

From Prison Gang to Transnational Criminal Organization. A Social Network Analysis of the Tren de Aragua

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Abstract. This research paper explores the evolution of the Venezuelan prison gang Tren de Aragua. This criminal group has emerged as one of the most influential entities in Latin America, exerting control that extends beyond prison walls into broader societal, business, and political spheres. This paper utilizes Social Network Analysis (SNA) to dissect the intricate relationships and networks surrounding the Tren de Aragua. We introduce the concept of "converged governance," which challenges traditional views of the separations between state and non-state actors. This theoretical framework proposes that the clandestine links between these state and non-state allow for covert collaborations that maintain internal cohesion while promoting extensive criminal activities. Our study not only provides a detailed map of the Tren de Aragua's network structure through SNA but also emphasizes the prison's role as a critical territory where state and non-state systems intersect. This offers a more systemic insight into the dynamics of criminal governance and its impact on national and regional security. By investigating the conditions under which prison gangs like the Tren de Aragua assume control over state facilities and evolve into transnational criminal organizations, this paper significantly enhances our understanding of systemic challenges. It also elucidates the complex, often symbiotic relationships between criminal organizations and state actors, highlighting the multifaceted nature of criminal governance in contemporary contexts.

Keywords: Tren de Aragua, Criminal governance, Social Network Analysis

Introduction

The growth of prison gangs has drawn global attention due to its significant impact on correctional systems and public safety. Initially formed around racial and ethnic identities primarily for protection, many prison gangs have now evolved into complex criminal organizations (Maitra, 2020). The most common references are the Mara Salvatrucha and Barrio XVIII. These two prison gangs originated in the United States, and have expanded their influence by establishing connections with other Violent Non-State Actors (VNSAs), including human- and drug trafficking organizations (Cawley, 2017; Schmidt, 2012). Over time, these gangs expanded their operations beyond the United States to Central America, particularly El Salvador, Honduras, and Guatemala (Ruiz, 2020). This expansion illustrates the increasing threat posed by prison gangs as they grow into more sophisticated and entrenched criminal organizations. But this problem is not limited to Central America as it rather expands to the entire Latin American region and beyond. A prominent example from South America is Brazil's Primeiro Comando da Capital (PCC), a prison criminal organization that was able to expand and establish a system of criminal governance in the city of Sao Paulo (Deneyer Willis, 2015). Similarly, Ecuador has witnessed a series of massacres in its overcrowded and inadequately controlled prisons, which has led to the deaths of over 350 detainees since 2021, particularly in the State of Guayaquil (HRW, 2022). Or, the Venezuelan Tócoron Penitentiary Center, which fell under the control of the Tren de Aragua, one of the nation's most influential criminal organizations.

The Tócoron prison became the epicenter of Tren de Aragua's operations, from where they coordinated various criminal activities, including drug trafficking, extortion, and violence, both inside and outside prison walls (InSight Crime, 2023). These cases illustrate how the evolution of prison gangs into more sophisticated criminal organizations presents a dual challenge. First, at the national level, prison gangs significantly contribute to increased violence, criminal activities, and instability within correctional facilities. This instability often spills into broader communities, leading to higher crime rates and heightened public safety concerns (Gundur, 2020). Additionally, these gangs have a considerable impact on the youth, as they frequently recruit and radicalize younger populations (Oxford Research Encyclopedia of Criminology, 2018). This perpetuates a cycle of crime and incarceration, further straining the criminal justice system and public resources. Second, from an international perspective, prison gangs can establish transnational networks, facilitating the spread of organized crime, illegal trafficking, and other illicit activities across borders (Paarlberg, 2022). These networks undermine the rule of law, foster corruption, and destabilize governments, particularly in regions with weak institutional frameworks, as often seen in Latin American contexts.

