



Breaking the cycle: how police, courts, and prisons influence homicide rates.

Croci, Gonzalo

Universidad ORT Uruguay

Centro de Estudios Latinoamericanos sobre Inseguridad y Violencia

Gómez, Joel

Universidad ORT Uruguay

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Abstract

This research examines the impact of three critical components of the criminal justice system—police investigation, judicial adjudication, and prison system effectiveness—on homicides. Using panel regression models, the study identifies which institutional factors exert the most significant influence on homicide rates. The findings reveal that prison system effectiveness has the strongest and most statistically significant effect on reducing homicides. Conversely, police investigation and judicial processes show negative but statistically insignificant correlations, suggesting that while these systems are essential, their effectiveness may be compromised by systemic issues such as corruption, inefficiencies, and delays. The results underscore the importance of prioritising well-functioning and rehabilitative prison systems as a more direct approach to crime prevention. The paper concludes by advocating for targeted reforms within the prison system while also addressing inefficiencies in police and judicial operations. These insights aim to inform future policy decisions and contribute to the development of effective crime reduction strategies.

Keywords: Criminal Justice System; Homicide Rates; Institutional Effectiveness

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1. Introduction

The relationship between government effectiveness and crime reduction, has recently become a subject of study. While numerous factors have been linked to variations in homicide rates, such as poverty, education, and urbanisation, the role of the criminal justice system's components—namely the police, judiciary, and penitentiary system—remains a key area of investigation. Understanding which element of the criminal justice system has the most direct impact on homicide levels is important for informing policy decisions aimed at reducing violent crime.

Prior research has identified a clear link between institutional effectiveness and crime reduction, with scholars arguing that ineffective governance, corruption, and lack of accountability in law enforcement and judicial systems significantly undermine deterrence efforts (Lappi-Seppälä and Lehti, 2014; Nivette, 2014; Dawson, 2017; Oberwittler, 2019; Croci and Chainey, 2023). However, the extent to which each component of the criminal justice system—police, judiciary, and prisons—contributes to variations in homicide rates is still unclear. While police effectiveness directly affects the ability to prevent and investigate crimes, the judiciary's role in administering justice and ensuring timely trials, and the penitentiary system's ability to rehabilitate offenders and prevent recidivism, all play critical roles in shaping crime outcomes.

Notable, Latin America continues to experience some of the highest homicide rates globally, despite efforts to reform and strengthen institutions (UNODC, 2023). Consequently, this paper aims to investigate the impact of three critical components of the criminal justice system—police investigation, judicial adjudication, and prison system effectiveness—on homicide rates in the region. Specifically, the research seeks to answer the following questions: Which component of the criminal justice system has the most significant influence on homicide rates? By addressing this question, this study aims to provide a comprehensive assessment of how each element contributes to variations in homicide rates. The findings will not only clarify the roles of these institutions but also provide evidence that can inform policy decisions aimed at improving public safety. Ultimately, this research aspires to fill existing gaps in the literature regarding the relationship between institutional effectiveness and crime reduction, thereby contributing insights for future reforms in Latin America's criminal justice system. While the dataset includes 61 countries, this paper pays particular attention to Latin America, where the interplay between weak institutions and high homicide rates is most acute (Croci, 2023). The region serves as a critical empirical lens through which broader patterns can be understood.

The next section presents a narrative literature review that examines the various factors associated with homicide rates, focusing on the effectiveness of the criminal justice system. This review highlights existing research on police effectiveness, judicial efficiency, and prison management, establishing a foundation for understanding their impacts on crime. Subsequently, the methodology section outlines the data sources and analytical techniques employed in the study. Thereafter, the results section details the findings of the analysis, emphasising the significant role of prison system effectiveness on homicide rates. Finally, the paper concludes with a discussion of the implications of these findings for policy reform, advocating for targeted improvements in the prison system while addressing inefficiencies within police and judicial operations.

2. Literature review

A substantial number of variables have been subjected to investigation with the objective of establishing whether they are associated with homicides, as well as with crime in general. The results achieved vary considerably, with the majority focusing on structural variables such as poverty (Messner, 1982; Neumayer, 2003; Ouimet, 2012; Rennó Santos et al., 2018), inequality (Fajnzylber et al., 2002a; Fajnzylber et al., 2002b; Pratt and Godsey, 2003; Nivette, 2011; Lappi-Seppälä and Lehti, 2014; Neumayer, 2003; Soares, 2004; Ouimet, 2012; Rennó Santos et al., 2018; Cao and Zhang, 2017), availability of weapons (Asongu and Acha-Anyi, 2019), education (Soares, 2004; Groot and van den Brink, 2010; Anderson, 2014), and others.

However, the relationship between institutional effectiveness and homicide rates has been a subject of growing interest, particularly in Latin America, where persistently high levels of violence challenge traditional crime prevention strategies. While socio-economic factors such as poverty and inequality are often cited as drivers of violence, institutional factors—including the capacity of law enforcement, judicial efficiency, and prison management—are increasingly recognized as central to understanding and reducing homicide rates (Lappi-Seppälä and Lehti, 2014; Cao and Zhang, 2017; Dawson, 2017; Tebaldi and Alda, 2017; Croci and Chainey, 2023; Croci and Gomez, 2024).

The current research evidence indicates that government effectiveness plays a crucial role in shaping security outcomes. The concept of government effectiveness encompasses a range of institutional factors, including the ability to enforce the rule of law, combat corruption, and deliver public services effectively. Several studies have found that weak institutions, particularly those related to the criminal justice system, correlate with higher levels of homicides. For example, Soares and Naritomi (2010) argue that institutional weaknesses, particularly in the areas of policing and the judicial system, are key to explaining the high levels of violence in Latin America. Their analysis highlights that the failure

of these institutions to hold offenders' accountable results in a pervasive culture of impunity, which encourages further criminal behaviour. Similarly, Prillaman (2003) contends that corruption and institutional inefficiency undermine efforts to combat crime, particularly homicides. In his analysis of policing in Brazil, Prillaman points out that the lack of public trust in law enforcement leads to underreporting of crimes and a reluctance to cooperate with the police, thereby further weakening the state's capacity to deter violence.

2.1. Police Effectiveness

The effectiveness of law enforcement is widely recognized as a crucial factor in crime prevention and deterrence. According to deterrence theory, as proposed by Beccaria (1767), the certainty of punishment is more effective in deterring crime than its severity. Empirical studies provide evidence to support this hypothesis. For instance, Levitt (2004) found that increasing police presence and improving the capacity to apprehend offenders can significantly reduce crime, including homicides (see also Durlauf and Nagin, 2011; Nagin, 2013). This underscores the importance of a well-resourced, adequately trained police force that can swiftly bring offenders to justice. Younker et al. (2013) further demonstrate that ineffective governance correlates with higher homicide rates, suggesting that poor governance can severely hinder crime deterrence.

In Latin America, however, police effectiveness is often compromised by systemic issues, including resource shortages, and inadequate training. For example, research shows that police forces in countries like Brazil and Colombia are frequently implicated in human rights abuses, including extrajudicial killings, which erode public trust and reduce citizen cooperation with law enforcement (Ungar, 2007). This mistrust weakens crime deterrence efforts and contributes to cycles of violence.

