REGIONAL GAP IN SPENDING ON PUBLIC SECURITY AND CRIME IN BRAZIL

*Fabrício Rios Nascimento Santos**
Universidade Federal de Alagoas (Brazil)
Corresponding author: fabricio.santos@santana.ufal.br
Viviani Silva Lírio
Department of Rural Economics, Center for Agrarian Sciences, Universidade Federal de Viçosa (Brazil)
Leonardo Chaves Borges Cardoso
Department of Rural Economics, Center for Agrarian Sciences, Universidade Federal de Viçosa (Brazil)

Manuscript received 15 June 2023; accepted 21 November 2023.

ABSTRACT

Theoretical literature indicates that public security spending matters to deter criminal behavior. Nevertheless, most empirical studies aiming to quantify the influence of public security spending on crime have largely been unable to establish a statistically significant relationship between these variables. In response to this, we introduced a novel proxy that measures the rationing of public security expenditures in each region. When testing it for crimes of homicide, robbery, and theft of vehicles through the GMM-SYS estimator, we found statistical evidence that its occurrence influences criminal behavior. We believe its inception contributes valuable evidence to the economic literature, shedding light on the debate surrounding the allocative efficiency of security spending resources.

Keywords: Gap, public security spending, crime, GMM-SYS.
JEL **Classification:** C23, H59, K42.

http://dx.doi.org/10.22201/fe.01851667p.2024.327.84855

BRECHA REGIONAL EN EL GASTO EN SEGURIDAD PÚBLICA Y CRIMEN EN BRASIL

RESUMEN

La literatura teórica indica que el gasto en seguridad pública es importante para disuadir el comportamiento delictivo. Sin embargo, la mayoría de los estudios empíricos destinados a cuantificar la influencia del gasto en seguridad pública sobre la delincuencia no han podido establecer una relación estadísticamente significativa entre estas variables. En respuesta a esto, introdujimos un indicador novedoso que mide la asignación de los gastos de seguridad pública en cada región. Al probarlo para delitos de homicidio, robo y hurto de vehículos a través del estimador GMM-SYS, encontramos evidencia estadística de que su ocurrencia influye en la conducta delictiva. Creemos que su inclusión aporta evidencia valiosa a la literatura económica, arrojando luz sobre el debate en torno a la eficiencia en la asignación de recursos del gasto en seguridad.

Palabras clave: brecha, gasto en seguridad pública, delito, GMM-SIS.
Clasificación JEL: C23, H59, K42.

1. INTRODUCTION

Crime has become one of the main issues on the agenda of Brazilian public policies, especially from the beginning of the 21st century, since its incidence and constant growth have afflicted society and worried government officials. Among violent crimes, homicides are recurrently used as markers due to the severity (loss of lives), as well as the lower underreporting and, consequently, higher quality of the databases. According to Cerqueira *et al.* (2020), in 2018, Brazil recorded 57,956 homicides, which corresponds to a rate of 27.8 homicides per 100,000 inhabitants. Rates greater than ten homicides are considered by the World Health Organization (WHO) as an epidemic[1] situation. According to data from the United Nations (UN, 2019), in 2017, the Brazilian rate was five times higher than the global average (6.1) and the second highest in South America.

[1] Worsening above the historical average of its occurrence.

Crimes against property are also at critical levels in the country, those typified as robbery and theft of vehicles had 1,935 and 243,808 thousand occurrences recorded, respectively, in 2018 (Fórum Brasileiro de Segurança Pública, 2019). In the period between 2005-2018, the crimes of homicide, robbery and vehicle theft presented, on average, a rate of 27.45, 0.99 and 109.46 per 100 thousand inhabitants, respectively. It indicates the need to verify which mechanisms can contribute to cooling down this situation.

In economic studies on crime, one of the biggest challenges involves the complexity of the elements that condition it and the various interrelationships between them. Even so, the specialized literature has discussed and pointed out which variables have greater explanatory power on the evolution of crime to understand what can be done to face and mitigate it. Among these variables that are presented as possible mechanisms to combat crime are public security expenses[2], derived from the understanding that they work as a deterrent[3] to delinquent behavior, given that higher expenses reflect a greater probability of apprehension.

In 2018, Brazil spent BRL (Brazilian Real) 91.2 billion on public security policy financing, representing 1.34% of Gross Domestic Product (GDP) and an increase of 3.9% (BRL 3.4 billion) over the previous year (Fórum Brasileiro de Segurança Pública, 2019). However, despite the theoretical convergence on the importance of spending on security to reduce crime, the empirical results differ in the understanding that spending on public safety is really a deterrent tool. A possible explanation for the differences lies in the allocative inefficiency of the available resources throughout the sequence of instances involved in fighting crime. Another possible explanation is the well-known endogeneity between crime and public security spending —just as higher public security expenditures tend to reduce crime rates, higher crime rates are related to greater investments in public security.

Among the studies that have identified statistical significance in this context, notable contributions include the works of Sachsida *et al.* (2010)

---

[2] Divided into Policing, Civil Defense, Information and Intelligence and Other Subfunctions.

[3] In addition to this, the economic literature on crime has also used the number of detainees in the total number of registered police incidents as a proxy for the deterrence variable. See Carrera-Fernandez and Lobo (2005).

and Becker and Kassouf (2017). In both studies, endogeneity was corrected using the System Generalized Method of Moments (GMM-SYS), and results indicated that public security spending effectively reduces crime rates. Applying the same method, Kume (2004), Santos (2009) and Marques Junior (2014) did not find empirical evidence that public security expenditures negatively impact crime rates.

Given the divergence in empirical evidence when examining the relationship between spending on public security versus crime and the importance of spending on security as one of the main tools to deter crime, our study proposes the development of a proxy that measures the rationing of spending on public security in each Brazilian region (GAP). The proxy is the value of misalignment of each state's security spending in relation to the national[4] average. Positive gaps indicate that the state spends less on security than its share of GDP. Thus, the hypothesis tested was that the existence of a positive GAP positively impacts crimes against property and negatively impacts crimes against the person. Understanding the negative relationship between GAP and crime against the person is supported by the works[5] of Balbo and Posadas (1998), Duce, Chavarria, and Torrubia (2000) and Teixeira (2011). To fulfill this purpose, the crimes of homicide, robbery and vehicle theft were considered through a dynamic panel data model estimated by the System Generalized Method of Moments (GMM-SYS). Our findings indicate a direct correlation between crimes against property and GAP_{PSE}, whereas crimes against the person exhibit an inverse relationship. This suggests that public spending may not be effectively reducing crimes against the person.

