational, public health, economic, in addition to lives that are lost, producing sadness and difficulties for families. These are potential talents that are lost in the generation of ideas, work, income, and development for the country. Loureiro, Moreira, and Sachsida (2013) suggest that locations with higher rates of violence tend to have higher suicide rates. In this sense, public policies can be debated, proposed, and implemented to mitigate or eliminate the cycle of violence. According to the Brazilian Yearbook of Public Security 2020, between 2018 and 2019 there was a reduction in the absolute number of intentional violent deaths, or even a reduction of approximately 17.7% in the rates per 100 thousand inhabitants. Spaniol, Júnior, and Rodrigues (2020) analyzed in a bibliographical and documentary way the Public Security Policies already adopted and concluded that there is a need for continuity and greater social participation in their constructions so that reductions and greater effectiveness in crime prevention occur. In this way, public security policies based on innovative information and communications technologies, successful experiences observed, and social participation can contribute to progress in reducing homicide rates.

Using a dynamic panel, Pinto, Farias, Costa, and Lima (2018) found that the variables average income and average schooling explain crime in the homicide modality, however, schooling alone leads to a reduction in the crime variable.Research by Becker and Kassouf (2017) suggests that reductions in crime rates can be observed, given increases in public spending on education and provided that a period for the perception of impact is considered. The research by Seillier (2010), with panel data in the period 2001-2005 to study crime in the Federation Units in Brazil, shows a regression model in which the results suggest that reduced schooling rates lead to increases in homicide rates. Based on models estimated by Loureiro, Moreira, and Ellery (2017), the Gini coefficient and the poverty rate are significant in explaining the homicide rate. Thus, in the research, increases in the Gini coefficient produce increases in the homicide rate, while increases in the poverty rate produce a reduction. Oliveira (2016) using panel data when studying the relationship between economic indicators and crime in the period 1990-2010 in the 27 Federation Units, observed that increases in per capita income produce negative impacts on the dependent variable homicide rate. Pinto et al (2018), based on the panel data models and Generalized Methods of Moments (GMM), considering the 27 FUs in the period 2001-2014, analyze the effect on the dependent variable, homicide rate, and the empirical results show significance in the explanatory variables education and mean income. However, the first has a negative sign and the second a positive sign. Jorge (2013), when analyzing four models that seek to study the causality of homicides in the State of Sergipe, in the period 2007-2010, verifies that the coefficients of the effective security rate consistently present the negative signs in these models. Sachsida, Mendonça, and Moreira (2016) highlight that the increase in the number of police officers represents a positive strategy to succeed in reducing these homicide rates, however, a portfolio of socioeconomic actions can enhance and foster robustness to security actions. Sachsida, Mendonça, and Moreira (2015), using panel data from 2003-2009 in Brazil to study the effects of public policies on homicide rates, point out that increases in the number of police officers and incarceration rates produce, importantly, decreases in rates of violence. Along the same lines, Sachsida and Mendonça (2013) also point out that one of the factors that can generate success in the fight against crime can be obtained by raising the rate of the police force, which contributes to reducing homicide rates. Carvalho and Taque (2014) researching explanations for crime in Brazil in the period 2001-2009 and using a static panel with fixed and random effects, found results that suggest the occurrence of lower homicide rates when greater security expenditures are made.

MATERIALS AND METHODS

In this paper, we are interested in analyzing the impact of government corruption indices (GCI) proposed by Boll (2010) on total homicide rates in Brazil, using an analysis with panel data with fixed and random effects, in addition to dynamic models, considering the period from 1998 to 2008 in all units of the Brazilian Federation. Thus, the analyzed period is restricted to the availability of government corruption indices available in the work of Boll (2010).Figure I presented below shows the sources of information and the definition of the respective variables related to the econometric models presented in section 3. In this study, the estimated econometric model relates the total homicide rate (dependent variable) with the explanatory variables, in which the main variable of interest is the government corruption index proposed in Boll (2010). In this context, we tested the hypothesis that corruption impacts total homicide rates.

