Public budget and crime: an analysis based on the examination of indicators of lethal and non-lethal crimes in the state of Ceará

Presupuesto público y criminalidad: análisis a partir del examen de indicadores de delitos letales y no letales en el estado de Ceará

Orçamento público e criminalidade: análise a partir do exame de indicadores de crimes letais e não letais no estado do Ceará

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Abstract

Objective: This article aims to analyze a possible relationship between budget execution and crime levels in the State of Ceará between 2012 and 2021.

Methodology: Use of linear regression using dependent variables (budgetary expenditures with the public security function) and independent variables (public revenue, intentional lethal violent crimes, seizure of weapons, violent property crimes, thefts, and sexual crimes).

Results: After evaluating the proposed variables, the results showed the influence of 2 (two) of the 6 (six) independent variables analyzed: revenue at 1% and theft at 10%. The other indicators related to intentional lethal violent crimes, gun seizures, violent property crimes, and sex crimes did not show consistent results.

Contributions of the Study: Expands the level of knowledge about possible relationships between budget expenditures and crime (its various typologies), in order to better understand whether effectively only spending on public security can influence the level of crime in a state of the federation.

Keywords: Public budget. Budget Execution. Crime. Linear Regression. Ceara.

Resumen

Objetivo: Este artículo tiene como objetivo analizar una posible existencia de relación entre la ejecución presupuestaria y los niveles de criminalidad en el Estado de Ceará entre 2012 y 2021.

Metodología: Uso de regresión lineal con el uso de variable dependiente (gastos presupuestarios con la función de seguridad pública) y variables independientes (ingresos públicos, delitos violentos letales intencionales, incautación de armas, delitos violentos, robos y delitos sexuales).

Resultados: Evaluadas las variables propuestas, los resultados indicaron la influencia de 2 (dos) de las 6 (seis) variables independientes analizadas: ingresos al 1% y robos al 10%. Los

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otros indicadores relacionados con los delitos violentos letales intencionales, la incautación de armas, los delitos violentos contra la propiedad y los delitos sexuales no presentaron resultados consistentes.

Contribuciones del Estudio: Aumenta el nivel de conocimiento sobre las posibles relaciones entre los gastos presupuestarios y la delincuencia (sus diversas tipologías), a fin de comprender mejor si efectivamente sólo los gastos de seguridad pública son capaces de influir en el nivel de delincuencia en un estado de la federación.

Palabras-clave: Presupuesto Público. Ejecución Presupuestaria. Crimen. Regresión Lineal. Ceará.

Resumo

Objetivo: O presente artigo visa analisar uma possível existência de relação entre a execução orçamentária e níveis de criminalidade no Estado do Ceará no período compreendido entre 2012 a 2021.

Metodologia: Uso de regressão linear com a utilização de variável dependente (gastos orçamentários com a função segurança pública) e independentes (receita pública, crimes violentos letais intencionais, apreensão de armas, crimes violentos patrimoniais, furtos e crimes sexuais).

Resultados: Avaliadas as variáveis propostas, os resultados apontaram a influência de 2 (duas) das 6 (seis) variáveis independentes analisadas: receita a 1% e furtos a 10%. Os demais indicadores relacionados a crimes violentos letais intencionais, apreensão de armas, crimes violentos patrimoniais e crimes sexuais não apresentaram resultados consistentes.

Contribuições do Estudo: Amplia o nível de conhecimento acerca de possíveis relações entre gastos orçamentários e criminalidade (suas diversas tipologias), no intuito de compreender melhor se efetivamente somente gastos em segurança pública são capazes de influenciar o nível de criminalidade em um estado da federação.

Palavras-Chave: Orçamento Público**.** Execução Orçamentária. Criminalidade. Regressão Linear. Ceará.

1. Introduction

According to Durkheim (1897), crime is classified as a normal social fact resulting from infractions in all societies, whose exacerbation of criminal events makes the social fact pathological. For the World Health Organization (WHO), there is epidemic violence when the number of homicides exceeds 10 per 100 thousand inhabitants (WHO, 1998).

According to the Brazilian Forum on Public Security (2022), Brazil had 22.3 homicides per 100,000 inhabitants in 2021. Although still worrying, some progress was made in 2017, 2018, 2019, and 2020; The indices were 30.9, 27.60, 22.,7, and 23.8, respectively.

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Despite a slight growth between 2018 and 2019, the improvement is noticeable compared to previous periods (Brazilian Forum on Public Security, 2022).

The State of Ceará obtained an increase of 75.1% in the mortality rate that was justified by the dispute between factions and the mutiny of the Military Police in the year 2020 (Brazilian Forum of Public Security, 2021). Regarding the first aspect (dispute of criminal factions), a similarity is perceived with the American experience of Chicago, in which the peaks and decreases in violence corresponded to the increase and decrease in the intensity of *crack warfare* (Blumstein & Wallman, 2000).

The second stated motive – the riot of the state military police – runs up against the issue of public investment in public security. In the last 4 years (2018 to 2021), the State's per capita expenditure with the Public Security Function has been increasing, as well as the percentage of the share of expenses made with public security in relation to the total public expenditure. However, the results seem unsatisfactory, being one of the demands made by the insurgents regarding the implementation of wage improvements (Brazilian Forum of Public Security, 2021a).

In Brazil, the idea of public security is still widely linked to a posture of combat and repression of the enemies of social life through the available apparatuses: police forces and the criminal justice system, being considered as a result of a focus on the punitive and repressive character (Magalhães, & Sabatine, 2012). There are, however, other approaches that indicate that the State's action in combating violence is carried out in a rational way, and social, economic, and demographic factors should be taken into account, as well as structural factors in a systemic approach to the problem (Afonso, 2017; Angels, Vieira, & Almeida, 2017; Costa, Pea, Viana, & Gomes, 2019; Goncalves Filho, Pena, Souki, & Mello, 2020).

Specifically, from an economic point of view, inefficient public security impacts the country's development. According to a report by the United Nations Development Program (UNDP), the level of insecurity is pointed out as an impediment to the progress of Latin American countries. This is what is noticed, for example, when there is economic strengthening without a decrease in poverty and crime, and the numbers of human development indicators remain out of the ideal, frightening the population and driving away foreign investments (United Nations Development Program [UNDP], 2013).