In terms of organization, this article is composed, in addition to this introduction, of four more sections. In the second section, the theoretical framework is presented; in the third, the methodology adopted to achieve the objectives is outlined. In sequence, the following section

[4] If state (*i*) has 10% of GDP, it is expected to also have 10% of public security spending. However, if it has only 5% of expenditures, the proxy will measure how much, in monetary terms, the state would need to spend so that the proportion of security expenditures is equal to the state's share of the country's GDP, in this case, 10%. For further explanation, see the Methodology section.

[5] These works found a direct relationship between homicide and public security spending.

discusses the results achieved. Finally, in the fifth section, the final considerations are woven together with study limitations and suggestions for further research.

2. THEORETICAL REFERENTIAL

In general terms, public policies are a set of actions that the government carries out to solve or at least minimize socially problematic situations. Among this broad set of actions, there are those aimed at security, of paramount importance for the good ordering of society, since they propose to protect rights and impose the fulfillment of duties. Naturally, the effectiveness of its actions is conditioned to the joint effort between society and the state apparatus in its different instances —federal, state and municipal.

With the aim of preventing violence and reducing crime, several plans[6] and programs were presented by the federal sphere, namely: National Public Security Plan of 1991, *National Public Security Plan of 2000*, *National Public Security Plan of 2003*, *2007 National Security with Citizenship Program*, *2011 National Border Strategy*, *2015 National Homicide Reduction Pact*, *2016/2017 National Public Security Plan* and *National Public Security and Social Defense Plan 2018-2028*[7].

However, considering the persistently high rates of criminal incidence witnessed in recent years, it is possible to question the efficiency of such public policies. As a result, in an attempt to measure the deterrent effects on criminal behavior, most national empirical analyses have used the variable public security expenditures as a deterrent factor, since they increase the probability of apprehension. This understanding can be inferred from the theoretical model proposed by Becker (1968). According to the author, the prohibition or restriction of an activity is due to the damage/damage caused to others, and this damage would present a direct relationship with the level of criminal activity, as follows:

---

6 For more details, see Spaniol and Rodriguez (2018).

7 Available in: <https://www.justica.gov.br/sua-seguranca/seguranca-publica/plano-e-politica-nacional-de-seguranca-publica-e-defesa-social.pdf/view>.

$$H_i = H_i(O_i),\ \text{whit } H_i' = \frac{dH_i}{dO_i} > 0 \qquad [1]$$

Where H_i is the damage caused by crime i, and O_i is the level of criminal activity. In the same sense, there is the social gain (G) derived from the criminal act, which tends to increase with the number of crimes, being,

$$G_i = G_i(O_i),\ \text{whit } G_i' = \frac{dG_i}{dO_i} > 0 \qquad [2]$$

That said, the net cost or loss to society is the difference between the loss and the gain, being written as

$$D_i = H_i(O_i) - G_i(O_i) \qquad [3]$$

Thus, offenders usually end up receiving diminishing marginal gains and inflicting increasing marginal damages for additional offenses, $G'' < 0$, $H'' > 0$ and

$$D'' = H'' - G'' > 0 \qquad [4]$$

Therefore, the "criminal offer" can be expressed as follows:

$$O_i = O_i\left[B_i, S_i(P), u_i\right] \qquad [5]$$

Where O_i is the number of crimes committed during a particular period; B_i is the expected benefit of criminal activity; P is the probability of being arrested; S_i is the severity of punishment, and u_i is other variables that affect crime.

It is understood that, at least theoretically, higher public security expenditures (PSE) significantly improve the probabilities of apprehension. Thus, equation [5] can be rewritten as follows:

$$O_i = O_i\left[B_i, S_i\left(P(PSE)\right), u_i\right] \qquad [6]$$

Where you have, $dO_i/dB_i > 0$, positive marginal effect on criminal behavior; $dO_i/dS_i < 0$, $dO_i/dP < 0$, and $(dO_i/dS_i)(dS_i/dP)(dP/dPSE) < 0$ negative marginal effects on criminal behavior.

3. METHODOLOGY

3.1. Identification strategy

The literature indicates that public security expenditures operate as a deterrence mechanism for criminal behavior. However, it should be noted that this relationship suffers from the problem of endogeneity due to simultaneity (Fajnzylber and Araujo Jr., 2001; Kume, 2004; Santos and Kassouf, 2007; Loureiro and Carvalho Jr., 2007; Sachsida *et al.*, 2010; Becker and Kassouf, 2017; Gomes, 2019). Furthermore, several studies (Kume, 2004; Santos and Kassouf, 2007; Santos, 2009; Marques Junior, 2014) have not found the deterrent effect of this variable after treating endogeneity on criminal behavior, allowing us to infer that expenditures were insufficient to prevent and/or combat it, or were used inefficiently.

Another measure used as a proxy to try to estimate the deterrent effects on criminal activity has been the number of police officers. However, there has also been no convergence in the results. While studies by Levitt (1997), Fajnzylber and Araujo Jr. (2001), Fajnzylber, Lederman, and Loayza (2002), Evans and Owens (2007), Apel (2013) and Nagin (2013a) concluded that greater police force negatively affects the criminality, those by Kleck *et al.*, (2005), Lochner (2007) and Kleck and Barnes (2014) found no evidence for the police-crime effect. In addition, Santos (2009) exposes that the indicators used in Brazil to measure the deterrent effects on crime are not, so far, ideal. Given this, the present study proposed the creation of a proxy that measures the rationing of public security expenses in each region.

Since the function of public security is to safeguard public order and the integrity of people and property (Brazil, 2018), the lack of investment (occurrence of rationing) in this department reverberates in less efficiency and effectiveness in the prevention and repression of illicit activities. Furthermore, it is emphasized that the development of a proxy is not a trivial task, since its quality directly impacts the robustness of the estimates. That said, its construction is initially based on the understanding that more developed regions (higher GDPs) spend more on public security than less developed regions (lower GDPs). However, as the less developed regions have the highest crime rates, spending on public security is directly related to the country's unequal income distribution.

Based on this understanding, an indicator was created, which was called the Public Security Expenditure Regional Index (PSERI), which is an adaptation of the famous “Locational Quotient” widely disseminated in the literature on regional economics. Its formula being:

$$PSERI_{it} = \frac{\dfrac{PSE_{it}}{PSE_{BR_t}}}{\dfrac{GDP_{it}}{GDP_{BR_t}}} \quad [7]$$

Where PSE_{it} is the expenditure on public security in region i, in year t; PSE_{BR_t} is public security spending in Brazil, in year t; GDP_{it} is the GDP of region i, in year t, and GDP_{BR_t} is the GDP of Brazil, in year t.

This indicator correlates the participation of a region in public security expenditures made by Brazil with its participation in the national GDP. When the indicator is equal to 1 (one), public security expenditures executed in the region are equivalent to the proportion of the state's GDP. If it is greater (or less) than 1 (one), it implies that the region obtained a share in public security expenditures greater (or less) than its share in the GDP distribution.

