

# Overcrowded and Violent: Prison Conditions and Organized Crime in the Southern Cone Paraguay- Brazil

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## **Abstract**

This paper investigates the relationship between prison overcrowding and the likelihood of organized crime related violent incidents in the Southern Cone, with a focus on Paraguay and Brazil. Using logistic regression models, it finds that extreme prison saturation significantly increases the probability of such attacks, particularly in border regions. These findings highlight the role of institutional weakness especially within carceral systems as a key factor in enabling criminal violence and governance.

# Institutionalism and Governance in Critical Zones

One of the dominant theoretical frameworks for explaining the entrenchment of organized crime in Latin America is grounded in institutionalist theory. According to North (1990), institutions both formal (laws, bureaucracies) and informal (norms, practices) shape the incentives and constraints within which actors operate. When institutions are weak or captured, they create governance vacuums that are easily exploited by non state actors such as organized criminal groups (North 1990).

This argument is further developed by Acemoglu and Robinson (2012), who argue that states with limited extractive and enforcement capacity often experience parallel systems of authority, where criminal organizations fill the role of service provision, dispute resolution, and informal governance (Acemoglu & Robinson 2012). Similarly, Soifer (2015) emphasizes that variations in subnational state capacity particularly in borderlands and rural zones explain why some regions become havens for organized crime while others resist criminal penetration (Soifer 2015).

Although corruption and institutional strength data are limited at the regional level, national indicators provide useful proxies. According to Transparency International’s Corruption Perceptions Index 2023, Paraguay ranks 149 out of 180 countries placing it among the most corrupt in Latin America only behind of Venezuela. Brazil, while still struggling, ranks 104, suggesting comparatively stronger (though far from robust) institutional integrity<sup>1</sup> (Transparency International 2023).

In addition, the Worldwide Governance Indicators compiled by the World Bank show Paraguay scoring significantly lower than Brazil in categories such as “Control of Corruption,” “Rule of Law,” and “Government Effectiveness.” These national discrepancies likely reflect broader structural weaknesses that influence local governance conditions in border areas like Amambay and Mato Grosso do Sul (World Bank 2023).

Linking with the previous section, this institutional asymmetry and variation in the capacity to combat organized crime may also help explain the stark contrast in lethal violence between these twin regions despite their geographic, demographic, and cultural similarities.

## Prison System Capacity and Its Nexus with Organised Crime

Institutional weakness manifests clearly in the state of judicial and penal systems, not only in crime suppression but also in reintegration. A robust literature connects prison conditions with the expansion of organized crime: prison gangs frequently originate and consolidate inside penitentiaries before projecting power externally. As Fondevila (2024) observes, overcrowded, under resourced prisons in Latin America often become centers of criminal governance, where inmates specialize, organize, and forge alliances across criminal networks (Fondevila 2024).

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<sup>1</sup>In the Corruption Perceptions Index, a lower rank indicates lower perceived levels of public sector corruption, while higher rankings reflect greater perceived corruption.

The World Prison Brief reports that Paraguay has a prison population rate of approximately 250 prisoners per 100,000 population, with an occupancy level near 183% indicating severe overcrowding. Brazil’s rate is approximately 390 per 100,000, with occupancy at 136% (World Prison Brief 2025). These systemic pressures, especially in Paraguay’s Tacumbú prison, which is designed for 1,500 inmates but holds over 4,000 under minimal guard presence, correlate with frequent inmate violence and PCC-related massacres (Associated-Press 2024).

In Paraguay, penitentiary overcrowding and corruption contribute to the rise of prison-based criminal leadership, from where groups like the PCC and Rotela Clan project influence into border zones. Many incarcerated individuals remain in pre-trial detention, reinforcing gang hierarchies. Presidential operations have been needed frequently to retake control during internal uprisings (Associated-Press 2024).

In Brazil, organized crime networks like PCC and Comando Vermelho emerged and expanded through prison systems. The PCC’s franchise model, built across prisons and reinforced by bribery and inter-prison mobility, allowed it to extend territorial control into Mato Grosso do Sul and beyond (Lessing 2016, Berg 2021).

## **Prisons as Centers of Criminal Power**

Prisons in these contexts function less as tools of rehabilitation and more as incubators of criminogenic networks. The most overcrowded systems often exhibit lower visible violence because gangs exert internal control, impose rules, and exploit economies from inside a paradox identified by multiple studies (Lessing 2016).