Latin American police forces also face a dual challenge: addressing high levels of violence, such as that linked to organised crime and drug trafficking, while operating with limited resources and outdated equipment (Bayley and Shearing, 1996). In some countries, such as Mexico and El Salvador, police militarization has been used to counter organised crime. However, this strategy often escalates violence and fosters a militaristic approach to policing, which in turn may diminish civil liberties and fuel public discontent (Flores-Macías and Zarkin, 2021).

Corruption within law enforcement is pervasive, affecting every level of policing in countries like Mexico, where it enables criminal organisations to operate with impunity (Calderón et al., 2015). Similarly, police collusion with drug cartels in Honduras severely undermines efforts to reduce homicides and violent crime (Ribando Seelke, 2012). Moreover, Dammert and Malone (2006) highlight

that the lack of accountability in many Latin American police forces perpetuates police brutality and corruption, as officers engage in corrupt practices without fear of punishment. This lack of oversight further weakens the police's capacity to combat crime effectively.

2.2. Judicial Efficiency

The judiciary's role in crime reduction relies on delivering timely and fair justice. Delays in judicial processes foster a culture of impunity, undermining deterrence and contributing to higher homicide rates. Fajnzylber, et al. (2002a) found that countries with efficient judicial systems experience lower levels of violent crime, as swift prosecution and punishment of offenders enhance the deterrent effect. Similarly, Soares (2006) argues that judicial efficiency promotes accountability, preventing offenders from escaping the consequences of their actions.

In Latin America, however, deficiencies in the judicial system—including case backlogs, resource shortages, and corruption—severely weaken the judiciary's crime-fighting capacity. Studies by Perry et al. (2007) show that in countries like Mexico and Peru, judicial officials, influenced by bribes or political pressure, sometimes release violent offenders, further eroding public trust. This distrust often leads to extrajudicial justice, such as vigilantism, which perpetuates cycles of violence as communities take the law into their own hands.

Furthermore, Ungar (2007) notes that the combination of delays and corruption fosters legal cynicism, as the public loses confidence in the justice system's ability to deliver justice. This lack of trust undermines the rule of law and encourages further criminality, as offenders believe they can evade timely punishment. In countries like Brazil and Mexico, judicial delays create a bottleneck of unresolved cases, leading to overcrowded prisons filled with pretrial detainees, which exacerbates existing issues within the penitentiary system (Fondevila and Quintana-Navarrete, 2021).

Corruption is deeply intertwined with judicial inefficiency in Latin America. Prillaman (2003) explains that even well-intentioned reforms aimed at improving judicial efficiency often fail if corruption remains unaddressed. In this context, the judiciary contributes to broader structural violence that sustains high crime levels. Others also emphasise that corruption within the judiciary allows powerful criminal organisations to evade justice, thereby fuelling a broader sense of lawlessness (Lora, 2006).

2.3. Prison Systems and Recidivism

The penitentiary system plays a critical role in preventing violence and reducing recidivism. Research shows that overcrowded and poorly managed prisons not only contribute to high recidivism rates but

also become breeding grounds for criminal organisations. In this context, Coyle (2021a) argues that effective prison management should prioritise rehabilitation and reintegration. However, in many Latin American countries, prisons are instead characterised by poor conditions, violence, and organised crime control. For example, in Brazil, criminal factions like the Primeiro Comando da Capital (PCC) use prisons for recruitment, expanding their networks both within and outside prison walls (Feltran, 2020).

Lessing (2017) further emphasises that powerful prison gangs in Latin America, such as the PCC and Comando Vermelho (CV) in Brazil and the Zetas in Mexico, have turned prisons into operational bases. These gangs maintain control over territories beyond the prison, exacerbating crime rather than reducing it. Paradoxically, incarcerating gang leaders has often strengthened these organisations, illustrating how poorly managed prisons can contribute to organised crime. Pierce and Fondevila (2020) add that Mexican prisons, marked by overcrowding and poor management, perpetuate violence, as inmates often rely on gangs for protection, which entrenches criminal behaviours and heightens recidivism risks upon release.

Additionally, Skarbek (2014, 2020) contends that state failure to control prison populations empowers criminal organisations. His work shows that gangs establish systems of order within prisons that serve to reinforce criminal cultures, making rehabilitation nearly impossible. The lack of effective state intervention allows these organisations to thrive, making prisons a crucial site for the expansion of criminal networks rather than for the rehabilitation of offenders. This informal governance by gangs leads to high levels of organised violence both inside and outside prison, fostering environments where criminal behaviour is normalised and cycles of violence are perpetuated.

Conceptually, ineffective criminal justice institutions contribute to higher homicide rates through multiple mechanisms. Weak police capacity reduces deterrence by lowering the likelihood of apprehension. Judicial inefficiency undermines the legitimacy of the state and encourages extrajudicial justice. Most critically, dysfunctional prison systems facilitate gang recruitment, perpetuate recidivism, and serve as operational hubs for organized crime. In regions with high incarceration rates and poor prison governance, such as Latin America, prisons often exacerbate violence rather than mitigate it (Skarbek, 2014; Lessing, 2017; Feltran, 2020).

3. Data and methods

This study utilises data from the World Justice Project's Rule of Law Index¹ (2024a) from 2014 to 2021 for 61 countries (see Table 2). The data includes observations from 12 Latin American and Caribbean countries and 49 countries across the rest of the world, allowing for a comparative analysis of criminal justice system effectiveness. In particular, three key variables from the Rule of Law Index are central to this study. The first, *Criminal Investigative System Effectiveness*, assesses the ability of law enforcement agencies to apprehend and prosecute offenders by measuring resources, freedom from corruption, and competency. The second variable, *Criminal Adjudication System Effectiveness*, evaluates the timeliness and reliability of judicial processes in prosecuting and convicting offenders, highlighting the efficiency and fairness of criminal judges and judicial officers. Finally, *Correctional System Effectiveness in Reducing Criminal Behaviour* examines whether correctional institutions are secure, uphold prisoners' rights, and prevent recidivism, capturing the rehabilitative function of the prison system (World Justice Project, 2024a). Each criminal justice system variable—investigation, adjudication, and prison system effectiveness—is based on responses from over 3,500 legal professionals and 214,000 household surveys across countries (World Justice Project, 2024b). The indices reflect perceptions of performance on specific components, with values ranging from 0 (least effective) to 1 (most effective). While perception-based, they offer globally standardized metrics for cross-national comparison and are frequently used in empirical studies due to their wide coverage and consistent methodology.

To analyse the relationship between these variables and homicide rates, this study employs a random effects panel regression model. The panel structure, incorporating both temporal (2014-2021) and country-specific variations, allows for control of unobserved heterogeneity, obtaining small standard errors and precise estimates. This approach provides insight into how variations in institutional effectiveness impact homicide rates across different Latin American countries. Therefore, data on homicide rates for all countries were obtained from the UNODC database (UNODC, 2024), where homicides are defined as any "unlawful death inflicted upon a person with the intent to cause death or serious injury" (UNODC, 2015) and includes homicides that occur within prisons and correctional institutions (UNODC, 2024). Due to the high dispersion observed in homicide data, and following methodologies employed in previous studies, a base-10 logarithmic transformation was applied to normalise the homicide rate data. This transformation helps stabilise variance and mitigate the impact of outliers, facilitating more reliable statistical analyses. In addition to the primary criminal justice

¹ For more information on the methodology, data collection and other information on the Rule of Law Index, please see: <https://worldjusticeproject.org/rule-of-law-index/about#whatwemeasure>

variables, control variables such as education (data was extracted from Radboud University's Global Data Lab, 2024), unemployment, GDP per capita, and urban population (all data extracted from World Bank, 2024) are included to account for socio-economic influences on crime and because they have been largely used in previous studies. In this step, the GINI Index was also considered for inclusion. However, due to the absence of comprehensive data, this option was ultimately not feasible. The final aim of this comprehensive approach is to isolate the effects of criminal justice effectiveness on homicide rates while considering broader socio-economic contexts, offering a robust analysis of the criminal justice system's role in crime reduction.