With this indicator, it was possible to establish a proxy that measures the rationing of public security expenses in each region, called GAP_{PSE}. The GAP_{PSE} refers to the financial resources necessary for the PSERI to be equal to the unit. Thus, it can assume positive or negative values. When the first case occurs, a situation is configured in which the region spends less on public security in proportion to its wealth (GDP), while in the second case the opposite would occur.

To carry out its calculation, the amount of public security expenses necessary for the region to have an expense exactly proportional to its GDP in relation to Brazil was derived. That said, equation [7] was rewritten as follows:

$$\frac{\dfrac{\widehat{PSE}_{it}}{PSE_{BR_t}}}{\dfrac{GDP_{it}}{GDP_{BR_t}}} = 1 \quad [8]$$

Where assume PSERI equal to 1 (one) and to determine $\widehat{PSE}_{it}$. With the calculation of $\widehat{PSE}_{it}$ is possible to measure the GAP_{PSE} for each region, the difference between $\widehat{PSE}_{it}$ and PSE_{it} being the same, that is:

$$GAP_{PSE} = \widehat{PSE}_{it} - PSE_{it} \qquad [9]$$

Then, the variable was transformed into a binary variable, where:

$$GAP_{PSE_{it}} \begin{cases} =1, \; GAP_{PSE_{it}} > 0. \text{ Spending was rationed.} \\ =0, \; GAP_{PSE_{it}} \leq 0. \text{ There was no rationing of expenses.} \end{cases} \qquad [10]$$

3.2. Model and method

One of the main difficulties inherent in the investigation of criminality in Brazil rests on the issue of recording (notification) of crimes, since there is a high rate of underreporting in official data (Fajnzylber and Araujo Jr., 2001; Santos and Kassouf, 2008; Sachsida *et al.*, 2010). As a consequence, this problem raises errors in measuring crime rates, which can intensify the appearance of biased results. Therefore, the model used in this study is a data panel composed of the Brazilian states observed from 2005 to 2014. This model proves to be more adequate as it allows not only to control the unobservable heterogeneity between states, but also partially solves the problem of measurement error caused by high rates of underreporting, considering the understanding that this rate is stable over time.

Based on the hypothesis that heterogeneity cannot be observed for all states, and that it is correlated with the variables used in the empirical model, a dynamic panel estimated by GMM-SYS is proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Even controlling for criminal behavior by socioeconomic and demographic characteristics, each state has regional/cultural idiosyncrasies that are relatively stable over time.

In addition to this feature, our method effectively addresses endogeneity concerns, as the proposed proxy does not introduce exogenous variation. Furthermore, it allows for the inclusion of the lagged dependent variable as an explanatory factor, enabling us to control for criminal dynamics and draw meaningful inferences regarding criminal persistence.

The logarithmic transformation was also applied to the data, except for the GAP_{GSP} proxy. This technique allows correction, in case the data present asymmetry and/or outliers. Furthermore, estimations were performed by GMM-SYS in two stages. According to Windmeijer (2005), for finite samples the estimation in two stages is more efficient than the estimation in one stage. Finally, fixed effects of time and correction for heteroscedasticity were used.

Thus, the empirical model used to verify the influence of public security spending rationing (GAP_{PSE}) on crime was as follows:

$$Crime_{it} = aCrime_{i,t-1} + GAP_{PSE_{it}}\theta + \mathbf{X}'_{it}\beta + \varepsilon_{it}, \quad [11]$$
$$\text{with } |\alpha| < 1,\ i = 1,\ldots,\ \text{Net} = 1,\ldots,T$$

Where $Crime_{it}$ is the crime rate per 100,000 inhabitants of state i, in year t. Being estimated for the crimes of homicide, robbery and vehicle theft. α e θ are scalars; $Crime_{i,t-1}$ is the lagged crime rate over a period of time. It was treated as potentially endogenous (Santos, 2009; Teixeira, 2011). Some studies (Sachsida *et al.*, 2010; Teixeira, 2011; Becker and Kassouf, 2017) have shown that lagged crime rates have a positive impact on current criminality, evidencing the existence of criminal hysteresis highlighted by Fajnzylber, Lederman, and Loayza (2002); $GAP_{PSE_{it}}$ is the gap of public security expenditures in state i, in year t. It assumes value 1 (one) if it is positive and 0 (zero) otherwise. It was treated as potentially endogenous. $\mathbf{X}'_{it}$ is a vector of control variables of dimension $1\times k$. Represented by *GDPpc*, *Young_1529*, *Educ_25* and *Gini* (See Table 1). β is the vector of dimension coefficients $k\times 1$, and ε_{it} is the model error term. Being:

$$\varepsilon_{it} = \omega_i + \varphi_{it} \quad [12]$$

Where $\omega_i \sim \text{IID}(0, \sigma^2_{\omega})$ and $\varphi_{it} \sim \text{IID}(0, \sigma^2_{\varphi})$. The ω_i component is the individual (state-specific) and time-invariant fixed effects. While φ_{it} represents the state-specific and time-varying shocks, being heteroscedastic and time-correlated across states, but not across states. Assuming then that:

$$\mathrm{E}(\omega_i) = \mathrm{E}(\varphi_{it}) = \mathrm{E}(\omega_i, \varphi_{it}) = 0 \quad [13]$$

$\mathrm{E}(\varphi_{it}, \varphi_{js}) = 0$ for each i, j, t, s with $i \neq j$.

3.3. Source and treatment of data

The data that were used in the preparation of this study were collected on the websites of Institute of Applied Economic Research (Ipea, *Instituto de Pesquisa Econômica Aplicada*), Ministry of Justice (*Ministério da Justiça*), through the National System of Public Security Statistics (Sinesp, *Sistema Nacional de Estatísticas de Segurança Pública*), Brazilian Institute of Geography and Statistics (IBGE, *Instituto Brasileiro de Geografia e Estatística*) and the Brazilian Public Security Forum (FBSP, *Fórum Brasileiro de Segurança Pública*). These are annual data for the 26 states plus the Federal District, which are specified in Table 1. The analysis period comprises the years between 2005 and 2014. The choice of this period is due to the availability of data for all the variables used.

Table 1. Description of variables

Variable	Description	Expected signal	Source
Homicide	Homicide rate per 100,000 inhabitants	NA	Ipeadata
Robbery	Robbery rate per 100,000 inhabitants	NA	Sinesp and FBSP
Vehicle theft	Vehicle theft rate per 100,000 inhabitants	NA	Sinesp and FBSP
GAP_{PSE}	Gap in public security spending	+ 0 –	IBGE an FBSP
GDP_{pc}	Real per capita state GDP. Deflated by the General Price Index – Internal availability for 2014.	+ 0 –	IBGE
Young_1529	Youth Rate. Ratio of population aged 15-29 to population over 29, times 100.	+	DATASUS
Educ_25	Mean years of study of men aged 25 years or older. Ratio between the sum of the number of years of schooling completed by men who are 25 years of age or older and the number of men in this age group.	–	Ipeadata
Gini	Gini coefficient. It measures the degree of inequality in the distribution of per capita household income among individuals.	+	Ipeadata

Note: NA - Not applicable.

