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HOMICIDES IN BRAZIL: AN ECONOMETRIC ANALYSIS OF ITS SOCIOECONOMIC, DEMOGRAPHIC AND EDUCATIONAL DETERMINANTS

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INTRODUCTION

For several decades, Brazil has confronted a public security crisis characterized by elevated rates of violent crime. From 2000 to 2022, the nation documented an annual average of 52,500 homicides, cumulatively accounting for approximately 1.2 million victims (SIM/DATASUS, 2024). Despite constituting merely 2.8% of the global population, Brazil was responsible for 15.3% of the world's homicides in 2016, and by 2018, 17 of its cities were listed among the 50 most violent globally (KOPITTKE; RAMOS, 2021). In an effort to address this, the Federal Government initiated a new National Public Security Plan in 2018 and established the "Sistema Único de Segurança Pública" (Unified Public Security System), setting forth guidelines for a coordinated approach among security forces at federal, state, and municipal levels (DELGADO, 2022). These measures led to a significant reduction in the homicide rate, which decreased from 30.6 deaths per 100,000 inhabitants in 2017 to an average of 21.3 between 2019 and 2022 (UNODC, 2024). Nevertheless, in 2020, Brazil still recorded the highest absolute number of homicides globally, with more than 40,000 incidents (LIRA; CERQUEIRA, 2022). Furthermore, in 2022, Brazil's homicide rate ranked as the fifteenth highest in the world, approximately three times greater than that of the United States and nearly ten times that of Canada, according to data from the United Nations (UNODC, 2024).

In this context, the National Secretary of Justice and Public Security recently described violent crime in Brazil as "almost an epidemic." According to him, the efforts of the Ministry of Justice and Public Security—focused on enhancing the criminal justice system, public safety, prison policies, and drug-related issues—are essential but insufficient on their own. These actions must be complemented by addressing structural socioeconomic issues such as poverty and inequality (BOTELHO, 2023). This perspective, combined with the growing paradigm of Evidence-Based Public Policy— which emphasizes the importance of using systematic data and rigorous methods to guide policy formulation—has stimulated extensive scientific research on the socioeconomic and demographic determinants of crime rates in Brazil.

A systematic review covering the period from 2002 to 2017 cataloged sixty studies published in both national and international scientific journals regarding the socioeconomic and demographic determinants of homicide rates in Brazil (WANZINACK; SIGNORELLI; REIS, 2018). However, only 30% of these studies were conducted on a national scale, providing insights for the development of strategic actions to mitigate homicides across the country. Among them, the study by Soares Filho (2011) stands out as the only one to econometrically assess the significance and intensity of socioeconomic determinants on Brazil's homicide rate. Additionally, our searches yielded working papers from the Instituto de Pesquisas Econômicas Aplicadas (IPEA), articles from meetings of the Associação Nacional de Pós Graduação em Economia (ANPEC), and doctoral dissertations, such as the works by Sachsida and Mendonça (2013), Cerqueira and Moura (2014), and Hartung (2009), which broaden this discussion.

Using time-series methodology, Soares Filho (2011) observed that in Brazil, between 2000 and 2009, the homicide rate increased among Black individuals regardless of their educational level, while it decreased among less educated White individuals. The study also revealed that the anti-gun legislation implemented in 2004 reduced violence among Whites but not among Blacks, exacerbating social disparities. Meanwhile, Hartung (2009) used a fixed effects panel data model, finding that the proportion of children aged 4 to 6 years not enrolled in preschool, the proportion of households in favelas, and the proportion of young people aged

15 to 25 were positively and significantly associated with the homicide rate; whereas the presence of the state, represented by the proportion of households with piped water and garbage collection, was inversely proportional to this rate. Subsequently, Sachsida (2013) utilized fixed and random effects panel data models to examine the influence of incarceration and policing rates on the homicide rate. His findings suggest that an effective reduction in homicides requires increases in police repression and incarcerations, casting doubt on the ability of isolated socioeconomic improvements to reduce the homicide death rate. Finally, Cerqueira and Moura (2014), using a fixed effects panel data model, investigated the impact of the proportion of young men in the population on the homicide rate, finding that an increase of one percentage point in this proportion results in a 2% increase in the homicide rate. Moreover, among the control variables, the estimated coefficients for the unemployment rates among men and for per capita household income were positive and significant, indicating that higher levels of unemployment and income tend to increase the homicide rate.

Investigating the factors that influence the homicide rate, assessing their statistical significance, and estimating their elasticities—namely, the percentage change in the rate for each percentage point increase in the determinants—are essential steps in formulating effective public security policies. However, the empirical literature on the socioeconomic, demographic, and educational determinants of the homicide rate in Brazil is still limited and unclear, emphasizing the need for further research that can provide dependable guidelines for public security strategies at the national level. To bridge these gaps, this study sets out to address the following research questions: (i) What factors are identified in criminological literature as socioeconomic, demographic, and educational determinants of the homicide rate? (ii) Which of these factors are significant in the Brazilian context? (iii) What is the magnitude of their elasticities nationally?