Concerning public security costs, it is important to mention that they are not restricted to public expenditures directly and indirectly allocated to the prevention and fight against crime but also the expenses made by the private sector directly in contracting security services and equipment. According to Kahn (1999), property losses resulting from illicit acts, whose values are not perceived by society, should also be considered. Therefore, it is possible to inquire whether there is any relationship between public spending, crime, and budget revenue.

Given the above, the present work aims to analyze a possible relationship between budget expenditures, crime, and public revenue in the State of Ceará. As specific objectives, it is intended: a) To investigate the legal nature of public security in Brazil, outlining the competencies and responsibility of funding; b) review theories of criminal genesis in order to find factors that contribute to the crime; c) analyze whether there is a relationship between public revenue, crime indicators and public spending used with public security.

The research is justified under the academic and social aspects. In relation to the academic, the research seeks to investigate a possible link between the result of the State's effort in terms of public spending and the advance in the fight against crime in the face of the indicators disclosed that relate to the public security function. An examination of the

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publications of the last 10 years has shown advances in research in this area but with few references to specific units of the Federation or possible origins of the issue (Inter-American Development Bank [IDB], 2019; Ribeiro & Freitas, 2021). As for the social aspect, the research is linked to the history of urban violence in the State of Ceará, identified in 2020 as one of the highest rates, with 45.2 deaths per 100,000 inhabitants (Brazilian Forum on Public Security, 2021a). There is an empirical understanding that if there were an increase in spending on public safety, there would be pressure on the upward curve of crime rates, and these would decrease. This understanding goes along the lines that the lack of public investments in sensitive areas, such as education, health, and public safety, end up evidencing the exit of the public power from these fields and, therefore, the non-provision of public services necessary with effects on crime. (Angels, Vieira, & Almeida, 2017)

The research includes the following structure, in addition to this introduction: theoretical framework, where the main issues related to crime in the country are addressed, as well as the theoretical basis, which seeks explanations for the nature of the events that occurred; methodological procedures employed; analysis and discussion of the data with the main examinations carried out and, finally, the conclusions reached by the research carried out.

2 Theoretical framework

In the items that follow below, we seek to highlight the theoretical bases that support the discussion of the theme under investigation, from the advent of the Federal Constitution of 1937 and the advances that followed it, in order to tune the main talks that are held on the theme of public security, notably security and legal order, criminal prophylaxis and previous studies collected.

2.1 Public Security and Legal System

Public Security has its first record in the Brazilian legal system in the Constitution (1937); The term used in the previous period was internal security. The creation of the public security chapter in the current Constitution was done along the same lines as the Estado Novo Constitution, that is, without concepts and with a pure description of the organizational structure (Lima, Bueno, & Mingardi, 2016).

Public security represents the right of citizens to have their physical and patrimonial safety preserved, as well as their individual rights and the right to the whole exercise of citizenship. As a state prerogative, it is configured as a mechanism that maintains order that prevents the commission of acts of violence or disturbance to public demand (Faria, 2019), which is why such rights must be protected and guaranteed by the State against possible threats.

In this sense, in the Constitution of 1988 (1988), public security is treated as a fundamental right and guarantee, a protection to the individual and collective prerogatives of Brazilian citizens, and is presented as a duty of the State. In Article 144 of the constitutional text, the Political Charter assigns the Union responsible for the federal highway and federal railway police (1988). According to paragraph 6 of that article, the military police and the military fire departments, auxiliary forces, and the Army reserve are subordinate to the state governments, the civil police, and the state criminal police.

Similarly, the State Constitution of Ceará (1989) deals with public security and civil defense in chapter V and bases its composition on the Civil Police and Military Organizations. Different functions were given to each component of this system, being reserved to the civil police to exercise the functions of judicial police and the investigation of criminal offenses exclusively, carrying out studies on their own initiative or through requests emanating from the

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judicial authorities or the public prosecutor's office. In turn, it is up to the military organizations (military police and fire department). Concerning military organizations, composed of the military police and body, the function of administrative police, which is the ostensive and preventive policing, and to this the coordination of civil defense compliance, among others of the activities described in Article 190 of the State Constitution (1989).

Concerning the municipalities, the Constitution endowed the municipal guard with police power, which should act in the set of prevention and protection with the action on preventing violence and heritage preservation. The development of action measures and inspection of public spaces in an ostensible way were hindered, thus curbing some harmful conduct to society (Silva & Saes, 2014).

Observing the structure exposed, one can see the maximization of the participation of the Brazilian State in the fight against crime in the so-called Citizen Constitution, not only with the mechanisms provided for in the Major Law but also in the composition of the National Force with its military police, civil police, military firefighters and professionals of expertise.

Contrary to the logic of who collects more, and spends more, the Union does not finance public security as intensely as the states. Added to this, the fact that the Union develops the macroeconomic policy and the decisions taken in this regard interfere in the collection of the primary source of resources of the states, the Tax on the Circulation of Goods and Services Therefore, it is perceived as a disadvantage of the States vis-à-vis the Union, since the most significant for applying resources to Public Security policies and lower power in the face of decisions that can increase their collection (Brazilian Forum of Public Security, 2019b).

A study of the behavior of spending on the public security function in the period from 2002 to 2017, Peres *et al.* (2016) proved that the states were the main financiers of security policies, as well as that it is clear that the expenses in the area have been showing growth among all federative entities in the same period. It is easy to predict that the structure of the security sector, based on the concomitant participation of two federative entities, causes disorganization because with different agencies acting without fine-tuning, it can generate conflicts and little use of effort.

Because of this, § 7 of Article 144 of the Constitution (1988) brings the need to issue a law disciplining the organization and functioning of the organs responsible for public security. Almost thirty years later, Law No. 13,675 (2018) was sanctioned, creating the Unified Public Security System (SUSP) that gives uniform form to public security at the national level and provides, in addition to data sharing, operations and collaborations in federal, state and municipal structures. As is already the case in the health area, SUSP security agencies perform combined operations.

In short, the Federal Government is the formulator of public security policies and an articulator between the federation and the states, while the state and municipal governments are the executors of this policy. This law also modified the National Public Security Fund, an important tool for inducing local public security policies and intergovernmental cooperation (Peres *et al.*, 2014).

It should also be noted that the law enabled the creation of the National Policy for Public Security and Social Defense (PNSPDS), resulting in the approval of the first Ten-Year National Plan corresponding to 2018-2028. This plan establishes objectives to address the challenges in the area of security and the high rates of violence and crime.