Source: Author's elaboration.

Where GAP_{PSE} is the proxy that measures public security spending rationing in each region. An ambiguous effect can be expected depending on the crime. If, on the one hand, greater rationing of spending on public security is expected to increase crimes against property, a reduction in crimes against people can also be expected, given that low investment in public security implies fewer police officers on the streets, which to a certain extent reduces the occurrence of armed confrontations and consequently the homicide rate. GDP_{pc} reflects the level of economic activity of the states. An ambiguous effect can be expected. If, on the one hand, it is expected to find in regions with higher levels of economic activity lower crime rates, since it raises the opportunity cost of crime, an increase in crime can also be expected, given that the expected benefit of criminal activity increases. *Young_1529* is the youth rate. A positive effect on crime is expected. Regions with many young people imply an increase in crimes against people, since young people are more willing to be aggressive than the elderly. In addition, young people are also involved in most crimes against property, in particular vehicle theft. *Educ_25* is the average education of men who are 25 years of age or older. Education is essential for achieving better opportunities in the legal labor market. Thus, a higher educational level results in a higher salary gain in the legal market and, consequently, increases the opportunity cost of crime. Therefore, the increase in human capital implies a reduction in crime. *Gini* is the income inequality. Greater inequality in income distribution implies a society composed of many individuals with low returns to the legal labor market (which implies low opportunity cost of crime), and few individuals with high income, making them potential victims of those. Therefore, income inequality positively affects crime.

4. RESULTS AND DISCUSSION

4.1 Descriptive analysis

Between 2005 and 2014, Brazilian crime increased in the categories of crimes: homicide (+33%), robbery (+22%) and vehicle theft (+16%). Other variables that showed the same behavior in the period: GDP per capita (+146%), the GAP in spending on public security (+31%), the average education of men (+22%). Contrasting with this behavior is

Table 2. Information on model variables, 2005 and 2014

Variable	Average		Standard deviation		Minimum		Maximum	
	2005	2014	2005	2014	2005	2014	2005	2014
Homicide	25.71	34.24	10.44	11.3	10.89	13.36	49.65	62.77
Robbery	1.01	1.24	0.91	0.52	0	0.3	4.7	2.56
Vehicle theft	69.03	80.19	79.36	83.53	0	0	312	292
GAP_{PSE}	0.22	0.29	0.42	0.46	0	0	1	1
GDPpc	9,795	24,185	6,266	12,788	3,701	11,216	34,514	69,216
Young_1529	71.96	57.12	12.71	10.43	49.84	41.47	94.53	77.81
Educ_25	6.08	7.43	1.11	1.07	4.22	5.65	8.96	10.08
Gini	0.54	0.49	0.03	0.03	0.46	0.42	0.60	0.58

Source: Author elaboration.

the youth rate and income inequality, with reductions of 20.62% and 9.25%, respectively (Table 2).

With regard to crime, it can be seen that the average growth witnessed in the homicide rate exceeded the vehicle theft and robbery rates by 105.19% and 45.7%, respectively. For a better understanding of this complex phenomenon, an interstate analysis was carried out, which can be viewed from Figures 1, 2 and 3.

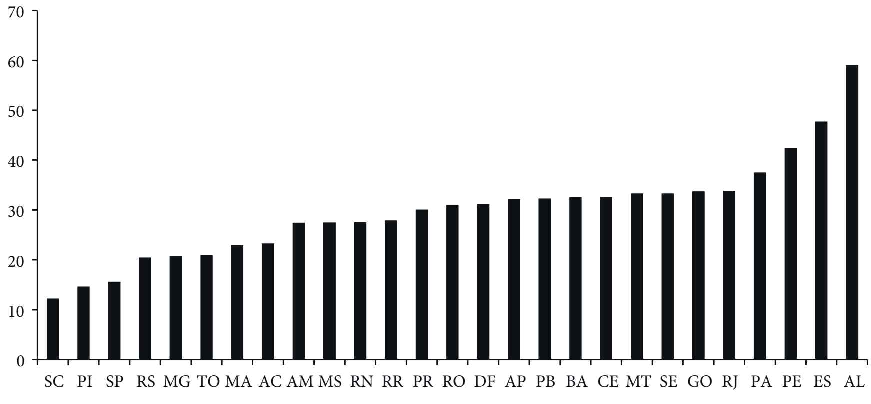
In possession of Figure 1, there was an intense heterogeneity between the Federative Units (FUs). It is observed that, while Alagoas had the highest average rate in the period under analysis, which was 59.07 homicides per 100,000 inhabitants, the state of Santa Catarina recorded the lowest, 12.24, which is equivalent to a difference of approximately 400%. Other FUs that had the highest averages were Espírito Santo (47.73), Pernambuco (42.47) and Pará (37.50).

The same heterogeneous behavior between the FUs is seen for robbery and vehicle theft rates. In Figure 2, it was up to Pará to stand out negatively with the highest average rate in the period, 2.3 robberies per 100,000 inhabitants; while the last place was awarded to Piauí, which recorded a rate of 0.36. The average rate presented by the former was more than 6 times higher than that witnessed by the latter. In time, it is important to point out that Pará was closely followed by the Federal District, which presented an average rate of 2.2. A possible explanation for this relatively high rate lies in its economic prosperity, since larceny is a property crime (patrimony).

With regard to the crime of vehicle theft, it can be seen in Figure 3 that the Federal District took the lead with a rate of 283.01 per 100,000 inhabitants, followed by São Paulo (225.07) and Rio Grande do Sul (168.45). At the other extreme, the state of Paraíba was observed with a rate of 9.11. The difference between this rate and that presented by the Federal District was 3006.59%. In view of what was observed, it can be inferred that this type of crime is not prevalent in regions considered to be poorer, since of the 13 FUs that had the lowest rates, there are 9 states in the Northeast and 3 in the North.

Given the above, it can be deduced that for the Government to be successful in mitigating the severe crime that has fallen on society, public policies to combat and mainly prevention must be outlined and focused based on the idiosyncrasies of each region/state, because this phenomenon behaves in a disparate way over the national territory.