The total homicide equation from panel data has the following form

$$H_{it} = \beta x_{it} + \gamma_t + v_{it}, \ parai = 1, \dots, 27; t = 1, \dots 11 \qquad (1)$$

where$H_{it}$is the total homicide rate of the *i-th* unit of the federation in period t, whose matrix contains an intercept, in whichx_{it} represents the vector of explanatory variables, $v_{it}$is the random term and$\gamma_t$aims to capture specific effects in the time. According to the methodology for panel data, we also have that $v_{it} = \alpha_i + u_{it}$, in which α is a stochastic term proper to the units. Substituting, we have:

$$H_{it} = \beta x_{it} + \gamma_t + \alpha_i + u_{it}, parai = 1, \dots, 27; t = 1, \dots 11 \qquad (2)$$

Hence i represents the *i-th* cross-sectional unit and t represents the *t-th*period of time. If each cross-sectional unit has the same number of time-series observations, then this panel is called a balanced panel, which is our case. According to Wooldridge (2011), the classic panel data approach is to verify whether or not the individual component (α) is correlated with some regressor. In the first case, the model must be estimated through the application of an estimator called the fixed effect. Also, according to Wooldridge (2011) the estimation of H_{it}depends on the assumptions that are made about the intercept, the slope, and the error term, u_{it}. In this study we are considering the variables arranged in models with panel data with fixed effects approaches, in addition to dynamic models by Arellano and Bond (1991) and Arellano and Bover (1995).

Figure 1. Sources and definitions of the annual database from 1998 to 2008

Variable	Source	Description	Expected sign
Dependent variable Total homicide rate *(Homicide)*	IPEA	Homicide rate (100,000 Inhabitants) "Death from external or unnatural causes, regardless of the time between the injury event and death itself, is categorized because of an injury caused by violence (accidents, homicides, suicides, or suspicious death). In this case, the rate per 100,000 inhabitants is calculated by dividing the main indicator (number of homicides) by the total population in question, and this result is multiplied by 100,000. Source: The original data comes from SIM-DATASUS.	
Gini Index *(Gini)*	IPEA	Income - inequality - Gini coefficient "It measures the degree of inequality in the distribution of household income per capita among individuals. Its value can theoretically vary from 0, when there is no inequality (the incomes of all individuals have the same value), to 1, when inequality is maximum (only one individual has all the income of society and the income of all the other individuals are null). Series calculated from responses to the National Household Sample Survey (Pnad/IBGE)"	Positive
Poverty rate *(Poverty)*	IPEADATA	The proportion of households with per capita household income below the extreme poverty line (or indigence or misery). The extreme poverty line considered here is an estimate of the value of a food basket with the minimum number of calories needed to adequately supply a person, based on FAO and WHO recommendations.	Positive
School delay *(School* delay*)*	IPEADATA/IBGE	Percentage of people who are behind in school by more than one year.	Positive
Household income per capita *(Income pc)*	IPEA	Household income per capita - average Unit: R$ per thousand October 2014. "Average monthly income of the population. Series calculated from the responses to the National Household Sample Survey (Pnad/IBGE), with real values at prices prevailing in the last edition of the survey, updated according to the Pnad income deflator presented by Ipeadata".	Negative
Expenditure on education and culture* *(Social expenditure)*	IPEA	Expenses by function - education and culture – State Unit: BRL per billion. "Expenses are broken down by heading: Education and Culture"	Negative
State GDP per capita. *(GDP pc)*	IPEADATA/IBGE	State GDP per capita. Unit: R$ (thousand), at 2010 prices. "State GDP at constant prices (series calculated by Ipeadata) divided by population". Deflator: Implicit Deflator of National GDP.	Negative
Government Corruption Index. *(GCI)*	BOLL (2010).	The Government Corruption Indicator (GCI) was generated for each state based on Boll (2010), from 1998 to 2008, ranging from zero to one. The value zero (0) indicates the least corrupt state, while the value one (1) represents the most corrupt state.	Positive
Military Police Force *(MPF)*	Brazilian Public Security Yearbook	A military police force of each year. Sources: State Departments of Public Security and/or Social Defense; IBGE; Brazilian Forum on Public Security.	Negative
unemployed population *(Unemployment)*	IPEA	"Number of people who searched for, but did not find, paid employment in the reference week of the National Household Sample Survey (Pnad/IBGE), estimated from the survey's microdata. Prepared by: Disoc/Ipea".	Positive
Households with drinking water in the general network. *(Water supply)*	IPEA	"Percentage of people in households with water supply through the general network with internal plumbing or through a well or spring with internal plumbing".	Negative

These dynamic models consider the issue of endogeneity of variables when using instrumental variables. The database considers the total homicide rate as the dependent variable and the rest of the variables recorded in Figure 1, as explanatory variables.