By examining these dynamics, it becomes clear that the influence of prison gangs extends beyond immediate criminal activities, impacting broader societal stability and international security. This indicates a need for a better understanding

of how to control the expansion of such gangs and raises questions about the hidden interactions between state and non-state actors. While the involvement of corrupt prison staff or officials is a common cause attributed to the problem, the reality extends beyond mere illegal economic transactions and points out deeper systemic challenges. The case of Venezuela's Tren de Aragua especially exemplifies this complexity. It highlights not only deficiencies in state control and prison management but also the connivance and convenience of its expansion for specific power dynamics inside the Venezuelan State. Therefore, examining the evolution of Tren de Aragua brings into focus the substantial impact of VNSAs on national security. Building on this, our research is driven by the following questions: How do prison gangs evolve into sophisticated criminal organizations? And what is the role of intermediary organizations in the evolution of Tren de Aragua? –Under what systemic conditions can prison gangs assume control over state-run facilities? By addressing these questions, we aim to uncover how these gangs expand their influence by strategically navigating and manipulating the borders between the criminal, political, and social worlds. Moreover, our analysis seeks to demonstrate how the division between state and non-state actors necessitates channels of communication and interaction, while still maintaining distinct boundaries.

The use of Social Network Analysis (SNA) will allow us to study the interactions, relationships, and networks within and surrounding the Tren de Aragua as a prison gang and as a criminal group. This approach will uncover the extent of the group's reach into society, business, and the political realm. Our objective is to illuminate both the internal and external structures of the organization, with emphasis on the roles of non-criminal figures that potentially took a role in its expansion. Then, portraying those circumstances where organized crime and political actors interacted is essential as it exposes not only systemic weaknesses and vulnerabilities but also the intricate and circumstantial ties between criminal organizations and state actors (Otero, 2023). Building on this foundation, our contribution to the field is twofold. At the theoretical level, we expand on existing theories of criminal governance by introducing the concept of *converged governance*. Existing theories suggest that in states with weak institutions, criminal organizations can play a major role in providing security in complex territories (Varese, 2011) and it represents competition in state-making (Felbab-Brown, 2018). Sometimes the state-criminal relation is interpreted from an approach where the state and the criminal organizations use this as an opportunity to gain legitimacy through the provision of security or services (Di John, 2010; Steward, 2011). Although there exist formal and informal interactions between these two actors, hybrid governance often portrays the state as weak leaving a vacuum of power that is filled by criminal organizations (Schlichte & Schneckener, 2015).

In this regard, we detected two gaps. First, the hybrid governance theory locates the State in a position of weakness or absence. Nonetheless, we claim that criminal governance is present also in places where the State is present and not necessarily weak. In fact, criminal governance can make use of state means and power relations to expand and consolidate their own governance. The second gap is that the theory does not expand on the specific mechanisms used for interactions between the State and criminal organizations. The theory does not explain thoroughly how opposing actors collaborate without merging their internal power structures. The concept of converged governance aims to address these gaps on three levels. First, it helps us understand that the power relations between state actors and criminal organizations can also expand where the State is present and strong. Second, it explains how they merge power relations without mixing as a larger group. Instead, they create converged channels of communication that allow them to interact without merging. Third, it delves into the specific mechanism for interaction. This concept expands on previous theories of criminal governance (Denyer Willis, 2015) by examining how non-state actors establish connections beyond prison walls through clandestine state/non-state networks. These networks engage in covert collaborations, enabling cooperation without compromising internal cohesion. Converged governance thus provides a clearer framework for examining the complex relationships between state and non-state actors.