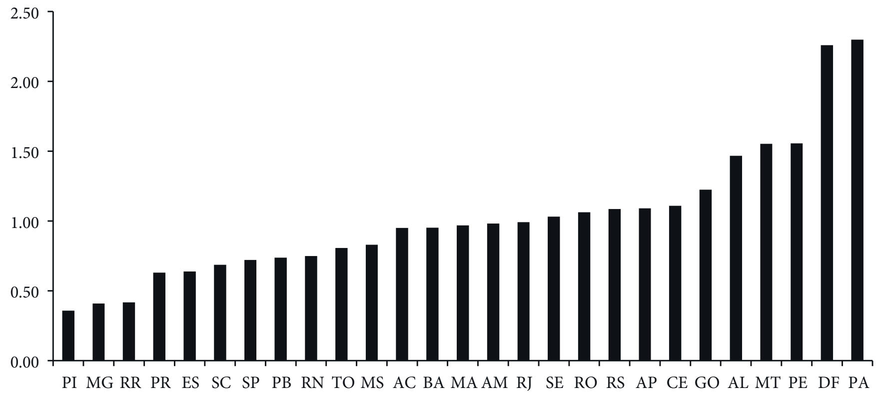
Figure 1. Average homicide rate per 100,000 inhabitants by state[8], 2005-2014



Source: Author's elaboration.

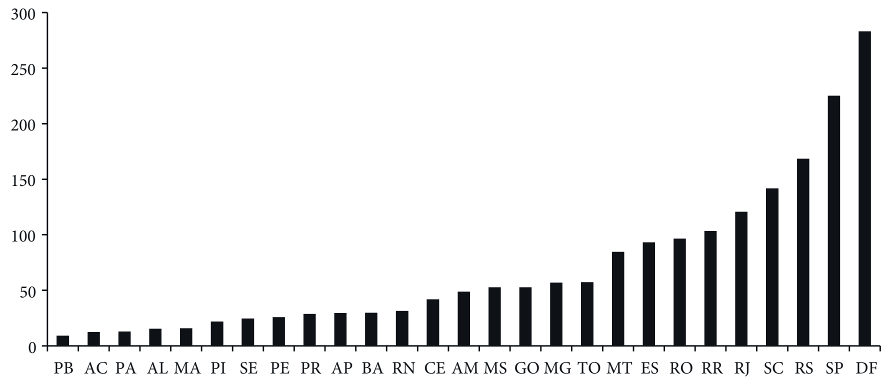
[8] To know the complete name of the Brazilian states, see appendix.

Figure 2. Average robbery rate per 100,000 inhabitants by state, 2005-2014



Source: Author's elaboration.

Figure 3. Average vehicle theft rate per 100,000 inhabitants by state, 2005-2014



Source: Author's elaboration.

Taking the state of Espírito Santo as an example, it can be inferred that the public security policies implemented in this period showed better results in combating crimes against property, since the state featured prominently in homicides. It demonstrates that different criminal practices must also be considered in addition to regional characteristics.

4.2. Econometric analysis: Evidence from the GAP_{PSE} proxy

As explained, in this study, the GMM-SYS estimator was used, and its application was ratified based on specification tests[9]. The validity (robustness) and exogeneity of the instruments were confirmed based on the Hansen and Hansen-Difference tests, respectively. While the first and second-order serial correlation tests, AR(1) and AR(2), respectively, found no second-order serial autocorrelation, attesting that the moment conditions were correctly specified (Table 3).

In addition, the robustness of the results related to the GAP_{PSE} proxy was also evaluated using sensitivity tests. By adding other controls as well as including the variable of interest lagged by one, two and three years, it was observed that there was no significant change, loss of significance and change in the sign of the estimated parameters (Appendix). Therefore, all the tests carried out confirm the robustness and efficiency of the model used, allowing to infer that the proxy is a viable alternative to circumvent the divergence in empirical analyses between spending on public security and crime.

Table 3 shows the results of the effect of the GAP variable on public security expenditures (GAP_{PSE}) on the crimes of homicide, robbery and vehicle theft. Beforehand, it can be seen that the estimated coefficients for the variable of interest (GAP_{PSE}) showed the expected sign and statistical significance. When considering crimes against property (patrimony), the results indicate that the occurrence of a rationing in public security expenses increases, on average, the robbery[10] and vehicle theft rates by 37% and 45%, respectively. This result finds support in the economic literature of crime, given the understanding that spending on public safety implies a greater police force in action, in addition to an information and intelligence system attuned to events and to the processing of information to anticipate the possible behavior of criminals. Therefore, the occurrence

---

[9] The null hypothesis of the Hansen test is that the instruments are valid (the overidentifying restrictions are valid), that of the Hansen-Difference test is that the instruments are exogeneous, and that of the AR(2) that there is no second-order serial autocorrelation.

[10] Robbery is a type of violent crime, which concatenates crimes against property and the person, however, its ultimate objective is theft, with murder being the means for its implementation.

of rationing is indirectly manifested in a lower probability of apprehension, and consequently reflects in greater stimuli to delinquent conduct.

Table 3. Results of estimations by GMM-SYS

Variable	Homicide	Robbery	Vehicle theft
Homicide$_{t-1}$	0.41**		
	(0.18344)		
Robbery$_{t-1}$		0.61***	
		(0.20671)	
Vehicle theft$_{t-1}$			0.59***
			(0.09626)
GAP_{PSE}	–0.14*	0.37*	0.45***
	(0.07585)	(0.21297)	(0.09696)
GDPpc	0.20^{NS}	0.60^{NS}	0.63*
	(0.30213)	(0.45668)	(0.36056)
Young_1529	0.01^{NS}	0.79*	0.98***
	(0.26251)	(0.40122)	(0.34801)
Educ_25	-0.63^{NS}	–2.24**	-0.49^{NS}
	(0.92504)	(1.05129)	(1.06804)
Gini	1.49**	0.95^{NS}	–2.66***
	(0.68165)	(0.92693)	(0.91908)
Specification tests (p-value)			
AR(1)	0.131	0.021	0.024
AR(2)	0.857	0.163	0.537
Hansen	0.211	0.594	0.466
Hansen-Diff	0.486	0.970	0.918
Instruments	30	28	30
Lags	2 a 3	2 a 4	4 a 5
Observation	270	270	270

Note: ***, ** and * denote statistically significant parameters at the 1%, 5% and 10% level, respectively. The NS implies no statistical significance. All variables are in logarithm, except for GAP_{PSE}. Robust standard error clustered in parentheses. All regressions include time dummies, and were estimated by GMM-SYS Two-Step.
Source: Author's elaboration based on the research results.

In this sense, Evans and Owens (2007) found that the regions that received subsidies from the Community Oriented Policing Services program for hiring new police officers showed reductions in the crimes of vehicle theft, theft, robbery and aggravated assault in the following years. Evidence that the increase in the size of police forces works as a deterrent mechanism on criminality was also found by Levitt (1997). When analyzing criminality in Argentina, Balbo and Posadas (1998) found statistical evidence that criminals, when committing the crime, consider the probability of being arrested and the seriousness of the crimes —which directly refers to the severity of the punishments. These studies ratify the result found here.