ANALYSIS OF EMPIRICAL RESULTS

Empirical results are presented in different econometric models to explain homicide rates, highlighting that the variable of interest in this research is the government corruption index.The estimates presented below are based on an analysis of panel data from 1998 to 2008, considering all 27 Federation Units. Based on dynamic models, we performed empirical tests to check whether the estimated coefficients of the GCI affect Homicide rates, using instrumental variables (IV) according to Arellano Bond and Arellano Bover models, as well as verifying whether other independent variables explain the phenomenon studied. We also use a fixed-effect model. The results presented in table 1 show that the estimated coefficient of the GCI is positive and statistically significant at the 5% level. Arellano Bond's model 1 shows an estimated coefficient of 2.920, while Arellano Bover's model 2 shows a coefficient of 3.596. The fixed-effect model displays a coefficient of 5.558. In this context, there is empirical evidence that corruption has a positive correlation with the homicide rate. Thus, higher corruption rates result in higher homicide rates. The dynamic models exhibit the effects of lagged dependent variables on the current dependent variable, homicide rates, showing an inertial effect in which past homicides influence current homicides. The estimated coefficients of the one-year lagged variables are positive with estimated values of 0.577 (Arellano Bond) and 0.690 (Arellano Bover) with robust errors. Notice that several coefficients of explanatory variables are statistically significant at least once in the empirical models. This means that relevant variables associated with the supply of water, education, unemployed population, poverty, and inequality have significant effects on homicide rates. Based on the empirical results presented, the following evidence can be seen considering the control variables. The estimated coefficient of the variable "MPF" in model 3, which indicates the number of the military police force, is negative and statistically significant at 10% level. This result suggests that increases in crime repression policies result in a reduction in total homicide rates as expected. These results are also observed by Sachsida and Mendonça (2013), Jorge (2013), Sachsida, Mendonça and Moreira (2015) and Sachsida, Mendonça and Moreira (2016). The variable "Water supply" represents the percentage of people living in households with access to piped water or well water. The estimated coefficient of this variable is positive and statistically significant at a 1% level in model 1. At first, the expected result would be an inverse relationship between homicides and water supply. However, if we assume the variable "Water supply" as a proxy for urbanization and considering that cities and states with a higher level of urbanization will attract more individuals willing to commit crimes and homicides due to better opportunities, then this positive correlation between these two variables may make sense. As for the GDP per capita by Federation Unit, it is observed that the estimated coefficients of this variable, presented in models 1and 3, show estimated positive and statistically significant coefficients at a 5% level, also considered an unexpected result. Here, we can also use the same argument as in the paragraph above when taking the variable "Water supply" as a proxy for urbanization.

Table 1. Determinants of the total homicide rate. Panel data – Arellano Bond, Arellano Bover and Fixed Effect models (1998-2008)

<table>
<tr><th>Variável</th><th>Arellano Bond: VCE Robust (Model 1)</th><th>Arellano Bover: VCE Robust (Model 2)</th><th>Cross-section fixed, and Period fixed (Model 3)</th></tr>
<tr><td>L1.Homicide</td><td>0.5774216***
(0.077107)</td><td>0.6909966***
(0.0884337)</td><td></td></tr>
<tr><td>(GCI)</td><td>2.920914**
(1.418734)</td><td>3.596657**
(1.437297)</td><td>5.558739**
(2.875818)</td></tr>
<tr><td>(Water supply)</td><td>18.0196***
(6.492704)</td><td>3.543869
(5.987851)</td><td>-14.99469
(16.98666)</td></tr>
<tr><td>(GDP pc)</td><td>-1.158609**
(0.4987194)</td><td>-0.4527802
(0.3407715)</td><td>-5.568250***
(1.326424)</td></tr>
<tr><td>(Income pc)</td><td>0.0096419
(0.0062364)</td><td>0.0055754
(0.0068068)</td><td>0.028256***
(0.010332)</td></tr>
<tr><td>(Social expenditure)</td><td>-1.12e-09**
(5.57e-10)</td><td>-4.28e-10
(5.84e-10)</td><td>5.40E-10
(1.50E-09)</td></tr>
<tr><td>(School delay)</td><td>0.7149609***
(0.2233344)</td><td>0.4157274**
(0.1873827)</td><td>0.452105
(0.436897)</td></tr>
<tr><td>(MPF)</td><td>5.41e-07
(0.0001414)</td><td>-0.0000321
(0.0002064)</td><td>-0.000569*
(0.000299)</td></tr>
<tr><td>(Unemployment)</td><td>-9.16e-06**
(4.52e-06)</td><td>6.78e-07
(5.30e-06)</td><td>6.29E-06
(9.15E-06)</td></tr>
<tr><td>(Poverty)</td><td>-0.2606561*
(0.1527657)</td><td>-0.3050685*
(0.1631559)</td><td>0.007006
(0.501314)</td></tr>
<tr><td>(Gini)</td><td>16.9495
(19.31429)</td><td>38.81229**
(19.75178)</td><td>20.19255
(42.56648)</td></tr>
<tr><td>Constant</td><td>-46.38619**
(21.04344)</td><td>-41.294**
(18.55658)</td><td>61.23671
(66.77216)</td></tr>
<tr><td></td><td>Fit statistics</td><td>Fit statistics</td><td>Fit statistics</td></tr>
<tr><td>Observations
Number of instruments</td><td>189
53</td><td>216
61</td><td>270</td></tr>
<tr><td>Arellano-Bond test for zero autocorrelation in first-differenced errors.
H0: no autocorrelation.</td><td>|Order| zProb> z
| 1 | -3.1693 0.0015 | 2 | 0.39663 0.6916</td><td>|Order| zProb> z | 1 | - 3.9826 0.0001
| 2 | 0.62152 0.5343</td><td>R2 Adjusted = 0.8722</td></tr>
<tr><td>Sargan test of overidentifying restrictions.
H0: overidentifying restrictions are valid.</td><td>chi2(41) = 62.35981
Prob > chi2 = 0.0173</td><td>chi2(48) = 17.04686
Prob > chi2 < 0.00001</td><td></td></tr>
</table>