The selected control variables are widely used in previous studies, specifically, those mentioned in the literature review section, such as poverty (Messner, 1982; Neumayer, 2003; Ouimet, 2012; Rennó Santos et al., 2018) or education (Soares, 2004; Groot and van den Brink, 2010; Anderson, 2014). The education variable is based on the Education Index, which is a component of the Human Development Index and is determined by integrating two key indicators: the average years of schooling for adults aged 25 and over and the expected years of schooling for children of school entry age (United Nations Development Programme, 2025). Furthermore, the unemployment variable refers to the share of the labour force that is unemployed but actively seeking employment and available for work (World Bank, 2025). In addition, GDP per capita (measured in US dollars) was selected as an indicator of poverty (following, for example, Lappi-Seppälä and Lehti, 2014). Finally, as homicides were also considered to occur mainly in urban areas (Neumayer, 2003; Baumer and Wolff, 2012), the urban population of each country was included in the model, with the data used corresponding to the proportion of the total population living in urban areas.

Additionally, a Variance Inflation Factor (VIF) analysis was conducted to assess potential multicollinearity among the predictor variables in the model. As will be mentioned subsequently, the VIF values for all variables were within acceptable limits, indicating moderate correlation without significant multicollinearity concerns.

4. Results

Table 1 shows the univariate statistics for the variables used in the analysis. The statistics reveal considerable variation in homicide rates across the dataset, which includes 488 observations. Homicide rates range from a low of 0.10 per 100,000 population to a high of 106.82 per 100,000 population, with a mean of 6.33 and a standard deviation of 11.67, indicating substantial disparity in levels of violence across different countries or regions.

The effectiveness of the investigation process, as measured by the respective index, ranges from 0.15 to 0.84, with a mean of 0.47 and a standard deviation of 0.15, showing moderate variation in law enforcement capacities across the sample. The adjudication variable, representing judicial effectiveness, has a mean of 0.53, with values ranging from 0.20 to 0.90, and a standard deviation of 0.16, suggesting some heterogeneity in how quickly and efficiently legal systems process cases. For the prison system performance, the values range from 0.03 to 0.97, with a mean of 0.46 and a standard deviation of 0.21, reflecting varied conditions in prison management and rehabilitation capacities across the dataset. Other variables such as unemployment also show significant variation, with a mean of 7.46 and a standard deviation of 5.02, ranging from 0.41 to 28.77. This variation across key variables underscores the heterogeneity that exists among the countries and regions included in the dataset, which will likely have important implications for the relationships explored in subsequent analyses.

Table 1: Descriptive statistics

Statistic	N	Mean	St. Dev.	Min	Max
Homicide rate	488	6.33	11.67	0.10	106.82
Investigation	488	0.47	0.15	0.15	0.84
Adjudication	488	0.53	0.16	0.20	0.90
Prison	488	0.46	0.21	0.03	0.97
Unemployment	488	7.46	5.02	0.41	28.77
Education Index	488	0.81	0.12	0.51	0.96
GDP per capita	488	20,679.64	20,126.70	753.68	97,666.70
Urban population	488	69.74	18.08	21.50	100.00

The correlation matrix in Table 2 presents the relationships between key variables—investigation, adjudication, prison system performance, and structural variables—and homicide rates. Starting with investigation effectiveness, there is a significant negative correlation of -0.485 with homicide rates. This suggests that countries with more effective investigative processes tend to experience lower homicide rates. The strength of this correlation highlights the importance of law enforcement's capacity to solve crimes and prosecute offenders as a deterrent to future criminal activity. When crimes are more likely to be solved, potential offenders may be dissuaded from committing violent acts, knowing that law enforcement is capable of identifying and apprehending them.

The relationship between adjudication (judicial efficiency) and homicide rates is also notably negative, with a correlation of -0.443. This indicates that as the judiciary becomes more efficient—processing

cases in a timely manner and reducing delays in delivering justice—homicide rates decrease. This supports existing literature that argues that the prompt administration of justice reduces impunity, a major factor in regions with high levels of violent crime. When judicial systems function effectively, they serve not only to punish offenders, but also to reinforce the rule of law, preventing the escalation of violent crime.

The prison system performance also exhibits a significant negative correlation with homicide rates (-0.470). This underscores the role that penitentiary systems play in controlling violence by preventing recidivism and rehabilitating offenders. Well-managed prisons that focus on rehabilitating individuals rather than relying on punitive measures, can reduce the likelihood of offenders returning to crime upon release. Additionally, effective management prevents prisons from becoming breeding grounds for further criminal activity, thus contributing to lower homicide rates.

While some of the independent variables exhibit moderately high pairwise correlations—for instance, between prison and education (0.683) or between prison and GDP (0.803)—the level of multicollinearity was assessed by conducting a Variance Inflation Factor (VIF) analysis. All VIF values were below the commonly accepted threshold of 5, with the highest result being 2.4, and suggesting that multicollinearity is present but not at levels likely to significantly bias the estimates (Hair et al., 2010; Kutner et al., 2005). It is acknowledged that multicollinearity is a matter of degree rather than binary presence, and therefore the coefficients in this model are interpreted with appropriate caution. Additionally, we opted not to use stepwise regression techniques, as our model specification was driven by theoretical considerations rather than algorithmic variable selection.

Table 2: Correlation matrix (n=61 countries)

	Homicide rate	Investigation	Adjudication	Prison	Unemployment	Education	GDP p.c.
Homicide rate							
Investigation	-0.485***						
Adjudication	-0.444***	0.844***					
Prison	-0.479***	0.790***	0.859***				
Unemployment	0.083*	-0.047	-0.101**	-0.143***			
Education	-0.331***	0.636***	0.667***	0.683***	0.046		
GDP p.c.	-0.310***	0.721***	0.779***	0.803***	-0.167***	0.791***	
Urban pop.	-0.043	0.333***	0.393***	0.348***	0.107**	0.711***	0.549***

Note: *p<0.1; **p<0.05; ***p<0.01

The results of the panel regression analysis, displayed in Table 3, examine the relationship between the homicide rate and three key components of the criminal justice system: investigation, adjudication, and prison system effectiveness, while controlling for socioeconomic factors such as education, unemployment, GDP per capita, and urban population. Each model presents different

variations of the key independent variables (investigation, adjudication, prison) to explore their specific effects on homicide rates.

The first model incorporates all three criminal justice variables—investigation, adjudication, and prison—simultaneously. The coefficient for prison system effectiveness is negative and statistically significant (-0.643, $p < 0.05$), confirming the fourth model's finding that effective correctional institutions are key to lowering homicide rates. However, both investigation (-0.356) and adjudication (-0.300) continue to show negative but statistically insignificant effects, suggesting that while these components of the criminal justice system are important, their independent effects on homicides are less pronounced when compared to the prison system's impact. The education index (-4.855, $p < 0.01$) and GDP per capita (negative and significant) remain critical factors, further emphasising the importance of socioeconomic improvements in addressing violence.