With regard to crime against the person, it was observed that the occurrence of a rationing of public security expenses reduces the homicide rate by 14%, on average. A possible explanation for the presence of this negative relationship is the fact that the smaller the number of police officers operating on the streets (the lower the expenditure on public security[11]), the lower the probability of an armed confrontation with criminals, and consequently the lower the number of registered homicides. Empirical evidence in this regard was verified by Trudeau (2022)[12]. It also allows us to infer that the public security authorities are a step behind in the fight against homicide, and their actions are only overloading the occurrences and not preventing them.

Balbo and Posadas (1998) state that the more efficient the police are (greater spending on public security), the greater the number of registered crimes. This understanding is corroborated by Duce, Chavarria, and Torrubia (2000). In the same sense, when estimating the effect of per capita spending on public security on homicides, Teixeira (2011) found a positive relationship between the variables.

Given the above, it appears that the GAP_{PSE} proxy is a good measure to circumvent the controversy established in empirical studies between spending on public security and criminal rates. Furthermore, with the

---

[11] Spending on policing represented, on average, 32% of spending on public security.

[12] When estimating the causal effect of the prohibition of the police operation in Rio de Janeiro on homicides committed by police and violence related to shootings using discontinuous regression and difference-in-difference models, a reduction of 66% of deaths caused by police forces was found as a strong decrease in the occurrence of homicides.

understanding that greater public security expenditures imply greater chances of apprehension, this proxy is also supported by several studies (Durlauf and Nagin, 2011; Nagin, 2013b; 2017) regarding the theory of deterrence, which expose that the certainty of apprehension is more effective than the severity of the punishment as a factor of discouraging the criminal practice.

With regard to the strategies[13] implemented by the police, Weisburd and Eck (2004) state that policing in "hot spots" (monitoring with geographic focus) and problem-oriented policing are the most effective in reducing crime. The latter involves community participation in identifying criminal sources. Therefore, given this evidence, it is up to the National Secretariat for Public Security to implement policies that reinforce the certainty of the apprehension, since the tangible threat of punishment discourages the criminal act. Thus, such policies should be aimed at expanding the number of police officers, improving anti-crime strategies, as well as improving the investigation system, for example.

As for the vector of control variables, light was shed only on those that were statistically significant. Thus, it was observed that an increase in GDP per capita positively impacts the crime of vehicle theft. As noted, the *GDPpc* can have an ambiguous effect on crime. Thus, it was found that the expected benefit of criminal activity surpassed the opportunity cost of crime in response to an increase in *GDPpc*.

With regard to the rate of young people (*Young_1529*), a direct relationship with the rates of robbery and vehicle theft was verified. Regarding crimes that result in death, several studies and surveys (Cerqueira and Moura, 2014; Waiselfisz, 2013; 2014; 2015; 2016) show that most victims and perpetrators are young people. With regard to the increase in vehicle theft, this is due to the fact that it is a crime whose peculiarity attracts young people. This crime is sometimes referred to as an "ostentation crime". According to Hirschi and Gottfredson (1983) and Kennedy and Forde (1990), youth reflects the subpopulation with greater willingness to criminality.

13 For an in-depth look at how police action can affect criminal opportunities, see Nagin, Solow, and Lum (2015).

For the variable *Educ_25*[14], there was significance in the explanation of the crime of robbery, where it was observed that an increase in the average education of men from 25 years of age discourages its practice. This result rests on the understanding that the higher the educational level, the greater the chances of getting a well-paid job, which increases the opportunity cost of crime, and this finding is corroborated by Kume (2004). In the same direction, using as a variable the average education of men between 15 and 30 years old, Santos (2009) found a negative impact on the rates of violent lethal and intentional crimes in the Brazilian states.

It was also identified that the worsening of the unequal distribution of income measured by the Gini coefficient (*Gini*) increases the crime of homicide and reduces the theft of vehicles. This direct relationship with homicide was also verified by Sachsida *et al.* (2010) and Becker and Kassouf (2017). As a possible explanation for the negative effect on the crime of vehicle theft, it can be inferred from an adaptation of the theoretical model by Cantor and Land (1985). In this case, replacing the unemployment rate with income inequality, and having as a corollary a greater net result on the part of the opportunity effect, since there will be fewer potential targets.

Finally, it is emphasized that the statistical evidence regarding the lagged dependent variable allows inferring that there is a transfer of crime from one period to another. This result demonstrates that criminal activity specializes like any other activity in the formal sector, which allows it to reduce operating costs. This inertial effect was also witnessed in the work of Kume (2004), Santos (2009), Sachsida *et al.* (2010), Teixeira (2011), Neanidis and Papadopoulou (2013), Becker and Kassouf (2017).

5. FINAL CONSIDERATIONS

In an attempt to resolve the established controversy regarding the effect of spending on public security on crime, the present study developed a proxy that measures the rationing of public security spending in each region, called GAP_{PSE}. In addition, it computed its effect on some cate-

[14] Treated as exogenous within the model, as in Santos (2009).

gories of crimes through a dynamic panel estimated by GMM-SYS, which proved to be a good measure.

Our results showed that crimes against property, larceny and vehicle theft, are directly related to the GAP_{PSE}, while crimes against the person, homicide, are inversely related. In other words, it was verified that homicide directly responds to higher expenses with public security. This leads to the conclusion that the strategy adopted by the security department is being ineffective in terms of prevention, only allowing for the occurrence of greater confrontations between the security forces and criminals. Given these results, the hypothesis was verified.

Therefore, in view of the above, the GAP_{PSE} proxy can be ratified as a good alternative to the measures already used in studies carried out in Brazil, whose objective was to verify the deterrent effects on criminal behavior. Thus, it is believed that its conception represents an important contribution to the economic literature of crime and the theory of deterrence.

The study's main limitation is the data availability, mainly on crimes against property and essential variables in explaining criminality, such as education. Furthermore, a suggestion for further research is to find a source of exogenous variation (instrumental variable) that allows correcting the existing endogeneity problem between crime and public security spending. ◄

REFERENCES

Apel, R. (2013). Sanctions, perceptions, and crime: Implications for criminal deterrence. *Journal of quantitative criminology*, 29(1), pp. 67-101.

Arellano, M., and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), pp. 29-51.

Balbo, M., and Posadas, J. (1998). *Una primera aproximación al crimen en la Argentina*.. [Documentos de Trabajo no. 10]. Univerdidade Nacional de la Plata, Buenos Aires, Argentina.

Becker, G.S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, 76(2), pp. 169-217.