At the methodological level, we present the first attempt to map the network structure of the Tren de Aragua using Social Network Analysis (SNA). This approach provides a novel perspective on the dynamics of criminal systems like the Tren de Aragua and their intricate relationships with other systems such as the political and economic. Additionally, our analysis underscores how prisons act as critical territories where State and non-state systems coexist and intersect. By doing so, this work sheds new light on the symbiotic nature of these relationships and highlights the complexity of criminal governance in modern contexts. The structure of this paper is as follows: First, we briefly introduce Tren de Aragua as a criminal organization. Next, we provide a comprehensive literature review in which we define criminal governance, discuss the theoretical framework of state absence, and introduce the concept of converged governance. This section will include the elaboration of the theory puzzle and our hypothesis. Then, we present foundational literature on Social Network Analysis (SNA) and its applicability to criminal governance and criminal organizations. In the methodology section, we apply SNA to the Tren de Aragua case. Our findings help to explain the relationships and conditions that allowed them to take over the Tocarón prison. Finally, we present our conclusions and their implications for understanding prison gang control and converged governance in Latin America.

Current Status of PhD Research

This research represents the current status of our PhD project, which has been ongoing for the past year. During this period, we have achieved significant progress in understanding the network dynamics of Tren de Aragua and are currently focused on further exploring the implications of converged governance. Our research journey has included extensive data collection and analysis from domestic and international sources, with major findings that highlight the role of covert state-criminal collaborations. The next steps in our research involve extending this analysis to other criminal organizations, refining the theoretical framework, and exploring the policy implications of our findings. This work aims to contribute to the broader discourse on criminal governance and its impact on national and regional security.

The origins and growth of Tren de Aragua

The Tren de Aragua started as a prison gang in the early 2000s within the Tocarón prison in Venezuela's Aragua state. They gained prominence between 2013 and 2015, when its members, reportedly part of a workers' union, got involved in a railway project in Aragua, where they were engaged in extortion and job-selling activities (Martin, 2023). This marked the beginning of their expansion into various facets of organized crime, including extortion, kidnappings, homicide, vehicle theft, drug trafficking, arms trafficking, human trafficking, and contraband (InSight Crime, 2020, 2023). The gang's operations not only have significantly impacted South America's security dynamics, but their territorial expansion across the continent is unprecedented for a Venezuelan gang and poses a substantial threat to regional security (U.S. Department of the Treasury, 2023, July 26). This gang's evolution exemplifies the complexities of combating organized crime in a region plagued by political and economic instability. Today, Tren de Aragua's multifaceted criminal endeavors and extensive network represent a significant challenge to peace and security across Latin America, and necessitates robust and coordinated international efforts to dismantle their operations.

Criminal governance and State presence

Criminal governance refers to the capacity of criminal organizations to exert control and regulate specific territories and activities, particularly in areas where the influence of the state is limited or non-existent. The criminal governance analysis is often matched with the State absence theories (Rotberg, 2004; Call, 2011; UNODC, 2024), which refers to situations where the state is unable to provide public services and protect its citizens. In such a vacuum, non-State actors, including criminal organizations, step in to fill the gap by assuming governing roles and asserting authority (Abello-Colak and Guarneros-Meza, 2014). The 'State Retreat theory' introduced by Naím (2012), argues that criminal governance does not imply a complete absence of the state but indicates a significant weakening of its presence and influence. This blurring of lines between lawful governance and criminal influence can have profound implications for the rule of law and the nature of governance in affected areas (Felbab-Brown et al., 2018). Hence, these theories are often used to explain why criminal governance intensifies in the context of an absent or retreating state authority.

The previous theories assume that criminal governance expands as the State retreats, however, the administration that both execute is not always exclusive. In many instances, criminal organizations operate as parallel authorities, which complicates the efforts of the state to establish control and maintain order (Lessing, 2016). The coexistence, however, does not necessarily imply a direct intertwining of their activities. Rather, it suggests a tactical understanding where each entity maintains its own sphere of influence and operations, a concept called *hybrid regimes* (Jaffe, 2013; Pimenta et al., 2021; Plancarte Escobar, 2021). This implicates the criminal organization to create and enforce their own rules and exert control over specific territories. In some cases, these non-state actors even gain social legitimacy (Lessing, 2021). In summary, theories such as State absence, State retreat, or hybrid regimes help understand the conditions for the formation and increase of criminal governance. By doing so they answer the questions of *why* prison gangs can evolve to sophisticated criminal organizations. However, none of these explain *how* the State-criminal interactions work. In response, we introduce a new concept, called *converged governance*, to specifically focus on the interactions between State and violent non-state Actors. We aim to explain the lack of clear boundaries between the State and VNSAs. This fading boundary paves the way for the development of intricate politico-criminal networks that intertwine the activities of both spheres. The concept is based on the theory of systems (Luhmann, 2012), which claims that social systems (political, economic, cultural) are operatively closed but open in terms of interaction with the environment. In our context, this means that while political, economic, and criminal systems operate independently, they remain open to interacting and influencing each other within the broader societal context. In particular, we assume that the State and non-State actors, such as criminal organizations, typically avoid direct collaboration to preserve their separate identities but utilize covert connections to reach their respective goals.