In this plan, for the first time, governance and management mechanisms in public security are treated, according to the recommendation of the Report of the Federal Court of

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Auditors on governance indices in Public Security (TCU, 2014), because there was an indication of the dispensability of effectiveness of public policies. The need for monitoring and evaluation by period is also highlighted, considering the 14 objectives and strategies present in the plan (Spaniol, Moraes, & Rodrigues, 2020). According to these authors, the program considers a priority:

a) overcoming the deficit of data and indicators, standardization of the registration of events, urban reorganization and guarantees of people's rights, evaluation, and re-equipping of the operational organs of the SUSP;

b) increase in the quality of technical preparation of police and SUSP agents;

c) combating criminal organizations and measures aimed at reorganizing the prison system;

d) combating corruption and the sources of financing of crime and the illicit flow of capital; combating trafficking in arms, ammunition, and drugs and smuggling at borders, in ports and airports and on the road network;

e) improvement of prison policy.

It should be noted, then, that, according to the plan, it is not enough to apply more resources to public security, but that these are allocated in a way that will produce results, that is, reduce violence. A good example of this is the study conducted by Monte and Leopoldino (2020), in which it was evidenced that, despite the increase in the application of resources, there was an average efficiency of 65.6%.

2.2 Criminal Prophylaxis

Crime prevention aims to determine the risk factors that make individuals more likely to be repeatedly involved in criminal incidents The following are some theories established in criminology and, consequently, sociology, biology, and economics since criminology has a multidisciplinary character.

The first studies on the causation of crimes are centered on the characteristics of the individual. Lombroso sought through the theory of the born criminal that features of the face and body could indicate the propensity to commit the crime; this idea was supported by his praxis as a medical examiner (Machado, 2021). This is an expression of the school of positive criminal anthropology or individual etiological criminology, in which the persecution of minorities is clear, and in a way, it is the application of ethnic-racial hygienism to the context of crime prevention (Medeiro, 2019). It is important to point out that modern biological theories have moved away from the initial paradigms; therefore, they no longer advocate biological determinism (Melo, 2010).

As a counterpoint to positivist theories, such as Lombroso's, and being part of the Chicago School, the Structural-Functionalist Theory of Deviance and Anomie explains the criminogenic phenomenon on the basis of the contradiction of society. In a better explanation, culture determines models of institutionalized behaviors, possessing the modalities and legitimate means for achieving these cultural goals. The contradiction occurs when the social structure, which sponsors legitimate modalities and means, offers unequal access to the means. The impossibility of reaching the goal can cause the use of illicit means (Ferro, 2006).

Another well-discussed theory belonging to the Chicago School is the social disorganization theory of Clifford Shaw and Henry MacKay, which shifts the focus of criminal genesis from culture to the environment (Penteado Filho, 2021). In this study, the responsibility for criminal conduct falls on the uncoordinated growth of cities, which made it known as

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Human Ecology. An understandable criterion, given the moment of its creation: a great expansion of American urban centers accompanied by a dizzying increase in crime.

In this same sense, the Theory of Broken Windows developed by Wilson and Kelling explains that criminality is strongly connected to communities with disorder and neglect (Oliveira, 2014). This theory states that crime is more recurrent in areas of abandonment, lack of public assistance, and disorder. The slightest presence of these elements would chain events of other worse ones. To avoid this, it is indicated that the police adopt the policy of minimum tolerance because, according to this theory, untreated disorder increases the fear of crime in a community, initiating a chain of events that eventually leads to high levels of criminality (Hinkle, & Weisburd, 2008).

A major problem with the previous theories is that they could not explain crime in situations with no problems with the environment, such as crimes committed by people of higher classes, especially white-collar crimes. For this, the theory of differential association or social learning developed by Sutherland (1974) sought to explain the involvement with criminal practices by close contact with people who have the habit of breaking the law. For this author, delinquency is the result of the excess of factors favorable to the learning of the violation of the law to the detriment of the inhibiting factors of the crime, this being the principle of differential association.

In addition to sociology, the economic sciences have also contributed to the studies of criminogenesis through theories, among them Gary Becker's Economic Theory of Crime or Rational Choice (Becker, 1968). This theory was intended to answer how much should be allocated to public safety and how it should be punished to enforce different types of legislation. For Becker, breaking norms is preceded by a rational choice because that individual who commits a crime, commits them against the patrimony and acts rationally weighing the costs of his actions and, if they are low in relation to their consequences, he will have more incentive to transgression.

2.3 Previous studies

This research has as its starting point the Economic Theory of Crime since it uses spending on public security as a dependent variable. Many studies have already been done taking into account social, economic, and demographic factors, such as education, economic situation, financial, population density, and criminal and legal potential (Anjos, Vieira, & Almeida, 2017; Arantes *et al*., 2012; Mendonça, 2000; Rezende, 2002; Sapori, 2001).

In the present research, we chose to determine the dependent variables and number of criminal occurrences, considering a possible relationship between budget expenditures and the fight against crime. Despite recognizing the importance of public policies of social welfare as a factor of importance in the prevention of crime, there is still literature that disagrees and points out the opposite effect (Brown, 2016; Chamlin, 1999; Cullen, Wright, Garland, 2001).

In this sense and considering the North American context, Fisher (1961) tried to identify the factors that determined public spending on public security. Kelly (2000) also researched something similar but innovative, giving way to sexual crimes as a variable. In turn, Shelton (2007) sought to analyze public spending on security in the face of collection in order to prove that the higher the collections, the greater would be the expenditures aimed at combating crime, that is, the essence of Wagner's Law. In the Nigerian context, a similar study was implemented by Ukweze (2015), with the differential of relating this to economic growth.

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Regarding the analysis of public security spending in the Brazilian context, there are some studies, such as those by Bohn *et al*. (2015), Freitas Júnior *et al*. (2020), Schull, Feitosa and Hein (2014) and Silva (2021). Among these, the first three used a non-parametric methodology of Data Envelopment Analysis in order to assess the efficiency of investments, while the last one presented an analysis of the determinants of spending on public security.