In the second model, which includes the investigation variable, the coefficient for investigation is negative (-0.314) but not statistically significant, suggesting that the effectiveness of the criminal investigation system alone does not have a robust, direct relationship with homicide rates when controlling for other variables. This may indicate that while investigation effectiveness plays a role in overall crime reduction, its impact on homicides specifically might be more complex or dependent on other aspects of the criminal justice system, such as adjudication and corrections. Socioeconomic variables, such as the education index (with a negative and significant value of -4.929, and $p < 0.01$) do show a strong and significant negative effect on homicides, meaning better educational attainment and higher economic development are associated with lower homicide rates.

In the third model, the adjudication variable is included, which measures the efficiency and timeliness of the judicial system. The coefficient for adjudication is negative (-0.051), but similarly to the investigation variable, it is not statistically significant. This implies that, on its own, adjudication effectiveness does not significantly influence homicide rates in this model. However, the education index continues to have a highly significant and negative effect on homicide rates (-5.666, $p < 0.01$), further supporting the notion that improvements in education reduce violence. Additionally, other control variables, like unemployment, remain statistically insignificant.

Table 3: Regression results.

	<i>Dependent variable:</i>			
	Homicide Rate			
	(1)	(2)	(3)	(4)
Investigation	-0.314 (0.244)	-0.356 (0.221)		
Adjudication	-0.051 (0.324)		-0.300 (0.286)	
Prison	-0.671** (0.264)			-0.643** (0.255)
Unemployment	0.004 (0.006)	0.004 (0.006)	0.003 (0.006)	0.003 (0.006)
Education.Index	-4.929*** (1.203)	-5.668*** (1.180)	-5.238*** (1.249)	-4.855*** (1.236)
GDP.per.capita	-0.00001** (0.00000)	-0.00001** (0.00000)	-0.00001** (0.00000)	-0.00001** (0.00000)
Urban.Population	0.008 (0.007)	0.007 (0.007)	0.003 (0.008)	0.005 (0.008)
Constant	4.968*** (0.718)	5.323*** (0.727)	5.253*** (0.761)	4.931*** (0.748)
Observations	488	488	488	488
R ²	0.152	0.132	0.116	0.133
Adjusted R ²	0.140	0.123	0.107	0.124
F Statistic	86.162***	73.011***	63.174***	73.718***

Note: *p<0.1; **p<0.05; ***p<0.01

In the fourth and final model, the focus shifts to the prison variable, which measures the effectiveness of correctional institutions in reducing recidivism. In contrast to the previous models, the prison variable is negative and statistically significant (-0.671, $p < 0.05$), indicating that better-performing prison systems are associated with lower homicide rates. This result suggests that the capacity of correctional institutions to rehabilitate offenders and prevent future crimes has a more direct and measurable impact on reducing homicides compared to the effectiveness of investigations or adjudication. This model emphasises the importance of the prison system in long-term crime prevention and highlights its potential role in addressing the root causes of criminal behaviour. The education index remains statistically significant, reinforcing their critical role in reducing homicide rates. Although the findings apply across the sample, descriptive statistics show that Latin American countries typically score lower in all the variables regarding institutional effectiveness and have higher

in homicide rates than the global average, suggesting the region's extreme values drive much of the observed variation.

The R^2 values range from 0.116 to 0.152, indicating a relatively low coefficient. However, this is to be expected in panel regression models due to the elimination of cross-sectional variation (only explaining how changes over time in the independent variables affect changes in the dependent variable), the high variability of macro-level data, the possible external shocks (for example, the COVID-19 pandemic), among others. The results show that the first model presents the highest coefficient (0.152) and third model the lowest coefficient (0.116), indicating that the differences between the coefficients are not substantial. In addition, the Adjusted R^2 is close to the R^2 in all models, suggesting that adding more variables to the model does not considerably increase the explanatory power.

5. Discussion

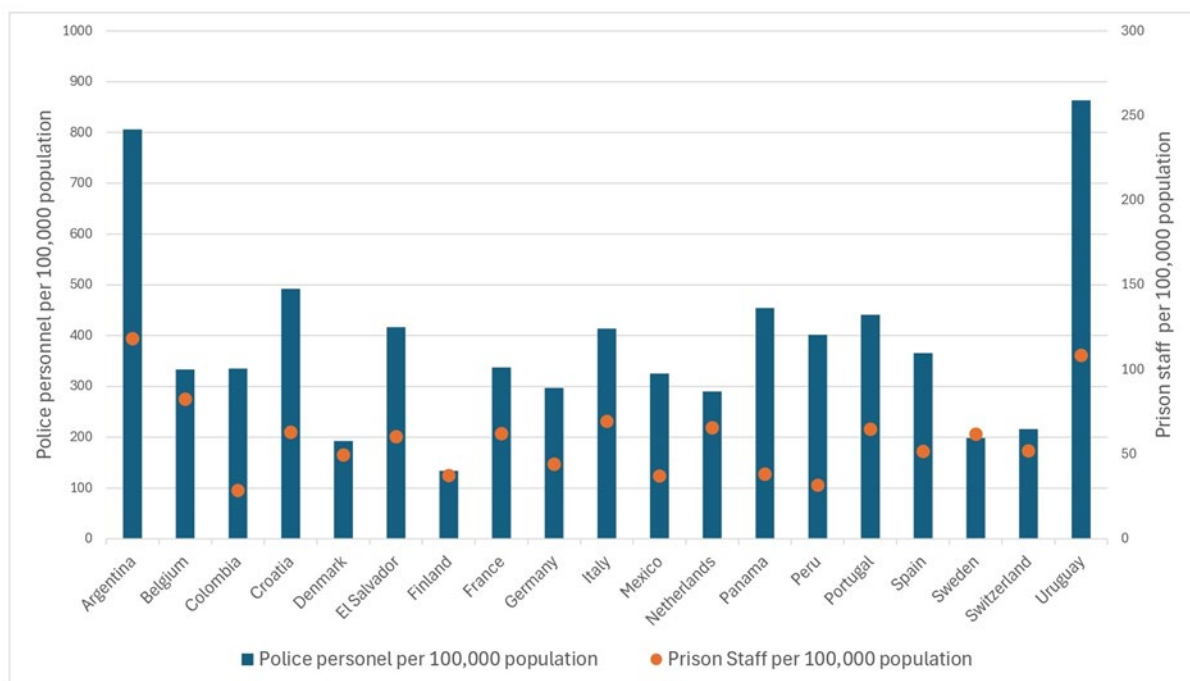
The findings of this study underscore the complex interplay between the components of the criminal justice system—police, judiciary, and prison systems—and their collective impact on homicide rates in Latin America. While the analysis confirms that prison effectiveness is the most significant factor in reducing homicides, probably by reducing recidivism, it also reveals critical insights about the limitations and challenges faced by police and judicial systems.