Becker, K.L., and Kassouf, A.L. (2017). Uma análise do efeito dos gastos públicos em educação sobre a criminalidade no Brasil. *Economia e Sociedade*, 26(1), pp. 215-242.

Blundell, R., and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), pp. 115-143.

Brazil (2018). *Constituição da República Federativa do Brasil*. Promulgated on 5 October, 1988. 55ª Edition. São Paulo: Saraiva.

Cantor, D., and Land, K.C. (1985). Unemployment and crime rates in the post-World War II United States: A theoretical and empirical analysis. *American Sociological Review*, 50(3), pp. 317-332.

Cerqueira, D., and Moura, R. (2014). Custo da juventude perdida no Brasil. In: C.H. Corseuil and R.U. Botelho (eds.), *Desafios à trajetória profissional dos jovens brasileiros*. Brasília: Ipea.

Cerqueira, D., and Moura, R. (2015). O efeito das oportunidades no mercado de trabalho sobre as taxas de homicídios no Brasil. *Encontro Nacional de Economia*, 43.

Cerqueira, D., Bueno, S., Alves, P., Lima, R., Silva, E., Ferreira, H., Pimentel, A., Barros, B., Marques, D., Pacheco, D., Lins, G., Lino, I., Sobral, I., Figueiredo, I., Martins, J., Armstrong, K., Figueiredo, T. (2020). *Atlas da Violência 2020*. Brasília: Ipea/FBSP.

Chioda, L., De Mello, J.M., and Soares, R.R. (2016). Spillovers from conditional cash transfer programs: Bolsa Família and crime in urban Brazil. *Economics of Education Review*, 54, pp. 306-320.

Duce, A.D.T., Chavarria, P.L., and Torrubia, M.J.M. (2000). Análisis microeconómico de los datos criminales: Factores determinantes de la probabilidad de denunciar un delito. [online] Available at: <http://www.revecap.com/iiieea/autores/D/120.pdf>.

Durlauf, S.N., and Nagin, D.S. (2011). Imprisonment and crime: Can both be reduced?. *Criminology & Public Policy*, 10(1), pp. 13-54.

Evans, W.N., and Owens, E.G. (2007). COPS and Crime. *Journal of public Economics*, 91(1-2), pp. 181-201.

Fajnzylber, P., and Araujo Jr, A. (2001). Violência e criminalidade. In: M.B. Lisboa and N.A. Menezes Filho (eds.), *Microeconomia e sociedade no Brasil*. Rio de Janeiro: Contra Capa Livraria.

Fajnzylber, P., Lederman, D., and Loayza, N. (2002). What causes violent crime? *European Economic Review*, 46(7), pp. 1323-1357.

Fórum Brasileiro de Segurança Pública (2019). *Anuário Brasileiro de Segurança Pública*. Fórum Brasileiro de Segurança Pública, Brazil.

Gomes, C. (2019). *Criminalidade e despesas públicas no Brasil. Estimativa do impacto dos gastos públicos em segurança sobre as taxas de homicídio* (Do-

cumento de Trabalho do BID no. IDB-WP-909). Banco Interamericano de Desenvolvimento, Brazil.
Hirschi, T., and Gottfredson, M. (1983). Age and the explanation of crime. *American Journal of Sociology*, 89(3), pp. 552-584.
IBGE (2020). [online] Available at: <https://www.ibge.gov.br/>.
Ipeadata (2020). [online] Available at: <www.ipeadata.gov.br>.
Kennedy, L.W., and Forde, D.R. (1990). Routine activities and crime: An analysis of victimization in Canada. *Criminology*, 28(1), pp. 137-152.
Kleck, G., Sever, B., Li, S., and Gertz, M. (2005). The missing link in general deterrence research. *Criminology*, 43(3), pp. 623-660.
Kleck, G., and Barnes, J. C. (2014). Do more police lead to more crime deterrence?. *Crime & Delinquency*, 60(5), pp. 716-738.
Kume, L. (2004). Uma estimativa dos determinantes da taxa de criminalidade brasileira: uma aplicação em painel dinâmico. *Encontro Nacional de Economia*, 32, pp. 1-16.
Levitt, S.D. (1997). Using electoral cycles in police hiring to estimate the effect of police on crime. *American Economic Review,* 87(3), pp. 270-290.
Lochner, L. (2007). Individual perceptions of the criminal justice system. *American Economic Review*, 97(1), pp. 444-460.
Loureiro, A.O.F., and Carvalho Jr., J.R.A. (2007). O impacto dos gastos públicos sobre a criminalidade brasileira. *Encontro Nacional de Economia*, 35.
Marques Junior, K. (2014). A renda, desigualdade e criminalidade no Brasil: uma análise empírica. *Revista Econômica do Nordeste*, 45(1), pp. 34-46.
Nagin, D.S. (2013a). Deterrence: A review of the evidence by a criminologist for economists. *Annual Review of Economics*, 5(1), pp. 83-105.
Nagin, D.S. (2013b). Deterrence in the 21st Century: A review of the evidence. *Crime and Justice: An Annual Review of Research*, 42, pp. 199-263.
Nagin, D.S. (2017). Deterrence. In: E. Luna (ed.), *Reforming Criminal Justice*: *Punishment, Incarceration, and Release*. Vol. 4. Phoenix: Arizona State University.
Nagin, D.S., Solow, R.M., and Lum, C. (2015). Deterrence, criminal opportunities, and police. *Criminology*, 53(1), pp. 74-100.
Neanidis, K.C., and Papadopoulou, V. (2013). Crime, fertility, and economic growth: Theory and evidence. *Journal of Economic Behavior & Organization*, 91, pp. 101-121.
Sachsida, A., de Mendonça, M.J.C., Loureiro, P. R., and Gutierrez, M.B.S. (2010). Inequality and criminality revisited: Further evidence from Brazil. *Empirical Economics*, 39(1), pp. 93-109.

Santos, M.J. (2009). Dinâmica temporal da criminalidade: mais evidências sobre o "efeito inércia" nas taxas de crimes letais nos estados brasileiros. *EconomiA*, 10(1), pp. 169-194.

Santos, M.J, and Kassouf, A.L. (2007). Uma investigação econômica da influência do mercado de drogas ilícitas sobre a criminalidade brasileira. *EconomiA*, 8*(*2), pp. 187-210.

Santos, M.J., and Kassouf, A.L. (2008). Estudos econômicos das causas da criminalidade no Brasil: evidências e controvérsias. *EconomiA*, 9(2), pp. 343-372.

Sinesp (2020). [online] Available at: <https://www.justica.gov.br/sua-seguranca/seguranca-publica/sinesp-1/bi/dados-seguranca-publica>.