Taken together, Paraguay’s strategic geographic location, fragile institutions, and high levels of corruption have created a fertile environment for organized crime to thrive. These conditions have enabled transnational criminal organizations to establish themselves in the country and use it as a base to project influence across the region.

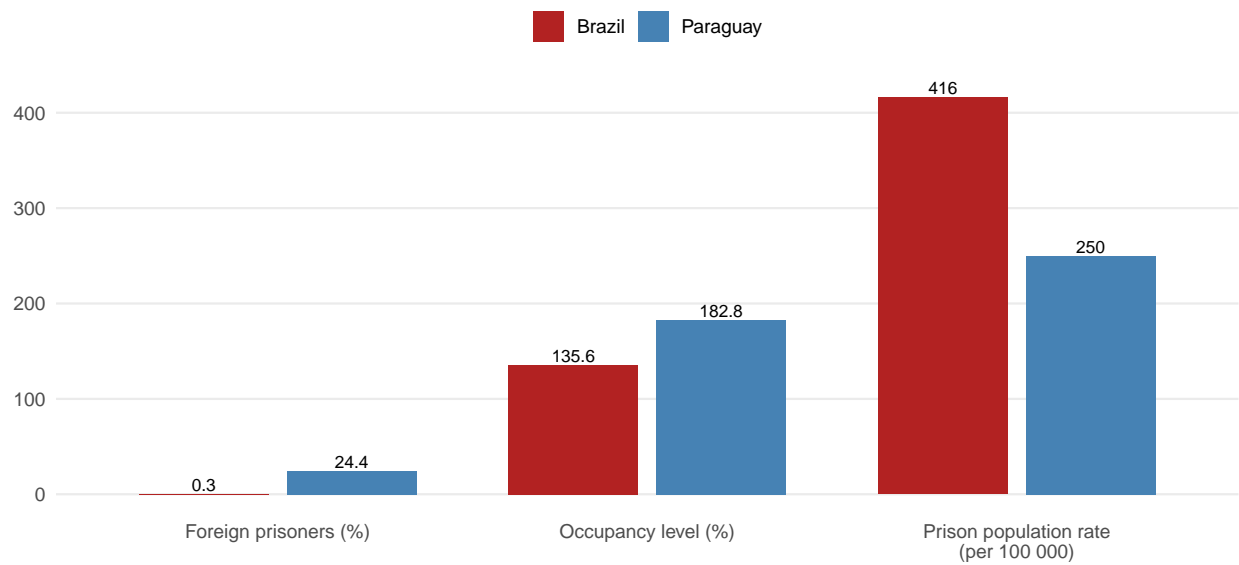


Figure 1: Prison Indicator Paraguay -Brazil

Notably, the high proportion of foreign nationals within Paraguay’s prison population reflects what could be described as a pattern of “crime importation” as shown in 1 where 24,4% of the prisoners in Paraguayan prisons are not paraguayan. Evidence suggests that many members of Brazilian criminal groups, particularly the PCC, operate from Paraguayan territory and even prefer to be detained there rather than face incarceration in Brazil’s high security prison system. This preference is often attributed to the weaker oversight and looser internal controls in Paraguayan prisons, which allow inmates to continue criminal operations and maintain privileges while incarcerated (InSight Crime 2023, World Prison Brief 2024).

## Research Design and Methodology

This research explores whether limited institutional capacity in the prison system contributes to a higher probability of incidents related to organized crime groups such as prison riots, escape attempts, tunnel excavations, and violence near or within correctional facilities.

## Risk of Organized Criminal Attacks in Weak State Environments

Building on the causal mechanism explored in the first part where the presence of criminal groups was found to increase violence, particularly in border regions, this second section shifts the focus inward, examining the institutional dimension of criminal governance. Specifically, it investigates whether prison overcrowding is associated with a higher likelihood of violent incidents attributed to criminal groups, within penitentiary facilities. To test this relationship, two logistic regression models are estimated: one using a continuous measure of the Prison Occupation Index, and another using categorical thresholds to capture potential nonlinear effects.