The observation that the effectiveness of investigation and adjudication is not significantly related to homicide rates is surprising. According to the study of Farrell and Clark (2004), of the global spending on criminal justice systems, 62% was allocated to police services, 21% to judicial services, and 17% to prison systems. These figures suggest a global tendency to prioritise police funding over other justice-related institutions, with prisons often receiving the least resources. Countries from Latin America follow the same trend. According to Farrell and Clark (2004), on average, Latin American nations allocate the bulk of their security budgets to the police (63.4%), followed by the judiciary (22.3%), and only 8.7% directed toward prisons. This investment in correctional facilities is approximately 10% lower than the spending levels observed in OECD countries (Izquierdo et al., 2018). For example, according to Uruguay's 2024 national budget, the Ministry of the Interior receives approximately UYU 50 billion (around USD 1.2 billion), which represents about 6.25% of the total budget of UYU 800 billion (around USD 19.2 billion). The Judiciary is allocated around UYU 15 billion (USD 360 million), accounting for approximately 1.88% of the national budget. Within the Ministry of the Interior, the *Instituto Nacional de Rehabilitación* (INR), which manages the country's prison system, receives about UYU 10 billion (USD 240 million), representing 1.25% of the national budget and approximately 20%

of the Ministry of the Interior’s allocation. This distribution highlights Uruguay’s prioritisation of public security and judicial functions, with specific and limited resources dedicated to prison management and rehabilitation (OPP, 2024).

In addition, it is also possible to observe the resource allocation effects in terms of human resources within the police and prison services. As can be seen from figure 1, countries such as Argentina and Uruguay have a number of police personnel per 100,000 population above 800, while the number of prison officers is below 120 per 100,000 population. Furthermore, in countries such as Denmark, Finland, Belgium, Sweden or Switzerland, the ratio between the number of police personnel per 100,000 population and the number of prison staff per 100,000 population is on average around 0.27 prison staff members per police personnel. Conversely, countries such as Peru, Colombia, Mexico and Uruguay have ratios of 0.08, 0.09, 0.11 and 0.12 respectively, showing that in these countries, as in the rest of the Latin American region, expenditure on human resources is mainly allocated to the police rather than the prison system.

Figure 1: Police personnel and prison staff per 100,000 population for selected countries (2019)



Source: own elaboration based on data from UNODC (2024). Note: All data included is from 2019 apart from Argentina (2015) and Uruguay (2020) where the most recent data available was used.

Given this substantial investment in police services, one would expect a corresponding improvement in crime outcomes, particularly in homicide reduction. The significant financial resources allocated to

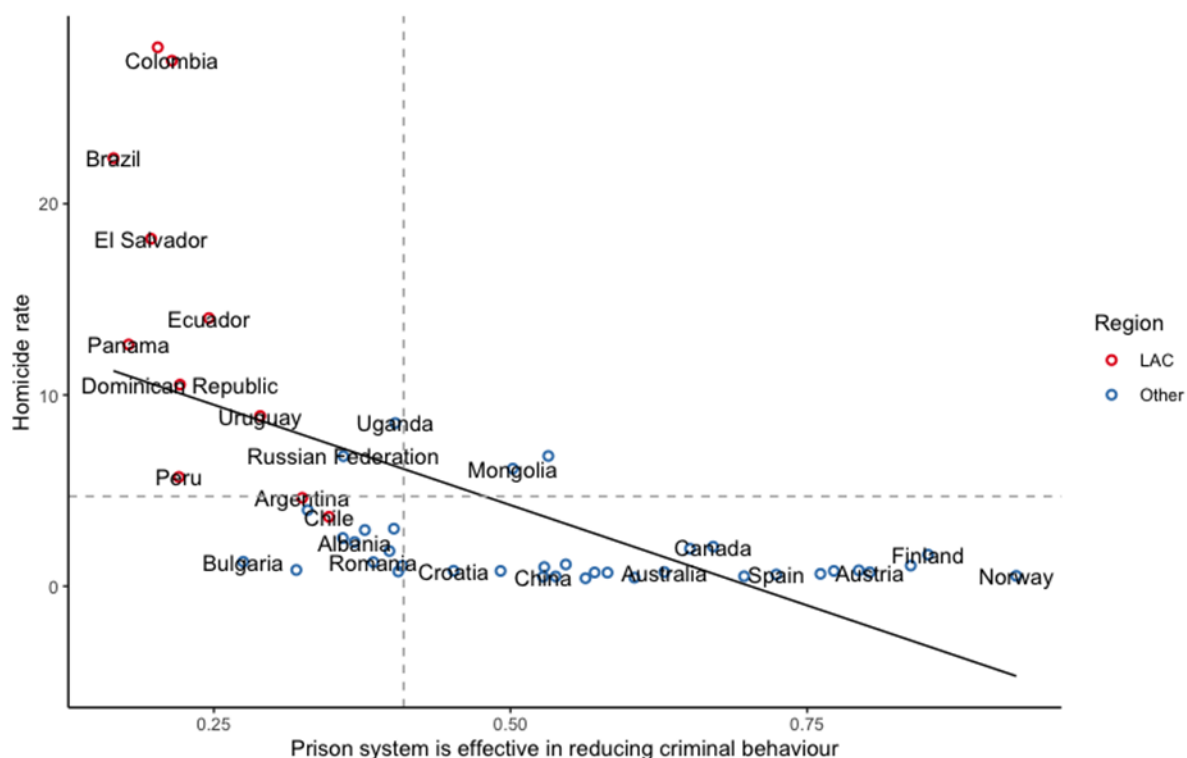
law enforcement should ideally enhance police capabilities in preventing crime and effectively investigating offences. However, despite this high level of funding, the anticipated positive relationship between police effectiveness and lower homicide rates has not materialised as expected. The UNODC's Global Study on Homicide 2023 highlights significant disparities in criminal justice system responses across regions, particularly in the Americas. In Latin America, the ratio of suspects brought into formal contact with the police per homicide victim is notably low, with approximately four suspects for every ten victims. In contrast in Europe, there are about eight suspects prosecuted for every ten homicide victims, reflecting a more robust criminal justice response (UNODC, 2023). In Mexico, for instance, the impunity rate for violent crimes is alarmingly high, with reports indicating that approximately 94.8% of such crimes go unpunished (Lee, 2023). This discrepancy raises questions about how these investments are utilised and whether systemic issues, such as corruption and inefficiency within police forces, undermine their potential impact on public safety. Additionally, a high level of correlation appears to exist among the measures for the three components of the criminal justice system (see Table 2). Consequently, it is probable that countries with inefficient and/or corrupt systems of law enforcement will also encounter similar issues in their courts and correctional systems. Ultimately, without addressing these underlying challenges, increased funding alone may not translate into improved outcomes in homicide reduction or overall crime prevention. Given that the influence of factors such as police corruption and the effective allocation of police resources—along with corruption within the other components of the criminal justice system—exceeds the scope of this research, we recommend that future studies explore these areas to provide deeper insights.

The lack of investment in the penitentiary system is particularly concerning for Latin America. Over the past 15 years, prison populations in Latin American countries have increased by more than 50%, with some nations like Colombia and Brazil witnessing their rates more than double (Penal Reform International, 2015). No other region globally has experienced comparable increases in incarceration rates (Vilalta and Fondevila, 2019). This rise in inmate numbers has not been met with a corresponding increase in funding for the prison system, which as stated above, remains one of the most underfunded sectors of the criminal justice system (Izquierdo et al., 2018). In a study of fourteen Latin American countries, the highest average expenditure was in police services, with an annual average of USD 54 per capita, representing 0.9% of GDP. In contrast, prisons received the lowest average expenditure, at just USD 9 per capita or 0.1% of GDP (Kruzel et al., 2014). In Brazil, for example, public security expenditures, encompassing police forces, were approximately 1.36% of the country's GDP in 2015. Judicial processes accounted for about 0.58% of GDP, while incarceration expenses were around 0.26% of GDP (Pasqualetti, 2020).