Spaniol, M.I., and Rodrigues, C.R.G. (2018). Políticas públicas de prevenção à violência no Brasil: Análise dos desafios e des(continuidades) de sua implantação nas esferas federal, estadual e municipal no campo da segurança pública. *Encontro Anual da ANPOCS*, 42.

Teixeira, E.C. (2011). *Dois ensaios acerca da relação entre criminalidade e educação*. Thesis Doctoral. Universidade de São Paulo, Brazil.

Thomé, D.B., and Vonbun, C. (2017). *Análise do impacto dos gastos públicos com programas de transferência de renda sobre a criminalidade* (Texto para Discussão no. 2315). Rio de Janeiro: Instituto de Pesquisa Econômica Aplicada.

Trudeau, J. (2022). Limiting aggressive policing can reduce police and civilian violence. *World Development*, 160, 105961. https://doi.org/10.1016/j.worlddev.2022.105961

UN (2019). *Estudo global sobre homicídios 2019*. [online] Available at: <https://www.unodc.org/unodc/en/data-and-analysis/global-study-on-homicide.html>.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, 126(1), pp. 25-51.

Waiselfisz, J.J. (2013). Mapa da violência 2013: homicídios e juventude no Brasil. Brasilia: Faculdade Latino-Americana de Ciências Sociais (FLACSO).

Waiselfisz, J.J. (2014). *Mapa da Violência 2014: Os Jovens do Brasil.* Brasília: Faculdade Latino-Americana de Ciências Sociais (FLACSO).

Waiselfisz, J.J. (2015). *Mapa da Violência 2015: Adolescentes de 16 e 17 anos do Brasil*. Rio de Janeiro: Falcudade Latino-Americana de Ciências Sociais (FLACSO).

Waiselfisz, J.J. (2016). *Mapa da Violência 2016: Mortes Matadas por Arma de Fogo*. Brasília: United Nations Educational, Scientific and Cultural Organization (Unesco).

Weisburd, D., and Eck, J.E. (2004). What can police do to reduce crime, disorder, and fear? *The Annals of the American Academy of Political and Social Science*, 593(1), pp. 42-65.

APPENDIX

Table A1. Checking robustness: Homicide, robbery and vehicle theft

Variable	Homicide			Robbery			Vehicle Theft		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
GAP_{PSE}	–0.10** (0.04994)	–0.11** (0.2026)	–0.13* (0.0769)	0.48** (0.2284)	0.37* (0.2135)	0.51*** (0.1782)	0.49** (0.2427)	0.39* (0.2681)	0.42** (0.1805)
GDPpc	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Young_1529	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Educ_25	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gini	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Attend_1517	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BF		Yes	Yes		Yes	Yes		Yes	Yes
$Income_{pc}$			Yes			Yes			Yes
Specification tests									
AR(1)	0.096	0.086	0.006	0.103	0.096	0.087	0.021	0.041	0.028
AR(2)	0.861	0.824	0.704	0.892	0.970	0.954	0.600	0.583	0.635
Hansen	0.966	0.979	0.735	0.184	0.281	0.658	0.372	0.393	0.597
Hansen-Diff	0.713	0.873	0.947	0.707	0.883	0.998	0.927	0.912	0.996
Instruments	44	46	34	28	30	35	32	33	35
Lags	2 a 3	2 a 3	2 a 3	5 a 6	5 a 6	5 a 6	4 a 5	4 a 5	4 a 5
Observation	270	270	270	270	270	270	270	270	270

Note: ***, ** and * denote statistically significant parameters at the 1%, 5% and 10% level, respectively. The NS implies no statistical significance. All variables are in logarithm, except GAP_{PSE}. Robust standard error clustered in parentheses. All regressions include time dummies. All estimations are by GMM-SYS Two-Step. In column (1) the equation was added with the variable *Attend_1517*, which represents the school attendance of people aged 15 to 17 years. In (2) the *BF* variable was added, which represents the volume of funds allocated to the Bolsa Família Program. In (3) the $Income_{pc}$ variable was added, which represents the per capita household income. These are variables found in several empirical studies on crime (Marques Junior, 2014; Cerqueira and Moura, 2015; Chioda, De Mello, and Soares, 2016; Thomé and Vonbun, 2017).
Source: Author's elaboration based on the research results.

Table A2. Checking robustness: GAP lagged in one, two and three years

Variable	Homicide	Robbery	Vehicle theft
GAP_{PSEt-1}	−0.21*	0.28*	0.22**
	(0.11124)	(0.16763)	(0.08218)
Specification tests			
AR(1)	0.043	0.044	0.040
AR(2)	0.944	0.276	0.406
Hansen	0.598	0.953	0.831
Hansen-Diff	0.878	0.589	0.641
Instruments	30	32	24
lags	2 a 3	4 a 5	2 a 3
GAP_{PSEt-2}	−0.04**	0.72*	0.47**
	(0.01969)	(0.41825)	(0.18554)
Specification tests			
AR(1)	0.020	0.063	0.022
AR(2)	0.955	0.543	0.371
Hansen	0.865	0.923	0.971
Hansen-Diff	0.968	0.476	0.957
Instruments	26	33	22
lags	2 a 3	4 a 5	2 a 3
GAP_{PSEt-3}	−0.11***	0.48*	0.21**
	(0.04017)	(0.26841)	(0.07845)
Specification tests			
AR(1)	0.046	0.215	0.035
AR(2)	0.908	0.657	0.818
Hansen	0.998	0.563	0.323
Hansen-Diff	0.874	0.864	0.190
Instruments	34	32	19
lags	3	4 a 5	4

Note: ***, ** and * denote statistically significant parameters at the 1%, 5% and 10% level, respectively. The vector of control variables was included in all regressions. All variables are in logarithm, except GAP_{PSE}. Robust standard error clustered in parentheses. All regressions include time dummies, and were estimated by GMM-SYS Two-Step.
Source: Author's elaboration based on the research results.

Table A3. Brazilian states

1 – (AC) Acre
2 – (AL) Alagoas
3 – (AP) Amapá
4 – (AM) Amazonas
5 – (BA) Bahia
6 – (CE) Ceará
7 – (DF) Distrito Federal
8 – (ES) Espírito Santo
9 – (GO) Goiás
10 – (MA) Maranhão
11 – (MT) Mato Grosso
12 – (MS) Mato Grosso do Sul
13 – (MG) Minas Gerais
14 – (PA) Pará
15 – (PB) Paraíba
16 – (PR) Paraná
17 – (PE) Pernambuco
18 – (PI) Piauí
19 – (RJ) Rio de Janeiro
20 – (RN) Rio Grande do Norte
21 – (RS) Rio Grande do Sul
22 – (RO) Rondônia
23 – (RR) Roraima
24 – (SC) Santa Catarina
25 – (SP) São Paulo
26 – (SE) Sergipe
27 – (TO) Tocantins