This study utilized data from the National Household Sample Survey (Pesquisa Nacional por Amostra de Domicílios - PNAD) from 2000 to 2014 and from Homicide Death records of the Mortality Information System (Sistema de Informações de Mortalidade - SIM/DATASUS, 2024). Employing a panel data model with random effects, we found that the dropout rates in the final years of high school, unemployment rates among the population over 15 years old, and the average per capita family income, all expressed in logarithms, are positively and significantly related to the logarithm of the homicide rate, with a statistical significance of 5%. Additionally, the proportion of interstate migrants in the population, also in logarithmic form, showed a positive association with the logarithm of the homicide rate, with a significance of 10%. The results suggest that increments of one percentage point in these variables result in increases of 0.144%, 0.371%, 0.351%, and 0.165% in the homicide rate, respectively. These findings corroborate existing theories and offer valuable insights for the formulation of public security policies.

The article is organized into six sections beyond this introduction. In the second section, we conduct a brief review of the literature on the three main theoretical streams that analyze the criminal phenomenon, identifying demographic and socioeconomic determinants of the homicide rate in Brazil and proposing hypotheses. In the third section, we describe the data used in the research and their respective sources. The fourth section presents the econometric method employed, explaining and justifying our methodological choices. The fifth section is dedicated to the analysis of the results, while the sixth section concludes the article by presenting a summary of the main findings and proposing guidelines for national strategic actions in the field of public security based on them.

2. CRIMINAL THEORIES, DETERMINANTS OF HOMICIDE RATES, AND HYPOTHESES

The propositions of this research are based on three important theoretical streams: the Ecological Theory of Crime, the Theory of Social Disorganization, and the Rational Choice Economic Theory. This combination of theories is necessary due to the complex nature of criminal etiology — the study of the causes and factors that motivate criminal behavior. In exploring this area, it is essential to consider the social, economic, institutional, and environmental aspects that influence criminality. Thus, by integrating these perspectives, we aspire to a more comprehensive and in-depth analysis of crime determinants, with an emphasis on homicides.

The Ecological Theory of Crime, a pioneer in the realm of modern criminology, was developed by scholars such as Park (1915) in the context of rapid urbanization in Chicago. This theory examines the relationship between urban growth and the increase in crime, highlighting that demographic expansion and industrialization, without adequate urban policies, tend to exacerbate social problems and violence. With this focus, the theory discusses the role of urban geography in the distribution of crimes, suggesting that the specific characteristics of each urban area influence the types of crimes that predominate there.

Park (1915) and Park and Burgess (1921) identified how American cities expand into concentric zones, each with distinct functions and characteristics that influence criminal patterns. For instance, central areas with intense economic activity tend to attract property crimes such as thefts and robberies, while peripheral regions are often the scene of violent crimes, such as homicides. This ecological approach emphasizes how the spatial configuration and economic dynamics of a city shape the incidence and nature of criminality.

Thus, considering the theoretical framework of the Ecological Theory of Crime, which emphasizes the impact of urbanization on the distribution and nature of criminality, we propose the following hypothesis for our study in Brazil:

H1 – There is a significant positive causal relationship between the rate of urbanization and the homicide rate.

In the first half of the 20th century, crime scholars from the Chicago School began transitioning from a purely ecological analysis to a more socially oriented approach (MOLINA, 1997). This shift brought with it a growing interest in the concept of "social disorganization." This concept seeks to understand the etiology of crime through a broader set of variables, including social, economic, and demographic factors, which outline the process of urbanization and its inherent contradictions.

The Theory of Social Disorganization posits that crime is often the result of a deterioration in social institutions such as families, schools, and community networks, especially in rapidly transforming urban contexts. When these fundamental social structures weaken or disintegrate, community cohesion decreases, leading to an increase in criminal behaviors. This theory emphasizes that the disintegration of these essential social structures can diminish community cohesion and increase criminal behaviors, creating an environment conducive to crime. It seeks to understand how a lack of social integration and failures in support networks can directly influence the rise in criminal incidence in cities.

Shaw and McKay (1942) further explored this idea, demonstrating that urban configuration can both influence and be influenced by social disorganization, directly affecting the spatial distribution of crimes. They observed that high crime rates persisted in certain areas

of Chicago over time, regardless of the populations residing there. This led them to propose that the social disorganization of these areas—characterized by poverty, high residential mobility, and weak community ties—contributed to the prevalence of crime. The lack of a strong community structure and the inability of local institutions to enforce effective social norms facilitated delinquent behaviors among the youth.

Given that access to basic sanitation services and education are fundamental to socioeconomic development, urban areas poorly served in these respects should exhibit high levels of poverty and social disorganization. Moreover, the deficient quality of education, reflected in high school dropout rates, interferes with the proper transmission of norms and behavioral values to children and adolescents, further weakening community ties. Based on this, we propose the following hypotheses:

H2 – The proportion of households with adequate sanitation infrastructure is negatively and significantly causally associated with the homicide rate.

H3 – The illiteracy rate has a positive and significant causal association with the homicide rate.

H4 – There is a positive and significant causal relationship between the elementary school dropout rate and the homicide rate.

H5 – The high school dropout rate is positively and significantly causally related to the homicide rate.

Hirschi e Gottfredson (1983) argue that the proportion of young people in the population should significantly affect the likelihood of crime occurrence, especially more serious offenses such as homicides. They explain that young people, due to biological, psychological, and social factors, tend to be more prone to risk-taking behaviors and transgressions, including criminal acts. Moreover, they contend that changes in the age composition—such as an increase in the proportion of young people in a population—should raise crime rates, due to the greater presence of individuals more inclined towards crime.

The relationship between age and the propensity for crime is crucial, as variations in the age structure among regions or across different periods can explain discrepancies in crime rates (CAMARANO, 2014). Increases in the young population, such as during baby booms, in regions with high young immigration, or with high school dropout rates, increasing the proportion of idle young people, tend to raise the incidence of crimes. Thus, Hirschi and Gottfredson (1983) enrich the Theory of Social Disorganization by proposing that different demographic configurations are associated with different levels of social stability and control, directly affecting crime rates.