In the state context, there are studies that investigate the motivating factors of public security in Minas Gerais, Espírito Santo but do not involve public spending on public security (Anjos, Vieira, & Almeida, 2017; Figueiredo *et al.,* 2021). Other works analyze the public collection of states, lethal violent crimes, state revenue, types of revenues and ideological perspectives (Santos, Gontijo, & Amaral, 2015).

In relation to the research conducted in the state of Ceará, Loureiro (2009) correlated the effective police, socioeconomic factors, and the repression of crime. When simultaneity was eliminated, a significant impact on the number of criminal occurrences was obtained as a result of the increase in the number of police officers, and the influence of socioeconomic factors on criminal behavior was confirmed. As can be seen, there is still a lack of studies in the area, especially in the state of Ceará, whose studies are scarce.

3 Methodology

According to Gil (2010), as for the objectives, the work can be classified as descriptive, documental, and correlational since it seeks to discover the existence of associations between variables. The epistemological character is empirical-analytical, as it uses collection, treatment, and analysis techniques of markedly quantitative data (Chein, 2019).

For Fávero and Belfiore (2017), multiple linear regression serves to understand how the dependent variable (Y) is related to the set of independent variables selected at the choice of the researcher. In this study, a set of independent and control variables considered explanatory affect public spending on security. To this end, the SPSS uses the method of minimum ordinary tables to calculate the coefficients in the multiple linear regression in such a way that the sum of the squares of the errors is as small as possible.

With regard to the definition of the population and sample, the study is classified as census, in view of the equality between both aggregates; that is, the population is equal to the sample, comprising the data surveyed between 2012 and 2021, the last year in which the data were made available on the website for research.

The data were collected through different databases, and those of an accounting nature related to public security expenses were taken from the Budget and Financial System (SIOF), which is linked to the Secretariat of Planning and Management of the State of Ceará (SEPLAG). Crime data were made available through a public request to the Superintendence of Research and Strategy of Public Security (Supesp) of the Secretariat of Public Security and Social Defense (SSPDS).

To identify the explanatory factors that contribute to the understanding of crime in Ceará, this study selected the following variables:

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Table 1
Summary of dependent and independent variables of the model

Variables	Acronym	Data Source	Variable Type	Previous Studies	Expected Signal
Expenditure on Public Safety	Desp	SIOF	Dependent variable	Fisher (1961), Freitas Júnior *et al.* (2020).	
Revenue	Rec	STN in state RREOs	Independent Variable	Fisher (1961), Ukwueze (2015)	+
Intentional lethal violent crimes	CVLI	SSPDS	Independent Variable	Freitas Júnior *et al.* (2020).	+
Seizure of weapons	ApArmas	SSPDS	Independent Variable	Loureiro and Carvalho Júnior (2006)	+
Violent Property Crimes	CVP	SSPDS	Independent Variable	Loureiro and Carvalho Júnior (2006)	+
Theft	Theft	SSPDS	Independent Variable	Fisher (1961), Shelton (2007)	+
Sex crimes	CSEX	SSPDS	Independent Variable	Kelly (2000)	+

Source: *survey data (2022).*

Given the foregoing, it was possible to construct the following research hypotheses:

H1: public spending on the public security function is influenced by the increase in public revenue;

H2: Public spending on the public security function is influenced by the increase in intentional lethal violent crimes (CVLI).

H3: Public spending on the public security function is influenced by the increase in the number of seizures of weapons (ApArmas).

H4: Public spending on the public security function is influenced by the increase in the number of violent property crimes (CVP).

H5: Public spending on the public security function is influenced by the increase in the number of thefts.

H6: Public spending on the public security function is influenced by the increase in the number of sexual crimes (CSEX).

The following equation presents the proposed model to verify the determining factors of public security spending:

$$\text{LnDesp}_t = \beta_0 + \beta_1 ln\text{Rec}_t + \beta_2 \text{CVLI}_t + \beta_3 \text{ApArmas}_t + \beta_4 \text{CVP}_t + \beta_5 \text{Furto}_t + \beta_6 \text{Csex}_t + \varepsilon_i$$

In which:
LnDesp = Natural logarithm of the amount spent on public safety spending per month from 2012 to 2021;
lnRec = Natural logarithm of the value of revenue in the state in period t;
CVLI = Number of intentional lethal violent crimes in the state in period t;
ApArmas = Amount of seizure and weapons;

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CVP = Number of violent property crimes in the state in period t;
Theft = Number of thefts in the state in period t;
CSEX= Number of sex crimes in the state in period t;
ε = regression error term.

As modeling, we opted for the transformation into the Neperian logarithm, the dependent variable, and the revenue variable, Log Log Model, in order to solve problems caused by the disparity of the magnitude of the values (Wooldridge, 2014). The research was conducted between July and December 2022,b and for data analysis and treatment, the SPSS *Statistics software*, version 16, was used to perform multiple linear regression of data in a balanced panel.

4 Analysis and Discussion of Results

The initial sample of this research was composed of 120 observations taken from the period between 2012 and 2021 regarding the dependent and independent variables. Note that the dependent variable and the revenue variable obey the requirements of being real, and positive but have disparate values because of their magnitude if compared with the other variables.

Table 2 shows the result of the descriptive statistics of the variables studied.

Table 2
Descriptive Measures - Model Variables

Variable	Minimum	Average	Median	Maximum	DP	% CV
Expense (R$)	69.568.922,61	222.459.013,62	203.073.854,25	1.413.164.347,00	134.974.779,17	60,67
Revenue (R$)	1.228.299.744,00	2.048.788.573,97	1.953.291.407,70	3.931.116.099,16	521.908.024,06	25,47
CVLI	164,00	326,97	324,50	516,00	77,04	23,56
ApArmas	328,00	508,64	507,00	695,00	70,08	13,78
Theft	2.139,00	4.503,79	4.663,00	5.944,00	673,09	14,95
CVP	2.436,00	4.786,96	4.462,00	7.787,00	1.093,37	22,84
Sex Crimes	88,00	152,21	154,50	212,00	24,40	16,03

Source: *survey data (2022).*

Initially, we analyzed possible simultaneity between the variables through the variance inflation factor (VIF), having presented low multicollinearity since it is between 1 and 2, as observed in the table below:

Panel 1
Multicollinearity test

Variable	BRIGHT
log (Recipe)	1,499348
CVLI	1,852997
FMC	1,450034
Theft	1,616699
Seizure of weapons	1,627393
Sex Crimes	1,192499

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Source: **Research** data (2022).