## Institutional Capacity and the Probability of Attack

In this framework, the probability of a criminal attack is used as a proxy for institutional weakness or limited state capacity. The logic is that violent events such as coordinated attacks, riots, or prison breaks are less likely to occur in environments where the state exercises strong institutional control. Conversely, if the likelihood of such events increases under conditions of overcrowding, it may indicate that institutional capacity has been exceeded.

By modeling the probability of attack as a function of overcrowding, the analysis captures how strained institutional environments become more vulnerable to organized violence. Hence, the estimated probabilities do not merely reflect the frequency of attacks, but also serve as indicators of systemic fragility.

## Data

The dependent variable, which captures attacks or events related to organized crime such as prison breaks, attempted escapes, and assassinations attributed to criminal organizations was constructed using web scraping techniques applied to news media sources.

To avoid confusion, it is important to clarify that although this variable is similar to the independent variable used in the first part, they capture different phenomena. In the first part, the variable measured the presence of organized criminal groups, while in this section it captures isolated violent incidents attributed to them, not their continued presence.

The first documented incident attributed to these transnational criminal groups in a given region sets the indicator to 1 for that year and all subsequent years. For the current analysis, however, the variable is coded as 1 only in the year when a specific act attributed to organized crime took place, based on documented media reports.

Regarding the independent variables, the prison occupational index is calculated as the ratio between the prison population and the official prison capacity<sup>2</sup>:

$$\text{Occupational Index} = \frac{\text{Prison population}}{\text{Prison capacity}} \quad (1)$$

To ensure statistical robustness and reduce multicollinearity when controlling for regional factors, this index was calculated at the regional level for both Paraguay (departments) and Brazil (federal units).

This indicator captures the degree of institutional saturation within penitentiary facilities, and is used throughout the analysis to evaluate its relationship with the likelihood of violent incidents linked to organized crime.

In the case of Paraguay, prison population data for 2016 was obtained from the Supreme Court of Justice. Due to the unavailability of data for 2017 and 2018, information for the years 2019 to 2023 was sourced from the National Mechanism for the Prevention of Torture.

Meanwhile, on the Brazilian side, the prison overcrowding rate calculated as the ratio between the prison population and the official prison capacity was provided by the National Secretariat for Penal Policies (Secretaria Nacional de Políticas Penais) for the period from 2016 to 2024. I control for the homicide rate, the same I used for the estimation in the first part. The resulting dataset is an unbalanced panel comprising 309 observations.

## Estimation

To estimate the effect of prison overcrowding on the likelihood of violent criminal attacks, I use a binary response model where the outcome variable is defined as:

$$attacks_i = \begin{cases} 1 & \text{if a criminal attack related to organized crime occurred in unit } i, \\ 0 & \text{otherwise.} \end{cases}$$

Given the binary nature of the dependent variable, I estimate logit models, which assume that the log odds of the outcome are a linear function of the covariates. The probability of an attack is modeled as:

$$\Pr(attacks_i = 1 \mid X_i) = \frac{\exp(X_i\beta)}{1 + \exp(X_i\beta)} \quad (2)$$

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<sup>2</sup>In the case of Paraguay, prison occupational rate is measured using the concept of *maximum real capacity*, as defined by the National Mechanism for the Prevention of Torture (MNP). This measure is grounded in human rights standards, calculating the number of inmates that can be accommodated based on a minimum of 7 square meters per person. This standard reflects the minimum required space to ensure humane conditions for individuals deprived of liberty and serves as the basis for the prison overcrowding index used in this study.

where  $X_i$  is a vector of explanatory variables and  $\beta$  is the vector of coefficients, estimated via maximum likelihood.

I begin with a specification that treats prison occupation rate as a **continuous variable**:

$$\text{logit}(\text{attacks}_i) = \beta_0 + \beta_1 \cdot \text{Prison Occupation rate}_i + \beta_2 \cdot \text{kill\_rate}_i + \varepsilon_i \quad (3)$$

where  $\text{kill\_rate}_i$  controls for the general level of violence in each unit.

Additionally, to allow for potential nonlinearities and threshold effects, I discretize the prison occupation rate into groups using quintiles of its empirical distribution and re estimate the model with categorical indicators.