From this perspective, authors such as Blumstein (1995), Thornberry (1996), Wallman e Blumstein (2005), and Fox e Zawitz (2010) observe that criminality, especially homicides, is strongly associated with males and varies significantly over an individual's lifetime. Typically, involvement in crime begins during adolescence, at ages 12 and 13, intensifies rapidly, and peaks between the ages of 18 and 24. Afterward, starting from age 25, the propensity to commit crimes begins to gradually decline, decreasing sharply after age 30. Blumstein (1995) uses the concept of the "criminal age curve" to illustrate how the likelihood of committing crimes increases during adolescence and young adulthood and decreases later in adulthood.

Based on this, we propose the following hypothesis:

H6 – There is a positive and significant causal relationship between the proportion of young men aged 15 to 29 in the population and the homicide rate.

Using the dual theoretical approach of Crime Ecology and Social Disorganization, Glaeser e Sacerdote (1999) explored the reasons why small municipalities and rural areas often exhibit lower crime rates. They suggest that social cohesion in these communities is strengthened by the proximity between the police and residents, which facilitates the identification of suspicious behaviors and unfamiliar individuals. In contrast, metropolitan areas face challenges due to their large size and population diversity, as well as the constant influx of migrants, factors that can undermine social cohesion and increase crime rates. Based on these observations, we propose the following hypothesis:

H7 - The proportion of interstate migrants in the population is positively and significantly causally related to the homicide rate.

In addition to the theories discussed, our theoretical model incorporates the Rational Choice Economic Theory, developed by Becker (1968). This approach proposes that the decision to commit a crime results from a rational process in which individuals weigh the benefits of formal employment and its salary against the potential gains from criminal activities, also considering the likelihood of the crime being discovered, the probabilities of arrest and conviction, as well as the duration and severity of expected penalties. Becker (1968) argues that investments that strengthen the police, judicial, and prison systems increase the probability of detection and conviction, acting as a deterrent to crime.

Furthermore, Ehrlich (1973) provides empirical support to Becker's Rational Choice Theory by evaluating the influence of socioeconomic factors such as the unemployment rate, average worker income, income inequality, per capita investment in public security, and the effectiveness of criminal law enforcement (evidenced by the incarceration rate and the average duration of sentences) on criminal decision-making. Additionally, Zimring (2007) and Fajnzylber, Lederman e Loayza (2002) argue that while these factors generally explain property crimes, they also play a crucial role as determinants of violent crime, which is often motivated by economic reasons. In light of these findings, we suggest the following hypotheses:

H8 – The unemployment rate is positively and significantly causally associated with the homicide death rate.

H9 – The average household per capita income is negatively and significantly causally associated with the homicide rate.

H10 – The per capita GDP has a significant negative causal relationship with the homicide rate.

H11 – There is a significant negative causal relationship between per capita government spending on public security and the homicide rate.

As previously discussed, the Theory of Social Disorganization highlights that the deterioration of fundamental social institutions—such as families, schools, and community networks, especially in rapidly changing urban contexts—tends to create an environment conducive to criminality, increasing its rates. In this context, the concept of anomie, introduced by Durkheim (1893), becomes particularly relevant.

Durkheim defines anomie as a social condition in which the norms governing human behavior become confused, conflicting, or absent. This phenomenon tends to occur particularly

during periods of rapid social change or crisis when the set of norms and values loses its relevance without being promptly replaced. This state of social disorganization and weakened normativity fosters deviant behaviors, which can, among other phenomena, intensify criminality. Merton (1938) expanded on this view, arguing that a materialistic culture combined with issues in income distribution can lead to a state of anomie and an increase in criminality. He posits that when the cultural emphasis on economic success and accumulation of wealth is disproportionate to the legitimate means available for individuals to achieve these goals, a state of conflict and anomie arises, leading them to question the law and consider the costs and benefits of criminal activities. Thus, the concept of anomie connects the Theory of Social Disorganization to the Rational Choice Theory, suggesting that an unequal distribution of economic resources — which accentuates the disparity between the rich and the poor— generates tensions and imbalances, potentially leading to property and violent crimes. Based on this, we propose the following hypothesis:

H12 – In the Brazilian context, economic inequality is positively and significantly causally related to the homicide rate.

The integration of the theories of Crime Ecology, Social Disorganization, and Rational Choice creates a rich and multifaceted framework that synthesizes environmental, social, and economic elements influencing the homicide rate in Brazil. In the following sections, we will develop an econometric model to test the proposed hypotheses; we will analyze the statistical significance of the estimated coefficients and evaluate the impact of these factors.

3. DATA BASE AND VARIABLES

To assess the impact of socioeconomic, demographic, and educational factors on homicide rates in Brazil, this study utilizes consolidated data from all 27 Brazilian states, covering the period from 2000 to 2014. The homicide rate, our dependent variable, is calculated as the ratio of the number of homicides to the population projections from the IBGE (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2024). Homicide records were obtained from the Sistema de Informações de Mortalidade (SIM/DATASUS, 2024).