Table 2 shows that the variable expenditures (in reais) have a high value of VC (%) - coefficient of variation, evidencing the spending policy of the State Government over time. The variable seizure of weapons has close mean and median values and the lowest VC value (%). The following are boxplot graphs of the variables expenses (in reais) and revenue (in reais):
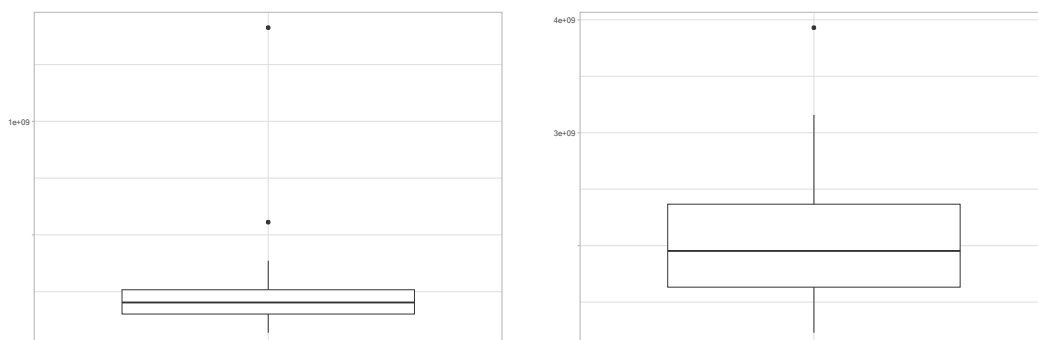
Figure 1 *bloxpot Chart*
Source: *survey data (2022).*

Note that Figure 2 presents, both in (i) and (ii), asymmetry to the right due to the extreme maximum values; however, there is still a certain symmetry in the quantile of the variables, represented in the graphs by the box.

The dispersion matrix of the variables under study is presented below. The analysis of the dispersion matrix is useful to perceive, at once, the relationship between the pairs of variables. The upper part of the dispersion matrix is occupied by the curve of levels two by two of each pair. The bottom of the matrix contains the two-by-two scattering information.

The Kernel density estimate of each variable occupies the main diagonal. It is important to note that from here, the analysis does not count on the 120 initial observations made available. This lack is justified by the absence of 3-instant information in the variable theft and violent property crimes (CVP) due to inconsistency in the SSPDS database, leaving 117 observations.
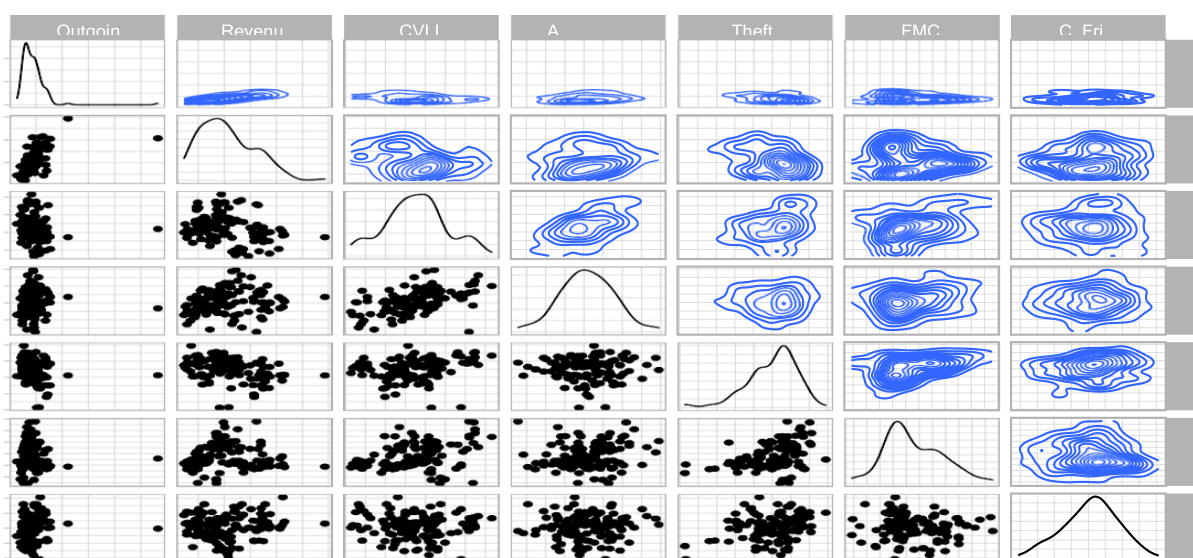
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Figure 2 Scattering Matrix - Model Variables
Source: Research *data (2022).*

Below is the variance and covariance matrix and the correlation information. The main diagonal is occupied by the variance information of the variables. The lower part of the matrix carries covariance information, and correlation information is on the opposite side of the matrix. Such information is relevant to the correlation calculation.

Table 3
Matrix of variance, covariance and correlation

	Expense	Revenue	CVLI	Ap. Weapons	Theft	FMC	C. Fri
Expense	18.627.838.127.124.300,00	0,58	-0,15	0,04	-0,25	-0,09	0,07
Revenue	41.719.910.104.256.000,00	274.318.403.220.009.000,00	-0,28	0,16	-0,33	-0,03	0,11
CVLI	-1.542.062.528,52	-11.304.591.624,00	6.059,83	0,51	0,23	0,33	-0,07
Ap Weapons	417.121.911,34	6.073.715.893,07	2.796,08	4.965,91	0,01	0,14	0,03
Theft	-23.262.245.361,78	-116.859.413.867,45	12.198,33	373,05	453.053,72	0,40	0,26
CVP	-12.806.736.857,69	-17.939.190.619,78	28.343,14	11.068,44	294.918,48	1.195.448,78	-0,08
C. Sex	219.569.438,05	1.401.804.195,28	-141,34	44,41	4.358,18	-2.260,60	603,50

Source: *survey data (2022).*

Analyzing together Figure 2 and Table 3, it is observed that the variables expenditure and revenue have a positive correlation, confirming the positive relationship of both variables pointed out according to previous studies by Ukwueze (2015) and the Inter-American Development Bank (IDB, 2019). Although the result demonstrates previous studies, it is important to highlight that it cannot be inferred from this that the volume of revenues is sufficient to cover the expenses with public security or that they were used efficiently. The result that flows from the case under examination is that they point in the same direction; that is, if one sees increased funds raised, the State Government directs part of them to its public security policy.