The final specification is:

$$\text{logit}(\text{attacks}_i) = \beta_0 + \sum_{q=2}^5 \beta_q \cdot Q_{q,i} + \beta_6 \cdot \text{kill\_rate}_i + \varepsilon_i \quad (4)$$

where:

- $Q_{qi}$  are dummy variables for the second through fifth quintiles of overcrowding, with the first quintile ( $Q1$ ) as the omitted baseline.
- $\text{kill\_rate}_i$  remains as a control variable.

Because logit coefficients represent changes in log odds, they are not directly interpretable. Therefore, I report odds ratios (OR), obtained via the transformation:

$$\text{OR} = \exp(\hat{\beta}) \quad (5)$$

An odds ratio greater than 1 indicates that the covariate increases the likelihood of a criminal attack; an odds ratio below 1 suggests a mitigating effect.

For added interpretability, I also approximate the change in predicted probability for each quintile relative to the baseline using:

$$\Delta \text{Pr} \approx \left( \frac{\exp(\hat{\beta})}{1 + \exp(\hat{\beta})} \right) - 0.5 \quad (6)$$

assuming a baseline probability of 0.5. This provides a more intuitive sense of how each level of overcrowding affects the likelihood of criminal violence.

## Key Findings

As previously mentioned, a logit model was first estimated using the continuous variable prison overcrowding rate. Although the results presented in 1 are not statistically significant, the marginal effects suggest that for every 1 point increase in the prison occupation rate, the probability of a criminal incident or attack linked to organized crime increases approximately 1.5 percentage points(pp) and between 5.7 and 10.6 pp in border regions.

Table 1: Effect of Prison Overcrowding Rate on the Likelihood of Criminal Attacks: Odds Ratios and Average Marginal Effects

	<b>(1) Full Sample</b>			<b>(2) Border Regions</b>		
	No Controls / With Controls			No Controls / With Controls		
Odds Ratio (OR)	1.19	/	1.18	1.40	/	2.23
AME (p.p.)	1.5 <sup>†</sup>	/	1.5	5.7*	/	10.6
SE (AME)	(0.97)	/	(1.40)	(2.71)	/	(11.24)

*Notes:* Table reports Odds Ratios (OR) and Average Marginal Effects (AMEs) from logit models. AMEs are expressed in percentage points (p.p.), showing the estimated change in the probability of a criminal attack for a one-unit increase in the prison overcrowding rate. Standard errors in parentheses.

<sup>†</sup>  $p < 0.1$ , \*  $p < 0.05$ . Models with controls include population size and homicide rate.

To avoid imposing arbitrary thresholds and to capture potential nonlinear effects across the distribution, I chose to estimate the model using quintiles of the prison overcrowding rate. This strategy allowed me to assess whether the risk of criminal attacks increases only at specific levels of institutional saturation.

Table 2, summarizes the characteristics of the different quintiles, reporting the minimum, average, and maximum occupancy rates observed in each group.

Table 2: Descriptive statistics of prison occupational rate by quintile group

<b>Quintile</b>	<b>n</b>	<b>Min</b>	<b>Mean</b>	<b>Max</b>
Q1 (Lowest)	62	0.25	0.49	0.57
Q2	62	0.57	0.62	0.67
Q3	62	0.67	0.74	0.81
Q4	62	0.81	1.09	1.62
Q5 (Highest)	61	1.64	3.61	9.03

**Note:** Quintile groups are based on the distribution of `Tasa_DH`, a proxy for prison overcrowding. Each row reports the number of observations (n) and the minimum, mean, and maximum overcrowding ratios within the group. Values are rounded to two decimal places.



Table 3: Effect of overcrowding quintile on the probability of criminal attacks

Variable	Coef.	OR	$\Delta$ Prob. (p.p.)	p-value	Sig.
Quintile Q2 (vs Q1)	0.737	2.090	17.6	0.300	
Quintile Q3 (vs Q1)	-0.432	0.649	-10.6	0.627	
Quintile Q4 (vs Q1)	0.297	1.346	7.4	0.746	
Quintile Q5 (vs Q1)	1.856	6.396	36.5	0.009	**

**Note:** The OR column reports the *odds ratio*, which indicates how many times more likely an attack is compared to the reference group.  $OR > 1$  means increased odds;  $OR < 1$  means reduced odds. The  $\Delta$  Prob. column shows the estimated change in the probability of an attack in percentage points, compared to the reference tercile (Q1). Model include control for homicide rate

Statistical significance: \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ .

As shown in Table 3, the probability of an organized crime related violent event increases by 36 percentage points in the highest quintile of the prison overcrowding rate, where the average occupancy exceeds 164%. This effect is statistically significant. Although the fourth quintile (the second highest) does not reach statistical significance, the positive direction of the effect suggests that as the occupancy rate approaches institutional capacity limits, the likelihood of criminal incidents tends to rise. An exception is observed in the third quintile, which displays a negative but nonsignificant effect. To make the quintile result more intuitive, I express it per 10 percentage point of overcrowding. The reference group (Q1) averages about 40% occupancy, whereas the highest quintile (Q5) begins at 160% a gap of roughly 120 percentage points. Moving from Q1 to Q5 raises the probability of an organised crime incident by 36.5 percentage points. Dividing that increase by the 120-point gap and scaling to a 10 point step gives

$$\frac{36.5}{160 - 40} \times 10 \approx 3 \text{ percentage points} \quad (7)$$

**Thus, each additional 10 percentage-point increase in prison occupancy is associated with approximately a 3 percentage point rise in the likelihood of an organised crime incident, for occupancy rates above 40%.** Stating the effect in this incremental form makes the magnitude easier to interpret than quoting the full quintile jump. The underlying mechanisms and implications of these results are discussed in more detail in the following section.

# Likelihood Ratio Test

Table 4: Likelihood Ratio Test for Logit Model Significance

Model Comparison	LR Statistic	Degrees of Freedom	<i>p</i> -value
Full model vs. null model	15.172	5	0.0097

*Note:* The full model includes prison overcrowding quintiles and homicide rate. The null model includes only the intercept.

To evaluate whether the explanatory variables jointly contribute to explaining the likelihood of organized crime related attacks, a Likelihood Ratio (LR) test was conducted. This test compares the log likelihood of the full model which includes prison overcrowding quintiles and homicide rate as predictors with that of a null model containing only the intercept.

The results indicate that the full model significantly improves model fit compared to the null specification. The LR statistic is 15.172 with 5 degrees of freedom, yielding a *p*-value of 0.0097. This implies that the included predictors jointly explain a statistically significant portion of the variation in the outcome.

## Reverse Causality

One potential concern in interpreting the results is the possibility of reverse causality namely, that organized criminal attacks could lead to higher prison overcrowding, rather than the other way around. However, several contextual and empirical factors suggest this is unlikely to be driving the observed association.

First, the measure of prison overcrowding used in this analysis is calculated based on the average inmate population over a given year, while the outcome variable (organized criminal attacks) typically captures isolated and often highly visible incidents that are not systematically linked to sudden surges in incarceration. Second, there is no evidence of mass imprisonment events (e.g., crackdowns or policy changes) following such attacks during the period under study that would significantly alter overcrowding ratios in the short term. Most facilities experience chronic overcrowding due to structural underinvestment, not sudden policy responses. Third, the timing structure in the data and the use of fixed effects in other parts of the analysis help account for unobserved heterogeneity and reduce concerns that the relationship is driven by omitted time-varying confounders.

While reverse causality cannot be entirely ruled out, these factors collectively suggest that the observed relationship is more plausibly interpreted as the effect of overcrowded and weakened penitentiary environments enabling or exacerbating organized violence, rather than the reverse.

## Discussion and Policy Implications

The logit confirms an overcrowding effect: in prisons with occupancy rates above 1.6, there is a greater likelihood of an organized crime incident compared to a baseline scenario of penitentiaries with occupancy rates below 0.6. Two mechanisms explain this result. First, overcrowded facilities function as recruitment markets; understaffed, unsegregated cell blocks allow factions such as PCC and CV to vet, co-opt, or coerce new members (Lessing 2016, United Nations Office on Drugs and Crime 2023). Second, congestion sustains lucrative internal economies, contraband phones, protection rackets, drug retail that criminal groups can monopolize (Feltran et al. 2022). Together, these processes increase organizational density inside prisons and expand the logistical capacity to plan escapes, contract killings, or coordinated riots (Daudelin & Ratton 2023).