Moreover, while effective adjudication systems are important for ensuring justice, the lack of timely and efficient judicial processes in many parts of Latin America means that judicial interventions are often delayed, diminishing their deterrent effect. Judicial inefficiencies, particularly case backlogs, also contribute to prolonged pretrial detention, which further strains the prison system. However, since the prison system's impact is more direct in addressing recidivism and long-term behavioural changes, it explains why prison effectiveness has a stronger and more significant effect on reducing homicide rates in the presented models.

The literature on the relationship between prison system effectiveness and homicide rates in Latin America suggests that the quality of prison management plays a crucial role in reducing violence, both inside and outside of prisons. Incarceration has long been a dominant response to crime in the region. However, the increasing use of imprisonment has often led to worsening conditions, resulting in overcrowding, violence, and the entrenchment of criminal organisations within prison walls. The significant negative relationship found between prison effectiveness and homicide rates in regression models aligns with broader findings in the literature. Studies consistently indicate that well-functioning correctional systems, which focus on rehabilitation and reducing recidivism, are central to lowering violence in society (Coyle, 2021b; Croci, 2023). Conversely, overcrowded and under-resourced prisons in many Latin American countries exacerbate violence and contribute to high recidivism rates (Bergman and Fondevila, 2021). The poor conditions often create environments where criminal organisations thrive, effectively turning prisons into "schools of crime" rather than institutions of rehabilitation (Lessing, 2017; Sozzo, 2022).

Figure 2: Prison system capacity to reduce criminal behaviour and homicide rates (2022)



Source: own elaboration based on data from WJP (2024) and UNODC (2024).

Several factors are central to understand the relevance of the prison system in the Latin American context. First, criminal governance plays a role in the rise of violence linked to prison systems. For instance, in Brazil, criminal groups such as the Primeiro Comando da Capital (PCC) have leveraged weak prison governance to recruit and expand their networks and influence, contributing to violence both inside and outside of correctional facilities (Reidy and Sorensen, 2017; Ferreira, 2019; Feltran, 2020). These criminal organisations often control illicit activities within prisons, such as drug trafficking, and their influence extends to external criminal markets, exacerbating violence and homicide rates in broader society. Similarly, countries with poorly managed prisons and high levels of recidivism tend to see continued cycles of violence and crime, which directly affect homicide rates (Fondevila and Vilalta-Perdomo, 2024).

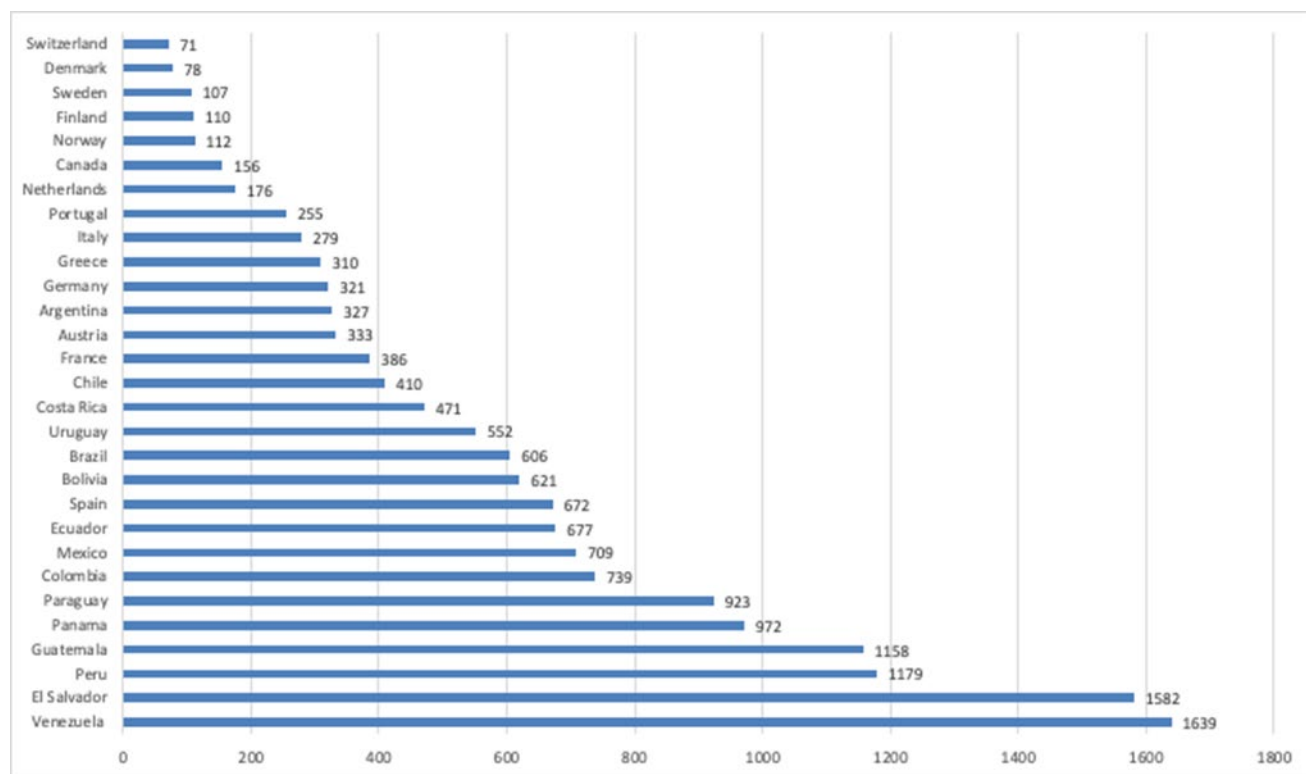
Second, one of the most pressing issues is overcrowding, which directly correlates with higher levels of violence and poorer living conditions in prisons. Overpopulated prisons, such as those in Brazil, El Salvador, and Mexico, foster competition for resources, creating environments where inmates resort to violence to survive. This environment allows for the growth of criminal networks inside the facilities,

which subsequently spill over into the general population, worsening crime rates (Stahlberg, 2022). Studies have shown that the higher the overcrowding levels, the greater the violence within prisons, which correlates with a continuation of crime outside once these inmates are released (Bouchard, 2020; Bergman and Fondevila, 2021).

Latin American countries, despite varying degrees of investment, generally struggle to meet international recommendations for humane incarceration conditions. Although there is no universal standard regarding the amount of prison space that is appropriate for each prisoner, most European high-income nations maintain ratios of approximately 100 to 300 prisoners per facility, aligning with best practices in prison management and human rights standards (Maculan et al., 2013; UNODC, 2021). For instance, in Venezuela, the ratio of prisoners to prison facilities is approximately 1,667 prisoners per prison, underscoring the severe overcrowding and resource strain afflicting the system. Even in countries with relatively stable governance structures, such as Uruguay, Costa Rica, and Ecuador, prison management challenges persist (see figure 3). According to data from the WPB (2024a) Uruguay houses around 16,000 inmates across 27 facilities, yielding an average of 593 prisoners per prison, well above the recommended range for adequate prisoner management and rehabilitation. Similarly, Costa Rica and Ecuador, with ratios of 471 and 677 prisoners per facility respectively. These ratios suggest systemic constraints within Latin American prison systems, where high occupancy rates and limited budgets strain the capacity to provide adequate living conditions and humane treatment for prisoners. In contrast, for example, several high income-countries maintain lower prisoner-to-prison ratios, aligned with best practices in prison management and human rights standards. Switzerland, for instance, holds around 6,252 prisoners across 88 facilities, resulting in a ratio of approximately 71 prisoners per prison, well within acceptable standards for adequate space and services. Similarly, Denmark, Sweden, and Finland maintain ratios of 78, 107, and 110 prisoners per prison respectively, ensuring that prisoners have sufficient space, access to rehabilitation programmes, and humane conditions.