Façades are vital for maintaining legitimacy in the eyes of the government and society. We expect that both governmental entities and criminal organizations, including prison gangs, primarily rely on these covert connections for interaction. This approach allows them to maintain their identities while engaging in mutually beneficial exchanges.

Real-life examples, such as the Aryan Brotherhood, Mexican Mafia, Nuestra Familia (Lyman, 1989), Mara Salvatrucha, and Barrio XVIII (Wolf, 2012; Ruiz, 2020) illustrate this phenomenon in action, where these groups subtly navigate and manipulate the interstices of state and criminal boundaries to sustain their influence and operations. To concisely put it, the covert interactions between state and non-state actors, such as criminal organizations, represent a complex dynamic where two distinct worlds - the State and the criminal underworld - engage with each other while maintaining their unique identities. This concept of converged governance is grounded in the understanding that these interactions are crucial for both parties to achieve their respective goals. Building on this framework, we propose the following hypothesis:

H1: *Criminal organizations and the State converge by utilizing covert connections to interact without diluting their borders.*

Following this hypothesis, we aim to delve into the interaction strategies between State and non-state actors, specifically examining the Venezuelan Government and the Tren de Aragua. It posits that these entities deliberately avoid direct interactions to safeguard their exposure, maintain legitimacy, and protect internal secrets. Instead, they are theorized to collaborate indirectly through organizations or people that act as social or economic facades to create a covert exchange of resources.

Criminal Governance, Legitimacy, and Corruption in SNA

To examine these relationships, we apply SNA to the Tren de Aragua. Most applications of SNA to organized crime can be broadly categorized in “micro” and “macro” approaches (Calderoni, 2011). Micro approaches, such as Natarajan's (2000) detailed examination of a cocaine trafficking organization and Morselli's (2005, 2009) analyses of drug trafficking networks have demonstrated the utility of SNA in understanding the structure and operations of criminal groups. Research has shown that within these networks, a small subset of highly connected individuals often drives most criminal activities, emphasizing a horizontal and opportunistic organizational structure (Morselli & Roy, 2008; Varese, 2006). On a larger scale, macro-level studies by Malm and Bichler (2009, 2011) have explored extensive criminal networks, revealing the interplay of various connection types, such as kinship and business partnerships, in sustaining organized crime. This body of literature underscores the value and applicability of SNA to uncover the multifaceted and interconnected nature of criminal organizations. However, as Calderoni (2011) points out, there is a need for more empirical studies of specific crime groups (micro level) and/or markets, especially outside the law enforcement realm. By focusing on Tren de Aragua's evolution, this paper aims to contribute to the aforementioned body of literature on SNA and organized crime groups, by using SNA to highlight multiplexity and the role of legitimate actors in criminal operations.