Regarding the variables theft, violent property crimes (CVP), seizure of weapons (ApArmas), and intentional lethal violent crimes (CVLI) have a positive correlation. This indicates that by increasing one of these variables, the others will also increase in the proportion indicated in the table. Except for the variable ApArmas, the others followed the same behavior as the studies conducted by Kelly (2000), Shelton (2007), and Freitas Júnior (2020), which had a decrease with increased investments.

Due to the difficulty of mathematically evaluating the fit of the model, it was decided to visualize a scatterplot of the predictive values versus observed values, and from this visualization, it is considered a good fit how close the points of the line are predictive values/observed values:
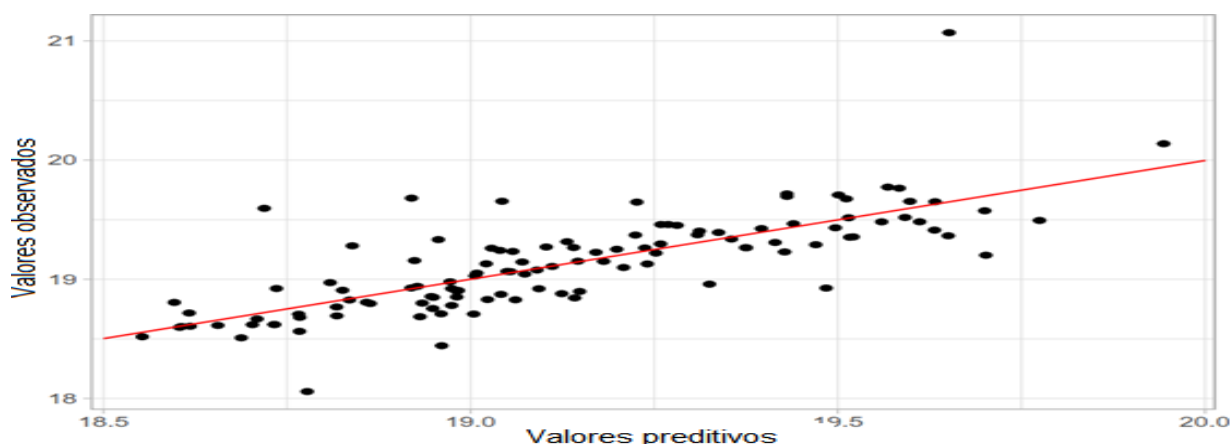
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Figure 3 *Summary of the proposed model*
Source: Research *data (2022).*

Figure 3 shows a large majority of the points around the line, indicating a good fit; however, the most distant points cannot be neglected, which will be analyzed later in the diagnostic analysis and confirmatory analysis.

The model has the statistic R2 = 0.585 and R2-adjusted = 0.562; such measures are always between 0 and 1 and can be interpreted as follows: a number close to 0 represents a regression that does not explain well the variance in the response variable and a number close to 1 explains the variance observed in the response variable.

In the table below are presented all the estimates for the regression coefficients β0, β1 (Rec), β2 (CVLI), β3 (ApArmas), β4 (Theft), β5 (CVP) and β6 (CSex) with the errors of each estimate, Standard Error, in addition to the hypothesis test, H0: βi = 0 versus H1: βi/= 0, i = 0, 1, 2, 3, 4, 5 and 6 associated with each estimate.

Table 4
Summary of the proposed model

Parameter	Estimate	Standard Error	quantile t	Pr(>|t|)
b0	-5,289170	2,615453	-2,02	**0,0456**
B1	1,146505	1,146505	9,37	**<0,0001**
B2	0,000121	0,000436	0,28	0,7813
B3	-0,000077	0,000450	-0,17	0,8649
B4	-0,000086	0,000047	-1,82	**0,0713**
B5	-0,000002	0,000027	-0,09	0,9283
B6	0,001729	0,001108	1,56	0,1214

Source: *survey data (2022).*

Table 4 shows that only the coefficients β1 (Revenue) and β4 (Theft) were significant at 1.00% and 10.00%, respectively. The other four variables were not significant (β2=CVLI,

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β3=ApArmas, β5=CVP, and β6=CSex), which demonstrates that their explanatory power has limitations of an explanatory nature.

Although the results are not significantly important – due to the number of variables at 1% and 5% – some conclusions can still be drawn.

First, the evidence indicates that in the State of Ceará, the expenditures on public security are not directly related to the fight against the various types of crimes observed; however, it is certain that the State Government allocates part of the revenues to the public security function (p-value Revenue = 1%). Second, among the crimes that are fought, the State Government has a tendency to give greater attention to thefts (p-value between 5% and 10%). Third, the non-direct allocation of resources to other crimes may occur due to the understanding on the part of the State that the security policy should not occur exclusively based on actions related to the public security function but by the coordinated use and associated with other public functions, such as culture, education, health, and social assistance. This deduction is echoed in results evidenced by several authors (Anjos, Vieira, & Almeida, 2017; Arantes *et al.,* 2012) who identified social welfare as a good inhibitor of the advance of crime.

In this sense, we chose to continue with the other variables of the model, since other models were performed in the absence of the variable Revenue, and in this context all variables were significant to the model:

$$LnDespt = -5,289170 + 1,146505 \, ln\text{Rec}_t + 0,000121\text{CVLI}_t - 0,000077\text{ApArmas}_t - 0.000086\text{Furto}_t - 0,000002\text{CVP}_t + 0,001729\text{Csex}_t + \varepsilon_i$$

Table 4 presents the proposed model's Analysis of Variance (ANOVA). The ANOVA provides information on the sum of squares (SQ), mean square (QM), degree of freedom (GL), and the hypothesis test (F test), each regression coefficient obtained through the QM ratio of each coefficient and the QM of the residue or through the quantile of t, presented in Table 2.3, squared.

Table 5
Summary of the proposed model

Parameter	GL	SQ	SQM	quantile F	Pr(>*F)*
B1	1	10,7777	10,7777	149,60	<0,0001
B2	1	0,0045	0,0045	0,06	0,8021
B3	1	0,0844	0,0844	1,17	0,2814
B4	1	0,1264	0,1264	1,75	0,1880
B5	1	0,0007	0,0007	0,01	0,9215
B6	1	0,1756	0,1756	2,44	0,1214
Waste	110	7,9247	0,0720		
Total	116	19,0941	11,2414		

Source: *survey data (2022).*

Table 5 shows that only the β1 coefficient was significant at 1.00%; however, as already

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reported, the other variables will continue to be part of the model since, in a previous adjustment, all variables were significant in the absence of the Revenue.