The explanatory variables, detailed in Table 1, were organized into three main categories: i) demographic determinants, ii) educational determinants, and iii) socioeconomic determinants. In the demographic determinants group, the variables include the proportion of young men aged 15 to 29, the urbanization rate, the proportion of households with adequate sanitation facilities, and the proportion of interstate migrants. These variables, linked to the theoretical framework of Crime Ecology and Social Disorganization, are derived from the National Household Sample Survey (Pesquisa Nacional por Amostra de Domicílios - PNAD).

In the educational dimension, we selected the illiteracy rate of individuals aged 15 and older, as illiteracy limits access to stable and well-paid jobs, increasing the likelihood of involvement in criminal activities. Additionally, we included two important variables: the dropout rates in the final years of elementary and secondary education. Adolescents and young people — who typically attend these educational stages between 11 and 18 years — face idleness during a critical period of cognitive and social development when they abandon their studies. This detachment compromises learning, sociability, and the development of relational skills, harming their future professional integration and increasing the propensity for involvement with crime. Moreover, school dropout occurs in a phase particularly vulnerable to violence, especially among young males, since the highest risk of involvement or exposure to violent crimes occurs between the ages of 15 and 29 (CERQUEIRA; MOURA, 2014; WAISELFISZ, 2014; ZANOTELLI et al., 2011). The data for these three variables were

collected from 2000 to 2014, sourced from the Annual Census of Basic Education conducted by the National Institute of Educational Studies and Research Anísio Teixeira (INEP/MEC).

Table 1 – variables framework

Code	Dimension	Variables	Source
V0	Violence	Homicide rate (dependent variable)	*SIM/DATASUS; IBGE*
V1	Violence	Proportion of young men (15 to 29 years)	*IBGE (Projections)*
V2	Violence	Urbanization rate	*IBGE (PNAD)*
V3	Demographics	Proportion of households with adequate sanitation facilities	*IBGE (PNAD)*
V4	Demographics	Proportion of interstate migrants (percentage of migrants relative to the state population)	*IBGE (PNAD)*
V5	Education	Illiteracy rate (individuals aged 15 and over)	*IBGE (PNAD)*
V6	Education	Dropout rate in the final years of elementary school	*MEC/INEP*
V7	Education	High school dropout rate	*MEC/INEP*
V8	Socioeconomic	Per capita GDP	*IBGE (Regional Accounts)*
V9	Socioeconomic	Gini coefficient	*IBGE (PNAD)*
V10	Socioeconomic	Unemployment rate (ages 16 and over)	*IBGE (PNAD)*
V11	Socioeconomic	Average household income per capita	*IBGE (PNAD)*
V12	Socioeconomic	Per capita government spending on public security, with time lag	*STN*

Source: Author's own.

Finally, in the socioeconomic dimension, we included variables associated with the combination of ecological and social disorganization theories as well as the economic theory of crime. These variables include per capita Gross Domestic Product (GDP), the Gini coefficient, the unemployment rate for individuals aged 16 and over, and the average household income per capita (deflated by the INPC to 2014 values) [i]. According to Rational Choice Theory, these variables can influence the decision-making process of committing or not committing a crime. This influence occurs through the comparison of gains from the legal market (work, salary income, among others) with gains derived from criminal activity (robberies, murders of rivals in territorial disputes, etc.).

In addition to these variables, we also included per capita public security spending—adjusted by the INPC for 2014 values—representative of the state's effort to deter crime. This variable, whose data are sourced from the National Treasury Secretariat (Secretaria do Tesouro Nacional - STN), is used with a one-year time lag (t-1) in relation to the homicide rate, to mitigate potential problems of reverse causality and endogeneity.

All variables were logarithmized so that the estimated coefficients express elasticities (Wooldridge, 2016). After excluding missing data, our variables formed a balanced panel, with a total of 405 observations.

4. METHODOLOGY

In this study, we employed a random effects panel data model using Stata® 11 software (STATA CORP, 2009) to conduct the econometric analyses. This model is particularly suitable for analyzing data involving multiple observations over time for the same units, in this case, the 27 Brazilian states. The advantage of the panel data model lies in its ability to adjust for unobservable heterogeneity. This means it can control for the effects of variables that are not measurable but remain stable over time for each unit (such as the effects of local culture) or remain stable across units at a given time (e.g., the effects of a macroeconomic shock). If not controlled, this unobservable heterogeneity could bias the estimates, hindering reliable identification of causal relationships between the homicide rate and the proposed factors in our hypotheses (STOCK; WATSON, 2007; WOOLDRIDGE, 2016).

Panel data models are divided into two types: fixed effects and random effects. The fixed effects model controls for unobservable heterogeneity—which is presumed to be correlated with the independent variables—to avoid omitted variable bias. In contrast, the random effects model assumes that unobservable heterogeneity operates as a random variable, uncorrelated with the independent variables. To determine the most appropriate model, we applied the Haussmann test, which assesses whether the differences in the coefficients estimated by the two models are statistically significant. If they are, the fixed effects model is recommended, as failing to control for unobservable heterogeneity could bias the estimates (WOOLDRIDGE, 2016).

In our study, the Haussmann test indicated that the random effects model is more appropriate, leading us to adopt it. By selecting this model, Stata® automatically applies the Generalized Least Squares (GLS) estimator. The GLS is a consistent and efficient method, not only producing unbiased coefficient estimates but also adjusting the standard errors to adequately reflect the intra-group variability of the units (i.e., states). This adjustment is crucial as it reduces the likelihood of underestimating or overestimating standard errors in the presence of heteroscedasticity, which is common in panel data. Accurate estimation of standard errors is essential for conducting reliable t-tests, ensuring that inferences about the significance of coefficients are valid (STOCK; WATSON, 2007; WOOLDRIDGE, 2016). Additionally, to further strengthen the reliability of statistical inferences about the significance of the estimated coefficients, we used robust standard errors in our analysis. This precaution guards against the possibility that heteroscedasticity is not fully corrected by the GLS.