**Policy implications.** Prison reform is equally crucial: enacting longer sentences or life imprisonment while prisons operate beyond capacity is counterproductive. The logit indicates that every ten percentage point rise in occupancy lifts the probability of an organised crime incident by roughly three percentage points. Expanding capacity, implementing risk classification regimes and professionalising custody staff would lower that probability. Evidence from São Paulo shows that prison based pacts limiting gang violence backed by credible sanctions for leaders who order attacks outside can reduce homicides without harsher sentencing (UNODC 2025). In short, tougher penalties without modernising the prison system enlarge gangs recruitment pools and may intensify violence rather than deter it.

## Limitations and Critics

**Variable selection.** A familiar limitation in organised crime research is that many key indicators are available only through proxy measures. Because direct observations of criminal activity are scarce or unreliable, this study relies on the closest feasible approximations. While these proxies capture the underlying phenomena reasonably well, they are not direct measurements; any conclusions drawn from them must therefore be interpreted with caution and explicitly framed as estimates based on indirect information.

**Data constraints.** In Paraguay, official statistics are either scarce or incomplete, so several key variables had to be reconstructed from public records requests, press reports, and ad-hoc estimations. In particular, the homicide rate series (per 100,000 inhabitants) relies on population projections based on the 2012 census, which the 2022 census later showed to be over-estimated by roughly 20%. Consequently, the entire Paraguayan time series is subject to a systematic upward bias. All figures could be compiled only at the *department (regional)* level, whereas Brazilian data are available at *state* and even *municipal* resolution. The absence of Paraguayan municipal data not only reduces the number of observations but also prevents the analysis from focusing on the most affected local hot spots. With municipal level data, the analysis would be ideal for conducting natural experiments, focusing on the twin cities of Pedro Juan Caballero (Paraguay) and Ponta Porã (Brazil). A range of methodological approaches could be applied, from Regression Discontinuity to Difference-in-Differences. Missing years and the reliance on imputed values leave the final dataset *unbalanced*, which further limits precision.

# Appendix

Variable / Data	Time series	Source
<b>Outcome</b>		
Homicide rate (Brazil)	2000–2009	Brazilian Institute of Geography and Statistics (IBGE); own calculation using population and homicide counts
	2010–2012	Brazilian Public Security Statistical Yearbook
	2013–2023	Atlas da Violência, Institute for Applied Economic Research (IPEA)
Homicide rate (Paraguay)	2010–2014	Atlas de Violencia, National Council for Science and Technology (CONACYT)
	2015–2023	National Institute of Statistics (INE)
<b>Treatment and Indicators</b>		
Presence of criminal groups (PCC/CV)	Varies by region	Constructed from administrative intelligence reports, media sources, and public datasets
Violent incidents attributed to organized crime	2015–2023	Constructed via web scraping from national and local news outlets
Border indicator (dummy variable)	Static	Constructed based on municipality adjacency to international borders
<b>Control: Institutional Capacity</b>		
Prison overcrowding index (Paraguay)	2016	Supreme Court of Justice
	2019–2023	National Mechanism for the Prevention of Torture (MNP)
Prison overcrowding index (Brazil)	2016–2024	National Secretariat for Penal Policies (Secretaria Nacional de Políticas Penais)

Table 5: Summary of data sources used in the empirical analysis

Table 6: Key Events Related to PCC, CV, and Organized Crime (2015–2023)

Country	Region / State	Year	Detailed Event
Paraguay	Amambay	2016	Assassination of Jorge Rafaat Toumani, a major drug lord, using .50 caliber weapons. Attack attributed to the PCC.
Paraguay	Alto Paraná	2017	Armed robbery at Prosegur vault in Ciudad del Este. Over 50 men involved, with up to USD 11 million stolen. PCC involvement confirmed.
Paraguay	Amambay	2019	Mass escape of 76 PCC inmates from the Pedro Juan Caballero prison through a tunnel.
Paraguay	San Pedro	2020	Riot in San Pedro prison involving PCC and CV factions. Multiple injuries and use of force reported.
Brazil	Roraima	2016	Prison massacre attributed to PCC and CV, with over 30 deaths due to internal gang conflict.
Brazil	Amazonas	2017–2023	Ongoing violence and expansion of PCC and CV. Notable events include a 2019 prison riot in Manaus with 55 deaths.
Brazil	Pará	2019	Altamira prison massacre: 67 inmates killed in a conflict between PCC and a local criminal faction.

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