The following are the figures referring to the graphs of adjusted values versus studentized residues, useful in the evaluation of homoscedasticity of the model, and qqplot graph, valid for the verification of the normality of the residuals:
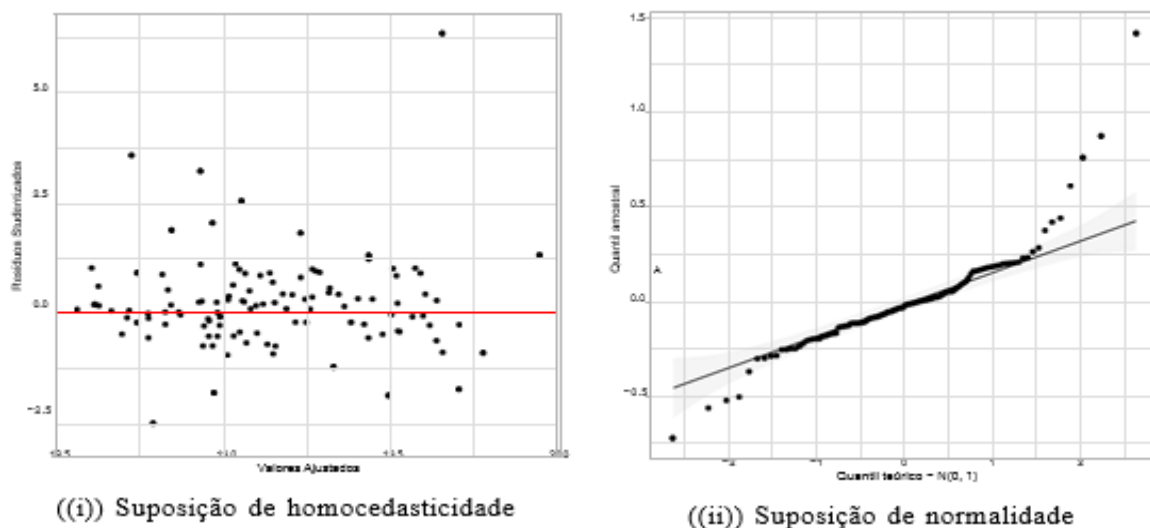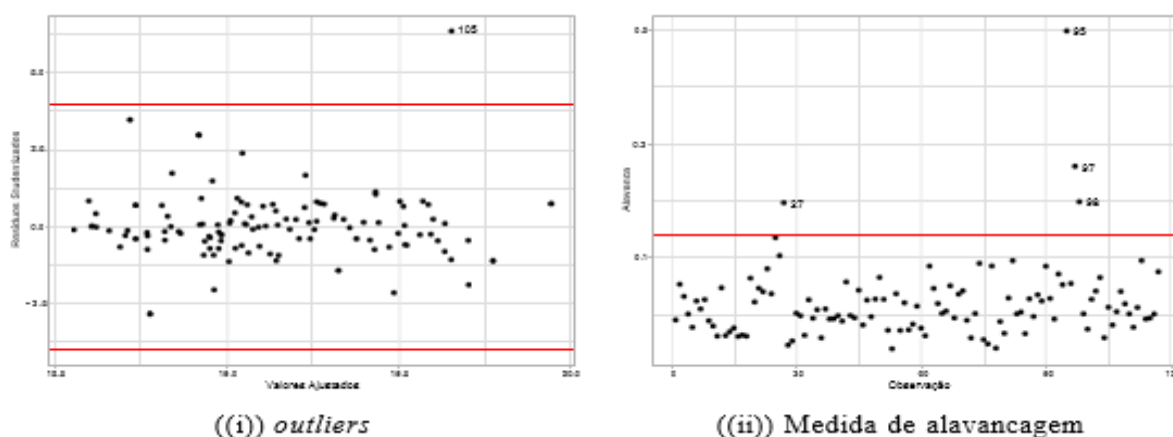

((i)) Suposição de homocedasticidade

((ii)) Suposição de normalidade

Figure 4 *Assumption of homoscedasticity and normality of residues*
Source: Research *data (2022).*

From Figure 4, it can be seen that in (i), the points closest to the line present random behavior, indicating the homoscedasticity of the model; that is, the variance remains constant throughout the model (Goldfeld–Quandt test; GQ statistic: 1.04, with 52 and 51 degrees of freedom; p-value: 0.4371) and in (ii) it is seen that in (ii) the data present approximately normal behavior, with some points on the farthest tails and that can be explained from the simulated envelope of 95% confidence. This means that the data follow a pattern, allowing modeling of the variables involved.

The following are graphical methods that help identify possible observations that may exert "perturbations" on the model:
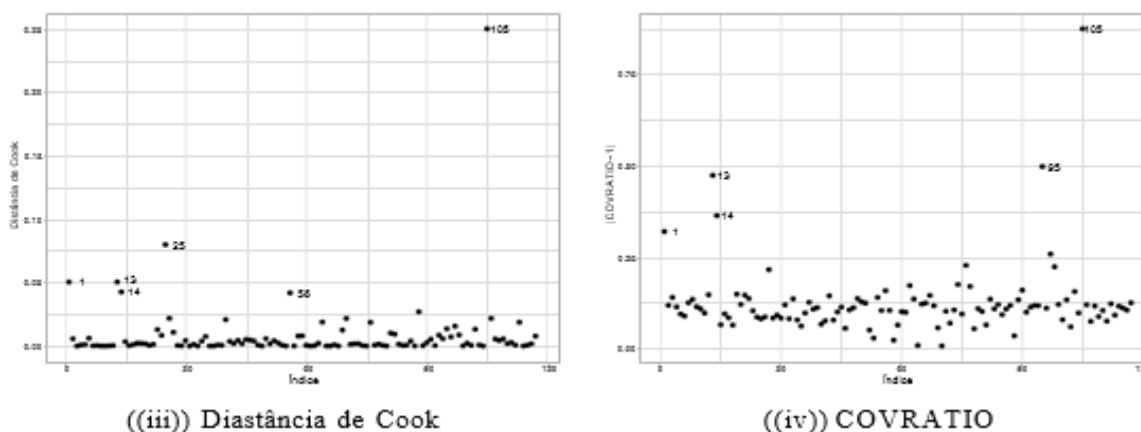