5. RESULTS AND DISCUSSION

This section presents and analyzes the research findings. Prior to that, however, we provide descriptive statistics in Table 2, which highlight the number of observations, minimum and maximum values, means, and standard deviations, as well as the correlation matrix of the variables in Table 3.

The analysis of correlations is necessary to investigate potential multicollinearity issues in the data. According to Stock and Watson (2007) and Wooldridge (2016), multicollinearity occurs when a high correlation is identified between two or more independent variables. When working with panel data structures, it is very difficult for explanatory variables not to exhibit multicollinearity. This is not inherently a problem. Multicollinearity can only compromise regression results when several explanatory variables are strongly correlated with each other. However, this is not the case in our dataset.

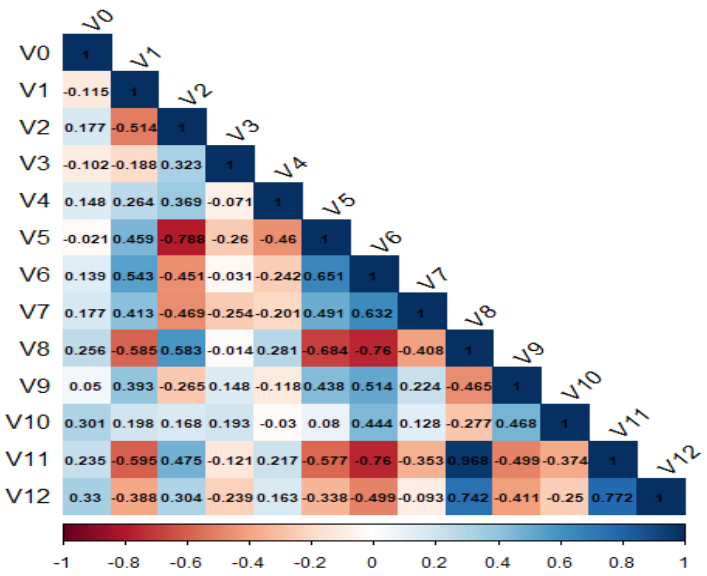
Table 2 – Descriptive statistics for the original non-logarithmic variables

Code	Variables	Obs.	Min	Max	Mean	SD	CV (%)
V0	Homicide rate (per 100,000 inhabitants)	405	6.21	71.39	28.89	12.30	42.58
V1	Proportion of young men (15 to 29 years) (%)	405	11.83	15.35	14.21	0.82	5.81
V2	Urbanization rate (%)	405	58.25	97.37	79.27	9.24	11.65
V3	Proportion of households with adequate sanitation facilities (%)	405	1.78	99.11	49.54	24.50	49.46
V4	Proportion of interstate migrants (%)	405	3.65	57.20	19.63	14.00	71.32
V5	Illiteracy rate (individuals aged 15 and over) (%)	405	2.73	31.11	11.35	7.02	56.00
V6	Dropout rate in the final years of elementary school (%)	405	1.20	21.90	8.27	4.94	59.80
V7	High school dropout rate (%)	405	3.90	26.40	12.15	4.33	35.65
V8	Per capita GDP (in R$)	405	846.21	61306.27	10031.97	9140.74	91.12
V9	Gini coefficient (inequality measure)	405	0.42	0.69	0.55	0.05	8.99
V10	Unemployment rate (%)	405	2.96	19.47	8.37	3.08	36.83
V11	Average household income per capita (in R$)	405	77.35	2377.00	460.70	345.51	75.00
V12	Per capita public security expenditure, with time lag (in R$)	405	0.30	568.88	132.70	108.42	81.72

Source: Author's own

The correlation matrix in Table 3 presents the Pearson coefficients for the dependent and independent variables in our study. Out of the 156 correlation coefficients calculated between pairs of variables, only the one associating average household income per capita (V11) and per capita GDP (V8) was particularly strong, with a value greater than 0.8 in absolute terms. Given the theoretical framework of our research, this association between per capita income and per capita GDP was expected and does not compromise the results of the empirical model. Therefore, it is concluded that there are no significant multicollinearity issues among the explanatory variables.

Table 3 – correlation matrix



Source: Author's own

Finally, Table 4 summarizes the research findings, presenting the estimated coefficients, their robust standard errors, and respective statistical significances, along with the results of the Wald test for the joint significance of the regressors, the adjusted R^2 value, the Haussmann test, and other supplementary information. The table shows that out of the twelve explanatory variables, four are statistically significant. Among these, three support hypotheses H4, H7, and H8, at least at the 10% significance level. Notably, the unemployment rate and average household income per capita emerge as key determinants of the homicide rate. Therefore, we begin by analyzing the hypotheses and results related to the economic dimension.

Hypothesis H8, grounded in Rational Choice Theory, posits a positive relationship between the unemployment rate and the homicide rate. According to this theory, individual decisions, including the choice to commit violent crimes such as homicides, are influenced by a rational assessment of costs and benefits. During periods of high unemployment, the reduction in household income tends to increase economic stress and the need for alternative means of support. If the expected benefits of criminal activities outweigh the risks of arrest and punishment, individuals may be driven to crime. In this context, homicides can occur as isolated events or in more complex situations, such as confrontations with the police, criminal gang disputes over territory, or power struggles within gangs.