The natural consequence is that virtually every country in Latin America is facing the challenge of overcrowding. For example, Guatemala ranks as the 9th country in the world with highest rates of overcrowding (with 299,4% of occupancy) and Bolivia as the 10th (with 287,8% of occupancy) (WPB, 2024b). According to a recent study, Latin America's prisons are running on average 60% above their capacity (Limoncelli et al., 2020), with 58% of the prisoners not sleeping in a bed (León-Jiménez, 2024). Not surprisingly, the region has some of the highest cases of mortality in prisons. For example, in 2021, Ecuador had 504 deaths in prisons, Argentina 358, Chile 133, Uruguay 85 and Bolivia 76 (UNODC, 2024).

Figure 3: Ratio prisoners per prison in selected countries (2022)



Source: own elaboration with data from UNODC (2024).

The high prisoner-to-facility ratios observed in Latin America reveal a need for systemic reform, with particular emphasis on decongestion strategies such as alternative sentencing, increased investment in rehabilitation programmes, and addressing the root causes of high incarceration rates. Failing to meet international standards hinders the potential of effective rehabilitation, as overcrowded and under-resourced facilities lack the capacity to provide essential services. Addressing these prison system inadequacies is essential for Latin American countries to transition towards more effective models of incarceration that prioritise prisoner welfare and societal reintegration.

A third significant factor is the lack of effective rehabilitation programmes in Latin American prisons, which contributes significantly to high recidivism rates and, consequently, elevated homicide rates. In many facilities, inmates lack access to educational and vocational training initiatives, leaving them without the necessary skills for reintegration into society. This absence of support often results in individuals becoming more entrenched in criminal behaviour upon release. Research indicates that enhancing rehabilitation services, ensuring basic living standards, and addressing prison overcrowding can substantially reduce crime and recidivism rates. For instance, a study by Bergman, et al. (2020) highlights that effective rehabilitation and reintegration programmes are crucial in reducing recidivism in the Caribbean, where 41% of inmates are repeat offenders, compared to 33% in Latin America.

Additionally, other scholars emphasise that meaningful rehabilitation programmes are essential to achieving the ultimate purposes of imprisonment, namely reducing recidivism and improving public safety (Cook, et al., 2005; Liem et al., 2014; UNODC, 2018). Addressing these issues is vital for improving public safety and reducing the cycle of reoffending. The following section will provide a brief overview and discussion of such policies.

5.1. Policy recommendations

Overall, the study shows that among the criminal justice system components, the prison system's effectiveness in reducing recidivism has the most substantial and statistically significant impact on homicide rates. In contrast, the effectiveness of criminal investigations and adjudication does not show a direct and significant relationship with homicides in the models tested. These findings underscore the importance of addressing the long-term prevention of crime through rehabilitation and correctional policies, while also recognizing the contributions of education and economic development in reducing violence.

Addressing overcrowding requires a multi-level response, including building new facilities and renovating existing ones. New prison designs must minimise violence among inmates, enhance security, and comply with international standards for adequate health services, mental health support and cleanliness. Smaller, decentralised facilities located closer to inmates' communities can facilitate a more equitable distribution of the prison population, reduce transportation costs, and improve family visitation, which is important for the rehabilitation process and the reduction of recidivism. Prisons must ensure inmates have sufficient space, privacy, and access to basic necessities such as clean water, bedding, and hygiene products (Engstrom and Van Ginneken, 2022). Additionally, implementing alternative sentencing programmes for offenders with substance abuse or mental health issues can alleviate overcrowding. Redirecting these individuals to appropriate treatment services, rather than incarcerating them, reduces overcrowding, recidivism, and justice system costs (Fox, 2021; Schucan Bird and Shemilt, 2019).

Latin American correctional systems lack effective rehabilitation programmes, as evidenced by high recidivism rates. Rehabilitation programmes are essential for changing criminal behaviour and reducing future criminal activities. Studies show that rehabilitation programmes can reduce recidivism by 10%-40% (Lipsey and Cullen, 2007). Prisons should offer educational opportunities, including literacy classes, high school equivalency programmes, and post-secondary education, which can improve inmates' employment prospects (Davis et al., 2013). Vocational training in marketable skills, ideally accredited by external bodies, is also essential to ensure the successful reintegration of inmates

(Mastrobuoni and Terlizzese, 2014; Byrne et al., 2015). Providing comprehensive mental health services, such as individual and group therapy, is also crucial for addressing issues like anger management, conduct disorders, and trauma, all of which support rehabilitation (Hopkin et al., 2018). Furthermore, the implementation of effective addiction treatment programmes focusing on detoxification, therapy, and support groups are important to reduce re-offending. Such programmes should be tailored for high-risk offenders and provide intensive treatment, follow-up care after incarceration, and simultaneous multi-faceted interventions (Bahr et al., 2012; de Andrade et al., 2018).

Effective prison management, with strict security protocols and robust anti-corruption measures, can prevent incarcerated individuals from continuing criminal activities. Well-managed prisons, with adequate resources, can facilitate rehabilitation, avoid overcrowding, and prevent gang activities and recruitment within prisons. One approach to improving management is the implementation of the Risk-Need-Responsivity (RNR) model, which focuses on tailoring interventions to the specific risk and criminogenic needs of each individual. The three core principles of the RNR model are: (1) the risk principle, which aligns the intensity of intervention with the offender's risk of reoffending; (2) the need principle, which directs interventions based on criminogenic needs; and (3) the responsivity principle, which maximises the offender's ability to benefit from rehabilitation (Bonta and Andrews, 2010; Hadfield et al., 2021). Implementing RNR and integrated offender management systems can improve prison administration, reduce overcrowding, and facilitate inmate rehabilitation (Vanderplasschen et al., 2019).

Investigation and adjudication show a negative correlation with homicide rates, however, this relationship is not statistically significant. This may suggest that the certainty and swiftness of punishment through police investigations and judicial processes are not strong enough deterrents, likely due to inefficiencies, corruption, or procedural delays. To address these issues, police reforms should prioritise strengthening internal oversight mechanisms to ensure accountability and transparency. Establishing independent oversight bodies within police departments to monitor misconduct and address abuse can build public trust and reduce instances of corruption and excessive force. Prior research supports the effectiveness of independent oversight in curbing police misconduct and corruption, particularly in regions where public confidence in law enforcement is low (Prenzler and Ronken, 2001; Walker, 2012; Prenzler, 2015).

Professionalization through enhanced training is another critical reform. Training programmes focused on human rights, community engagement, and de-escalation techniques can reduce excessive force incidents and improve public relations. Evidence suggests that such training increases public

cooperation and strengthens crime deterrence by equipping officers to handle conflicts non-violently (Skogan, 2006; Braga et al., 2015). Additionally, raising recruitment standards through rigorous background checks and psychological evaluations helps police departments attract candidates with high ethical standards and a community-focused mindset (Rydberg and Terrill, 2010). Furthermore, implementing data-driven policing strategies—such as allocating resources based on high-crime areas and monitoring officer performance—has shown promising results in improving accountability and optimising crime response (Weisburd and Eck, 2004; Weisburd et al., 2010; Eck and Rossmo, 2019). Collectively, these reforms have the potential to foster the development of a more trustworthy and effective police force, capable of contributing meaningfully to crime reduction efforts.