((i)) *outliers*

((ii)) Medida de alavancagem

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Figure 5 *Assumption of homoscedasticity and normality of residues*
Source: *survey data (2022).*

Figure 5: (i) the observation of index 105 is a candidate for *outlier* of the model, that is, it has a high residue value; (ii) there is information that possible lever observations, that is, can disproportionately influence the slope of the adjusted line, in the case of observations 27, 95, 97 and 98; (iii) brings with it information of the Cook distance, emphasis on observations 1, 13, 14, 25, 56, 105, that is, that helps to identify influential points and that cause substantial changes in the parameters when they are removed from the adjustment; (iv) and the COVRATIO measure, responsible for identifying possible influential points of the scale parameters, observations 1, 13, 14, 95, 105.

Compiling the points listed, it can be said that these are points that hinder the inferences of the model and follows a brief summary of these:

a) Observations 13, 14, and 105 - The three largest proportional investments in the series, with observation 105 also being the largest absolute investment;

b) Observations 1, 25, 56 - The three smallest proportional investments in the series, with observations 1 and 25 being the two lowest absolute investments;

c) Note 105 - The lowest number of CVLI in the series;

d) Observation 95 - The lowest seizure of weapons and the highest number of occurrences of CVP in the series;

e) Observation 97 and 98 - The lowest number of theft in the series, and observation 97 is also the lowest number of sexual crimes.

Observations 13 and 14 come from the year 2013, in which the Raio Battalion and new vehicles for the Military and Civil Police carried out the acquisition of new vehicles. In the same period, funds were also released for the purchase of uniforms for the entire Military Police, the acquisition of vehicles and technological equipment for the new Tourist Protection Police Station and for the new 2nd DP, the convocation of inspectors of the Civil Police, the release of resources for the beginning of public events to hire men for Military Police and Military Firefighters, implementation of 100 new cameras for the Capital Video Monitoring System, structuring of the units of the Military Police and the Military Fire Department in the Industrial and Port Complex of Pecém, purchase of equipment for the Forensic Expertise Center of the Inhamuns Region.

Observations 97, 98, and 105 were obtained in 2020. Despite being good numbers, this was a year of the public security crisis in Ceará that began with the mutiny of some of the state's

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military police. The main demand was salary increases and more investments in public safety. The unraveling ended with the guarantee of the State Government of investment of R $ 495 million with the salary of police officers until 2022, in the same year there was an increase in the salaries of police officers.

Observation 95 was obtained in the year 2019. It is important to say that despite being the smallest seizure in numerical terms, in the same period one of the largest seizures of large-caliber weapons was made. At the time, the then-secretary of public safety attributed the drop to a decrease in guns in the hands of criminals.

Returning to the model that was adjusted, disregarding the observations listed above, it can be considered a good model, since in the absence of the previous observations, the estimated parameters were not drastically affected:

Table 6
Comparison between full model and incomplete model

Parameter	Complete model	Incomplete template	Percentage impact (%)	Absolute impact
b0	-5,289170	-4,417335	-0,164834	0,871835
B1	1,146505	1,099052	-0,041389	-0,047453
B2	0,000121	-0,000134	-2,102503	-0,000255
B3	-0,000077	0,000144	-2,882926	0,000221
B4	-0,000086	-0,000066	-0,224578	0,000019
B5	-0,000002	0,000003	-2,385348	0,000006
B6	0,001729	0,001611	-0,068600	-0,000119

Source: *survey data (2022).*

Note that in Table 6, the significant variables for the model ($\beta 1$ and $\beta 4$) presented little percentage impact in the estimates, and those that even obtained a high percentage impact did not present considerable absolute impact, thus indicating that these observations, together, do not exert great influence on the model.

Such a conclusion does not cause strangeness since previous studies have already obtained results in the same sense (Loureiro, 2006; Mendonça, 2000). In such studies, the inexistence of a consistent deterrent power of repression measures such as spending on public security on crime in Brazil was evidenced, even when the problem of endogeneity is taken into account, with the exception of homicides and alternative estimates, where short-term public repression reduces this type of crime.

Therefore, regarding the hypotheses in the study, hypotheses H1 and H5 should be accepted and hypotheses H2, H3, and H4 should be rejected, considering that the latter exceeded the p-value at 10%.

5 Conclusion

This study sought to evaluate whether there is a relationship between the execution of the public budget and crime in the state of Ceará, having as a starting point the Economic Theory of Crime that considers crime as a product of rational choice on the part of those who practice it, taking into account costs and the results obtained. This theory was used because it

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allows the focus on the role played by the state of Ceará as *an investor player* and formulator of public policies to combat violence.

Through a multiple linear regression, the variables spent on security, revenue, violent crimes against life, violent property crimes, seizure of weapons, theft, and sexual crimes were collected and analyzed for the period between 2012 and 2021. The examination of the data showed a relationship between budget expenditure applied in the public security function, revenue (p-value at 1%), and theft (p-value at 10%). The other variables were not significant (intentional lethal violent crimes, seizure of weapons, violent property crimes, and sexual crimes), which demonstrates that, according to the model, their power has limitations of an explanatory nature.

Based on the results, it is possible to conclude that, although the expenses with the public security function have not been related to most of the types of crimes selected for study, with the exception of thefts (p-value a10%), it is certain that the State Government allocates part of its revenues to the public security function. A possible answer to this behavior can be explained by the understanding of the State authorities to use other public functions (culture, health, education, and social assistance), corroborating studies that treat social welfare as an important mechanism to combat the phenomenon.

As a limitation of the work, it is possible to mention the unavailability of data on some types of crimes with the Government of the State of Ceará portal since some months did not have records. In addition to the issue of the inconsistency of the state database, there is also that without mentioning the existence of underreporting of some crimes, notably those involving sexual assault and theft of minor amounts.

As a suggestion for future research, it is proposed to associate crime rates with expenses related to the functions of culture, health, education, and social assistance, in addition to public security itself, in order to confirm eventual behavioral changes of managers in the execution of this public policy.

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