Table 4 – Econometric results

Variables	Coef.	Std. Error
Proportion of young men (15 to 29)	-0.541	1.428
Urbanization rate	-0.193	0.735
Proportion of households with adequate sanitary facilities	-0.006	0.036
Proportion of interstate migrants	0.165 *	0.093
Illiteracy rate (15+)	0.204	0.139
Elementary school dropout rate	0.144 **	0.066
High school dropout rate	0.104	0.081
GDP per capita	0.038	0.173
Gini (measure of inequality)	0.208	0.277
Unemployment rate (15+)	0.371 ***	0.102
Average household income per capita	0.351 **	0.185
Per capita expenditure on public security	0.007	0.031
Constant	1.041	5.406
Observações	378	
Prob > chi²	0.000	
R2	0.337	

Dependent variable: Homicide rate (in logarithm)
Note: * p<0.10, ** p<0.05, *** p<0.01

Source: Author`s own

Hypothesis H9, on the other hand, also grounded in Rational Choice Theory, predicted a negative relationship between average household income per capita and the homicide rate. However, our results do not confirm this expectation. Similar to the findings of Cerqueira and Moura (2014), we identified that this relationship is significant but positive. The elasticity estimate, significant at the 5% level, was 0.351, implying that for each 1% increase in average household income per capita, the homicide rate will increase by an average of 0.351%. This result, although surprising, is supported by Rational Choice Theory. On one hand, higher incomes can discourage crime by representing a high opportunity cost for individuals engaged in lawful activities, such as workers and entrepreneurs who do not want to risk their jobs and businesses. On the other hand, higher incomes can also incentivize crime by increasing the profitability of activities like drug trafficking, kidnappings, and violent forms of property crimes, such as cargo theft, bank robberies, and armed assaults, which can result in fatalities.

Our results suggest that in Brazil, this conflict of forces leads to a greater incentive for crime, producing the positive and significant coefficient observed in our regression.

These findings are crucial for guiding public security policies, indicating that policies aimed solely at promoting employment and income may be insufficient to reduce violent crime. While increases in employment tend to reduce the homicide rate, they also raise average household income, potentially offsetting some of the benefits achieved. Additionally, increases in household income that do not stem from employment, such as pension and retirement adjustments above inflation, can exacerbate property and violent crimes. Therefore, policy planning must be cautious to avoid adverse effects.

Hypothesis H10 posits a negative and significant relationship between per capita GDP and the homicide rate. Per capita GDP, reflecting the social wealth per inhabitant and the economic health of a region, is generally associated with greater resources for investments in infrastructure, education, and public security. Such investments can improve the quality of life and strengthen social cohesion, reducing both the attractiveness of criminal activities and the propensity to commit crimes. Additionally, according to Rational Choice Theory, in regions with high per capita GDP, the opportunity costs associated with committing crimes are high, as individuals have more to lose in terms of wages, profits, and living conditions if they are caught and punished. However, our results indicate that per capita GDP did not show statistical significance in explaining the homicide rate. This lack of significance may be attributed to the presence of variables such as average household income per capita and the unemployment rate, which more directly capture the economic variations that impact criminality.

Finally, hypotheses H11 and H12 were also rejected. H11 predicted a positive and significant causal relationship between government per capita spending on public security, with a one-period lag, and the homicide rate; while H12 suggested a negative and significant relationship between income distribution and the homicide rate.

In the case of H11, the lack of statistical significance, although unexpected, is understandable. Research in various fields of Public Administration reveals that government investments do not necessarily guarantee tangible results. For instance, in the educational sector, researchers such as Hanushek (1995), Tan e Mingat (1992) and Rajkumar and Swaroop (2008) have observed that government per capita spending on public education often does not translate into significant improvements in quality and access indicators. This lack of impact, more prevalent in developing countries than in the United States or European countries, is often attributed to corruption and administrative inefficiencies that divert or waste resources, resulting in a much lower application of funds than planned. These factors contribute to weakening the coefficients between public spending and service indicators, making them weak or non-significant (KRAKOWIAK; SEIXAS, 2023; SURYADARMA, 2012).

Indeed, data from the 8th Annual Report of the FBSP (FÓRUM BRASILEIRO DE SEGURANÇA PÚBLICA, 2014) show that although the proportion of public security expenditures relative to GDP is similar in Brazil and the 27 countries of the European Union (1.26% and 1.30%, respectively), the homicide rate in Brazil was nearly 25 times higher. In 2014, Brazil recorded 25.2 homicides per 100,000 inhabitants, compared to 1.1 homicides per 100,000 in Europe.

The rejection of hypothesis H12, which posited a positive and significant relationship between income distribution and the homicide rate, is also not entirely surprising. Hartung's (2009) research, which investigated the determinants of the homicide rate in the Brazilian

context, reached the same conclusion. Hartung (*op cit*.) notes that the inclusion of demographic variables in his regression models reduced the statistical significance of income disparity in determining the homicide rate. He highlights that in most of his regressions on violent crimes, inequality, measured by the Gini index, ceased to be significant when demographic variables were included. According to Hartung, "it is possible that studies that do not consider these important determinants of crime are overestimating the effect of inequality on homicides due to a possible omitted variable bias" (HARTUNG, 2009, p. 5)

Merton (1938) theorized that in a materialistic society where the cultural emphasis on economic success and the accumulation of goods is disproportionate to the availability of legitimate means to achieve these goals, a state of anomie arises among the less privileged. This state could lead individuals to question the laws and weigh the costs and benefits of criminal activities. Despite the validity of this reasoning, our results indicate that in Brazil, this variable is statistically insignificant in determining the homicide rate. Thus, while this mechanism may, in specific cases, lead individuals to crime and lethal violence, in general, the frustration and anguish caused by this dilemma do not present themselves as a relevant determinant of homicides in Brazil.