Regarding the judicial system, fast-track processes for minor offences can significantly alleviate case backlogs, freeing up judicial resources to focus on more serious crimes. Expedited procedures for minor cases have proven effective in reducing court congestion, enabling the timely adjudication of major cases. This, in turn, helps to reinforce public confidence in the justice system's ability to deliver swift and fair justice (Bradford et al., 2013; Dandurand, 2014). Furthermore, the implementation of digital case management systems can streamline judicial processes by tracking cases electronically, reducing administrative delays, and enhancing transparency. Countries that have adopted such systems report significant reductions in case duration and improved efficiency in managing court workloads (Djamaludin et al., 2023; Bakhramova et al., 2023). To further address judicial inefficiencies, specialised courts for specific case types—such as domestic violence or drug-related offences—may facilitate a more focused and informed adjudication. Research supports the effectiveness of specialised courts in delivering consistent and informed decisions, fostering greater public trust and enhancing deterrent effects (King, 2010). Finally, alternative sentencing options, including community service and rehabilitation programmes, provide viable alternatives to incarceration for minor offences. These alternatives not only help alleviate the burden on courts and prisons, but also contribute to lower recidivism rates by emphasising rehabilitation over punitive measures (Tonry, 2006; Bales and Piquero, 2012; Morales Peillard and Salinero Echeverria, 2020).

6. Limitations

The limitations of this paper primarily revolve around data availability, methodology, and the complexity of systemic issues within the criminal justice system. First, the study relies on data from various sources, which may vary in quality and reliability. Inconsistent definitions, differences in reporting standards, and varying levels of transparency across countries can affect the accuracy of the findings. Composite indices are useful for summarising complex phenomena, but they also present several limitations. The weighting and aggregation of indicators often involve subjective decisions,

which can lead to the potential overestimation or underestimation of certain aspects. Additionally, these indices may obscure important details by merging diverse variables into a single score, making it difficult to identify which specific factors influence the dependent variable. It is also important to mention that the Rule of Law index is constructed using annual surveys from 214,000 households and 3,500 legal practitioners and experts (World Justice Project, 2024b). This means that the index is perception-based and may not fully capture the actual situation of the institutions in an objective manner. For instance, a country with robust institutions but negative public perceptions might receive a lower score than another country with weaker institutions but a more optimistic public perception. Nevertheless, the decision to utilise the index is motivated by its design, which facilitates cross-national studies by ensuring uniform data collection parameters and methodologies worldwide, thereby enhancing the comparability of data across different countries.

Additionally, while the paper focuses on homicide rates as a key indicator of violence, it may overlook other forms of violent crime that could provide a more comprehensive understanding of the effectiveness of the criminal justice system. The reality of cross-national data on homicide cannot be ignored. The figures for each country and each year are provided by each country, which means that the definition of 'intentional homicide' may vary from one country to another. To mitigate this problem, a base-10 logarithmic transformation has been applied to normalise the homicide rate data. There may also be missing data in a particular year for a particular country, but the period and countries have been carefully chosen to avoid or minimise this problem.

Additionally, the utilisation of panel regression is subject to certain limitations, including its inability to effectively address endogeneity, which can allow for the emergence of potential reverse causality. For example, an increase in the number of homicides may lead to deteriorating prison conditions through over population, undermining the effectiveness of the system. Moreover, although the panel regression model used is an efficient method as it leverages both within-unit and between-unit variation – resulting in smaller standard errors and more precise estimates – it cannot fully eliminate confounding factors. For instance, stronger respect for human rights in some countries may influence prison policies, leading to lower recidivism rates. This, in turn, could contribute to fewer homicides, making it difficult to isolate the direct effect of the criminal justice system on crime rates. While the model may be useful for broader generalisation and efficiency, its validity may be weakened. To mitigate the latter point, the use of strong theoretical support is fundamental.

Moreover, the findings are primarily based on data from Latin America, which may limit their generalizability to other regions with different socio-political contexts and criminal justice dynamics. The unique challenges faced by each country should be considered when interpreting results. The

analysis may also not adequately account for external factors such as economic conditions that can influence crime rates and institutional effectiveness. Furthermore, while corruption is acknowledged as a significant factor impacting the criminal justice system, its complex nature makes it difficult to quantify and control for in regression models. Addressing these limitations through longitudinal studies, broader crime category analyses, and more nuanced qualitative research could enhance the robustness of future investigations into the relationship between criminal justice system effectiveness and homicide rates.

7. Conclusions

This study highlights the role that the components of the criminal justice system—police, judiciary, and prison systems— have in relation to homicide rates. The findings reveal that prison effectiveness, particularly in reducing recidivism, has the most substantial and statistically significant relationship with homicide rates. This underscores the need for a paradigm shift in how we approach crime reduction strategies in the region. While police investigation and judicial adjudication are vital elements of the justice system, their effectiveness is often undermined by systemic issues such as corruption, inefficiencies, and public distrust. While each component of the criminal justice system—police, judiciary, and prisons—plays an essential role in addressing violence, the interaction between these institutions is equally important. Researchers argue that improving institutional coordination is key to achieving long-term reductions in crime (Dammert and Malone, 2006). For example, enhanced cooperation between police and judicial authorities can ensure that offenders are swiftly apprehended and prosecuted. Similarly, better coordination between the judiciary and the penitentiary system can ensure that sentences are properly enforced and that rehabilitation programmes are effectively implemented.

While the police and judicial systems are essential components of the criminal justice system, the prison system's role in reducing criminal behaviour and preventing reoffending appears to be the most directly impactful in terms of reducing homicides. The evidence suggests that enhancing prison management, with a greater focus on rehabilitation rather than mere punishment, could lead to more effective crime prevention outcomes. Targeted reforms aimed at improving conditions within prisons and implementing programmes that facilitate reintegration into society are essential steps towards breaking the cycle of violence. Future research should explore specific reform strategies that have proven successful in other contexts and assess their applicability in Latin America.

In summary, findings are supported by the literature on Latin American prisons, which emphasises the importance of focusing on rehabilitation and preventing recidivism as the most effective strategies for

addressing violence. Improving police and judicial systems is important, but these reforms must be implemented in conjunction with a well-managed prison system. This suggests that investments in prison reforms—focused on rehabilitation, improving living conditions, and reducing overcrowding—are critical for breaking cycles of violence and reducing overall homicide rates.

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Table 4: List of the 61 countries included in the analysis.

Albania	Ghana	Peru
Argentina	Greece	Poland
Australia	Hungary	Portugal
Austria	India	Republic of Korea
Bosnia and Herzegovina	Italy	Republic of Moldova
Brazil	Jamaica	Romania
Bulgaria	Japan	Russian Federation
Canada	Jordan	Serbia
Chile	Kenya	Singapore
China	Lebanon	Slovenia
Colombia	Malaysia	South Africa
Croatia	Mexico	Spain
Czechia	Mongolia	Sweden
Denmark	Morocco	Türkiye
Dominican Republic	Myanmar	Uganda
Ecuador	Netherlands	United Kingdom*
El Salvador	New Zealand	United Republic of Tanzania
Estonia	Nicaragua	United States of America
Finland	Norway	Uruguay
France	Pakistan	
Germany	Panama	

* United Kingdom of Great Britain and Northern Ireland