As highlighted by Smith & Papachristos (2016), multiplexity refers to the complex layers of a network where criminal, personal, and legitimate ties intersect. These multifaceted connections are crucial for the operation and survival of criminal organizations, as they often require a facade of legitimacy to protect their activities and garner social and/or political support (Morselli & Giguere, 2006; Lauchs et al. 2011). Therefore, the engagement of criminal organizations with legitimate actors is not an incidental aspect of their operations but a strategic component integral to their resilience and capability to operate discreetly. This dynamic is significantly reinforced by corruption, which serves as a bridge between the 'underworld' of organized crime and the 'upper world' of legitimate social sectors. 'Underworld' actors refer to those directly involved in the criminal sphere, engaging in illicit activities like drug trafficking or extortion. 'Upper world' actors, on the other hand, are individuals or entities from legitimate societal sectors, such as politics or business, who may engage in corrupt activities by colluding with the underworld (UNODC, 2024.; Blumberg, 1974). Social Network Analysis (SNA) illuminates these complex, often covert relationships, by revealing them to be more than mere financial exchanges. Instead, they form a dense network of social and political connections that underpin and facilitate illicit activities. Such behaviors, rooted in trust and reciprocity, are crucial for enabling the corrupt exchanges that sustain criminal enterprises (Cartier-Bresson, 1997; Costa, 2017). This interlacing of legitimate and criminal actors and their networks is at the heart of our theory of converged governance. Here, governance is not solely the domain of the state or criminal actors but a contested space where both may exert influence and control in the same sphere. Through SNA, the extent of this convergence becomes visible by highlighting how state actors and criminal entities may not only coexist but also coalesce. This leads to our second hypothesis:

H2: *The convergence of Tren de Aragua or similar criminal organizations with the political sector is influenced by the strength of their internal ties and the gang's multiplexity, which determine the scope and nature of their governmental connections.*

This hypothesis posits that the internal network dynamics within a criminal organization like Tren de Aragua play a crucial role in shaping its interactions with governmental entities. Specifically, it suggests that the stronger and more numerous the internal connections within the organization, the more effectively it can engage with, or converge with, the government. These internal ties are key in forming a cohesive, well-coordinated group. This cohesion and coordination are essential for the organization to navigate the complex landscape of interacting with government structures.

Power Dynamics and Secrecy in Criminal Networks

Lastly, understanding the nuances of power dynamics in criminal organizations is crucial for answering our research questions. Duran-Martinez (2018) explains the effects of power relations between state and criminal organizations in terms of frequency and visibility of violence. Then, the mere existence of direct or indirect channels of communication between these actors have a bigger repercussion in the type of violence that societies experience. These elements encompass various aspects such as leadership, hierarchy, communication, information flow, and the influence of external factors, all playing pivotal roles in the operations and longevity of these criminal entities. The structure of hierarchy within criminal organizations significantly impacts their internal power dynamics. As described by the UNODC (2023), these groups typically operate with a clear hierarchical system, defining a spectrum of roles from leaders to subordinate members. Leadership styles within these organizations can be diverse. While some leaders show direct, active involvement in criminal activities, marked by initiative and participation, others might exercise their influence more subtly.

According to Porter and Alison (2006), leadership in many criminal networks is often characterized by indirect strategies and actions, rather than explicit commands. These leaders tactically guide their groups, orchestrating operations and setting agendas in ways that suggest their authority, thereby highlighting the varied and adaptable nature of governance within the realm of organized crime. In these criminal networks, the concept of tie strength, whether weak or strong, plays a crucial role in their functioning. Weak ties can offer strategic advantages such as operational flexibility and broader network reach, while strong ties are key to promoting solidarity and cooperation among network members. Calderoni's (2011) research supports this by suggesting that in drug-trafficking groups, the majority of nodes are marginal players involved only in specific operations or tasks. These marginal players represent weak ties, contributing to a horizontal structure that is ideal for a flexible and fast-changing environment. This setup allows criminal activities and illicit partnerships to depend more on opportunities than on any formal organizational arrangement. This concept also applies to non-criminal actors. The involvement of business professionals, political figures, and community leaders is significant in maintaining the network's secrecy and extending its reach into legitimate areas. Even though these ties are usually considered flexible and weak, Smith & Papachristos (2016) and Granovetter (1973) note that these actors are essential for the network's adaptability and survival. They often orchestrate operations and setting agendas, thereby highlighting the varied and adaptable nature of governance within organized crime. Understanding these roles is crucial for uncovering the informal power structures within criminal organizations.