In addition to exploring economic determinants, our study also evaluated the impact of demographic and social factors on the homicide rate. Among the hypotheses tested, H1 and H7, grounded in the combination of Ecological and Social Disorganization theories, propose a positive and significant causal relationship between the homicide rate and, respectively, the urbanization rate and the proportion of interstate migrants in the population. Additionally, hypothesis H2 posits an inverse and significant relationship between the proportion of households with adequate sanitation facilities and the homicide rate, while hypothesis H6 suggests a positive association between the proportion of young men (ages 15 to 29) and the homicide rate.

As discussed, the Ecological Theory of Crime explains that as cities expand; concentric zones of transition emerge, represented in Brazil by urban peripheries. These areas experience rapid population growth due to the high cost of housing in central regions and the availability of more affordable housing in the peripheries, as well as the expansion of public transportation infrastructure connecting these areas to the city center. However, this population growth often exceeds the government's capacity to provide adequate infrastructure and services, such as education and healthcare, leading to social disorganization in the peripheries. This situation is further exacerbated by the influx of migrants who are often poorly integrated into local social networks, intensifying social disorganization and hindering community control, which can result in an increase in deviant behaviors and violent crimes, including homicides.

Furthermore, communities with high population turnover and ethnic, cultural, and economic diversity face challenges in establishing strong bonds among residents and with social institutions, such as schools and the police, reducing the community's ability to deter crime. Weak integration into the community can lead a portion of migrants, especially those with lower education levels and during periods of low economic activity, to engage in informal and vulnerable occupations like street vending and prostitution, which are susceptible to assaults, robberies, and violence, thus exacerbating the homicide rate. From the perspective of Rational Choice Theory, the deprivations faced by this group may also lead them to choose crime as a means to ensure subsistence or improve their living conditions. Although such criminal activities are predominantly of a property nature, they may contribute to an increase in violent crime and homicides.

Our results support hypothesis H7, which demonstrates a positive and statistically significant causal relationship between the proportion of interstate migrants and the homicide rate, with each 1% increase in this proportion raising the homicide rate by 0.16%. On the other hand, hypotheses H1, H2, and H6, which proposed a positive association between the homicide rate and, respectively, the urbanization rate, adequate household sanitation infrastructure, and the proportion of young men among the population, were rejected, as they did not show statistical significance.

These findings validate the Ecological and Social Disorganization theories by confirming the influence of interstate migrants on the homicide rate. Additionally, they suggest that: (1) in isolation, increasing urbanization may not be a significant factor in raising the homicide rate in Brazil. Aspects such as the quality of urbanization and specific characteristics of urbanized areas may have a more substantial impact on crime than merely the proportion of the urban population in a given region (COSTA, 2022; LIRA; MONTEIRO, 2018); (2) specific improvements in sanitation infrastructure do not significantly affect homicide rates, although this does not exclude the possibility that broader and more diversified public investments, which genuinely represent the presence of the State in communities, could reduce them; (3) a higher proportion of young men aged 15 to 29 in the population does not seem to elevate homicide levels on its own, indicating that variables such as unemployment, income, education, and social inclusion may play a more critical role in preventing lethal violence than the proportion of individuals in this age and gender group.

Finally, three other hypotheses examine the impact of the access to and the quality of education on the homicide rate in Brazil. Of these, however, only hypothesis H4 finds support in the data, revealing a positive and significant causal relationship between the dropout rate in the final years of elementary school and the homicide rate. This relationship is statistically significant at the 5% level, with a coefficient of 0.144, suggesting that a 1% increase in the school dropout rate at this educational stage is associated with approximately a 0.14% increase in the homicide rate.

Conversely, hypotheses H3 and H5, which proposed a positive relationship between the homicide rate and, respectively, adult illiteracy (age 15 and above) and the high school dropout rate, were not confirmed. The lack of statistical significance for illiteracy may be explained by the influence of other educational variables present in the model, such as dropout rates at different educational levels. The exclusion of these variables from the model could theoretically reveal a positive and significant influence of illiteracy, as suggested by hypothesis H3. However, this action would introduce risks of endogeneity due to the correlation between illiteracy and school dropout rates[ii], leading to potential omitted variable bias, as highlighted by Wooldridge (2016).

The same reasoning applies to the high school dropout rate, whose estimated coefficient is positive but not significant. In this case, however, there are reasons to believe that this variable may not be a causal determinant of the homicide rate in Brazil. Research indicates that the percentage of idle youth—those who neither study nor work—aged 19 to 24 is higher among those who drop out before completing elementary school than among those who drop out of high school. According to Monteiro's (2013) study, idleness rates for youth with incomplete elementary education were 9% in 2001 and 14% in 2011, while for those with incomplete high school education, the rates were 3% and 6%, respectively. Thus, children and teenagers who leave school in the final years of elementary school are almost three times more likely to

become idle, increasing their vulnerability to recruitment by criminal gangs and involvement in drug trafficking.