Source: Prepared by the authors. Values in parentheses are standard errors. Note: (***) significant at 1%; (**) significant at 5%; (*) significant at 10%.

In the same vein, the variable "Income pc" referring to the average monthly income of the population, shows a positive and statistically significant estimated coefficient in model 3, at a 1% level. As for the variable "Social expenditure", referring to expenditure on education and culture, the empirical results show that, based on model 1, the higher the expenditure on education and culture, the lower the homicide rate, as expected. Pinto (2018) also finds a negative result for schooling, which depends on spending on education and culture. Seillier (2010) also shows that a reduction in schooling rates leads to an increase in homicide rates. Regarding the variable "School delay", which refers to the percentage of people who are more than one year behind in school, the results show that the greater the school delay, the higher the homicide rate as expected, according to models 1 and 2. The variable "Unemployment" shows empirical result from model 1, in which the larger the unemployed population, the lower the homicide rate at 5% level, which is counterintuitive. However, if we consider that higher unemployment implies lower income, then we can expect that there will be lower incentives to commit crimes and homicides due to lower earnings for criminals. The estimated poverty rate coefficient is negative and statistically significant at 10% level, and counterintuitive, as they show that the higher the poverty rate, the lower the homicide rate. However, Loureiro, Moreira, and Ellery (2017) also show that increases in the poverty rate produce a reduction in the homicide rate. Finally, the variable "Gini index", which measures the degree of income inequality, shows that the estimated coefficient from model 2 is positive and statically significant at 5% level, showing an expected result. Confirming this result, Loureiro, Moreira, and Ellery (2017) show that increases in the Gini coefficient produce increases in the homicide rate.

DISCUSSION

This research paper tests the hypothesis that increases in corruption rates produce increases in total homicide rates. In this context, it appears that total homicides are partly explained by actions of corruption in society. The variable, Government Corruption Index (GCI) created by Boll (2010), is the explanatory variable of interest for the models studied. In the empirical models presented, the variable government corruption index shows the estimated coefficient with a positive sign as expected, that is, it confirms the hypothesis that increases in corruption rates produce increases in total homicide rates. This paper has important contributions to the criminality literature because it uses a corruption variable to explain another type of crime, that is, homicides. This is a topic that has been little explored by national and international literature. Considering that there are indexes of perception of corruption just by countries, it becomes even rarer and more difficult to find studies on this relationship between corruption and homicides by municipalities or states of the federation. However, this work is initial and can be extended to other periods and variables. In this regard, we suggest that the GCI be updated to more recent periods, since we do not have access to the data made available by the Federal Court of Auditors after 2008. Another contribution would be to assess the regional effects of corruption on homicide rates. Finally, we suggest conducting studies on the same topic using country panel data showing the effect of the Corruption Perceptions Index of a given sample of countries to explain the effects on homicide rates.

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