The findings of Carvalho e Soares (2013) complement this view by revealing how school dropout influences recruitment into organized crime. Their research, which involved interviews with 233 young gang members in 34 favelas in Rio de Janeiro, showed that 88% of the respondents were under 18 years old, with the majority (67%) between 16 and 18 years old. Among the respondents, only 10% were attending school, while 70% had dropped out in the final years of elementary school, and 57% had done so before the age of 15. These data are crucial for understanding why there is no significant causal relationship between high school dropout rates and homicide rates, unlike the dropout rates in the final years of elementary school. Additionally, they clarify why the proportion of young men aged 15 to 29 does not significantly affect homicide rates in Brazil. According to Beresford and Wood (2016) the main individuals involved in homicides, both as victims and perpetrators, are gang members[iii], and these, as noted by Carvalho and Soares (*op. cit.*), are concentrated in a much narrower age range, from 16 to 18 years old.

6. CONCLUSIONS

This study conducted a comprehensive investigation into the socioeconomic, demographic, and educational determinants of the homicide rate in Brazil. Utilizing a broad dataset and a random-effects panel data econometric model, the results highlight the complexity of interactions among these factors and their influence on violent crime, both corroborating and challenging hypotheses from three important criminological theories in the fields of sociology and economics.

The findings confirm that the unemployment rate and average per capita income are significant determinants of the homicide rate. In line with Rational Choice Theory, the study revealed a positive and significant causal relationship between the unemployment rate and the homicide rate, suggesting that unemployment, by limiting legitimate earning opportunities, reduces the opportunity cost associated with crime, thus encouraging it. On the other hand, the analysis of average per capita income reveals a more complex dynamic: while increases in income can discourage crime by raising the opportunity cost for those earning salaries and profits in legitimate activities, they can also make criminal activities more profitable and attractive to habitual offenders. Therefore, crimes such as kidnappings, cargo theft, bank robberies, and armed assaults may increase with rising income, elevating the homicide rate. The positive and significant coefficient found for average per capita income suggests that, in Brazil, the tendency towards crime prevails in this conflict of forces.

The implications for public security policy are profound. The results suggest that strategies for reducing violent crime should not rely excessively on employment and income generation policies. This is because, while increased employment may reduce the homicide rate, this benefit is partially offset by the concomitant increase in average household per capita income. Additionally, increases in family income not linked to employment, derived, for example, from minimum wage adjustments—affecting pensions and social security— may foster property and violent crime. The positive and significant coefficient for this variable implies that, in a national public security policy, planners should consider average per capita income as a potential catalyst for the homicide rate, integrating this insight into their forecasts and strategic actions.

The study also highlighted the role of educational factors, particularly emphasizing the positive and significant relationship between the dropout rate in the final years of elementary school and the homicide rate. This finding suggests that strategies focused on keeping students, especially those aged 11 to 14, in school can significantly reduce the homicide rate. Therefore, within the scope of a national public security policy, promoting well-structured curricula and engaging educational strategies that make pedagogical content more appealing, as well as encouraging full-time schooling and vocational training programs, are crucial. These actions, along with sports and cultural activities, can reduce school dropout rates while providing skills that facilitate employability, reducing idleness and the potential for involvement in criminal activities.

Additionally, the study confirmed a positive and significant causal relationship between the proportion of interstate migrants and the homicide rate, highlighting how the challenges of integrating these individuals and the resulting erosion of social cohesion—driven by population growth and diversification—can intensify crime. Particularly during periods of low economic activity, migrants with lower education levels tend to face unemployment or informal and vulnerable jobs, significantly increasing the risk of becoming victims of property or violent crimes, or being recruited into crime. This context underscores the need for national policy support for local initiatives aimed at welcoming and integrating migrants through public policies on housing access, vocational training, employment, and income.

Conversely, reducing inter-regional disparities in economic development can lessen socioeconomic vulnerability and the need for interstate migration. Therefore, federal government efforts to promote more balanced regional development, using fiscal instruments such as government transfers and subsidies, are crucial for an effective national public security policy. The success of this policy, however, depends on consistent incentives for control and oversight institutions, such as the Comptroller General's Office, Courts of Accounts, Public Policy Councils, and Public Prosecutor's Office, to ensure the proper use of transfers and the transparent and efficient expenditure of public resources (FERRAZ; FINAN, 2018)

In Brazil, the efficiency of public spending remains a significant challenge. Studies show that corruption and administrative inefficiencies often prevent government expenditures from translating into effective public services, resulting in weak or statistically insignificant coefficients in the relationship between public spending and policy outcome indicators (KRAKOWIAK; SEIXAS, 2023). This seems to be a plausible explanation for the statistically insignificant relationship between per capita state spending on public security and the homicide rate found in this study for Brazil. This finding underscores not only the need for transparency and accountability in public fund management but also the importance of robust evidence-based planning for public security policies to enhance the effectiveness and efficiency of their actions (PINHEIRO, 2020)

The findings highlight the need for a comprehensive national public security policy that integrates social, economic, demographic, and educational initiatives to address the complex causes of homicides in Brazil.

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[i] INPC stands for Índice Nacional de Preços ao Consumidor – National Consumers Price Index – a measure of inflation.

[ii] See table 3.

[iii] According to Beresford and Wood (2015), various self-report studies have found that gang members are responsible for 70% of all violent crimes committed by adolescents. Additionally, Huff (1998) discovered that in the context of four major U.S. cities, members of these criminal organizations were ten times more likely to commit homicide, four times more likely to assault a rival, and three times more likely to assault their fellow gang members.