In other words, besides understanding the hierarchy of a network, identifying influential individuals or hubs is critical. These hubs, as described by Krebs (2002) and Perliger (2010), play central roles in coordination, recruitment, and information dissemination. Their influence and strategic importance are often determined using centrality measures such as closeness, betweenness, and eigenvector. Closeness measures how connected an actor is to all other actors. Betweenness counts how often an actor connects two others, showing their control over information flow; a higher score means more influence on information flow. Eigenvector centrality rates an actor's influence based on the quality of their connections. This understanding of power dynamics and the identification of influential hubs form the basis for our Hypothesis 3.

H3: *The level of sophistication of a criminal network is determined by its ability to establish ties with members of other societal sectors. These diverse connections enhance the network's operational capabilities and social legitimacy, which, in turn, enables more extensive and resilient criminal activities.*

In this study, we assume that Tren de Aragua's network likely presents ties to cultural, economic, and social systems in the Aragua environment. This hypothesis reflects the adaptability and complexity of the Tren de Aragua as a criminal organization that interacts with various aspects of its environment.

Methodology – SNA applied to the Tren de Aragua

Our study utilizes SNA to delve into the complexities of Tren de Aragua's organizational network and its connections

with various entities. To begin, we describe our data collection process and then we move on to our analysis. We employed 'aplify' to systematically scrape data from a variety of newspaper magazines. We looked at media outlets dedicated to investigative journalism such as Insight Crime, Al Jazeera, BBC News, Transparencia Venezuela, BioBio Chile, and DW. This selection includes both Spanish and English language sources. Also, we remitted to official communications from the governments of Venezuela, the US, and Colombia. The intentional mix of Spanish and English sources is crucial in gathering a diverse range of information, which is particularly important given the transnational nature of the Tren de Aragua and the varying regional focus of these publications. Following the initial data scraping, our analysis focuses on extracting specific details about Tren de Aragua members. We search for mentions of individual names and any available information about their roles and activities within the organization. This includes examining their relationships with each other and with external entities, such as political figures or other criminal groups. Each actor's name and associated information are systematically cataloged within a matrix. We include all individuals with established direct links to Tren de Aragua. For creating links between individuals/organizations with Tren de Aragua we used two criteria.

First, we consider a solid link when the source mentions a direct connection between two actors. Second, we consider an environmental link when there is an indirect connection. By this, we refer to individuals or groups who do not have explicit connections to Tren de Aragua but occupy strategic positions in institutions and organizations that have contributed to the gang's expansion. These connections are considered environmental or circumstantial. In such cases, we formulated hypotheses suggesting that if two individuals are related to the same organization (e.g., 'Aragua Prison system') and operate in interconnected areas, there is a higher likelihood of indirect interactions or collaboration. This implies that even without direct evidence of a link, the interdependence of their positions within related institutions increases the probability of at least indirect interactions. This approach, which combines direct and indirect links, provides a more comprehensive understanding of the network's structure and dynamics, capturing both explicit relationships and the broader context of interactions.

This process illustrates that mapping the networks of organized crime groups involves several critical methodological choices. One approach involves relying on the members' definitions of the group's boundaries. However, in scenarios where direct access to group members is limited, a nominalist approach becomes necessary. In this approach, the researcher defines the boundaries based on their theoretical interests, to encompass all actors involved in the group's criminal activities. This is what we did. Nevertheless, it's essential to acknowledge that defining what constitutes significant participation within these networks is a complex endeavor (Perliger, 2010). In summary, our methodology involves systematically cataloging information about Tren de Aragua members, including those with direct links and cases where reasonable inferences can be made. Such an understanding is crucial in unraveling the complex web of relationships that underpin the Tren de Aragua's control over the Tócorón Penitentiary Center and beyond. The network shown is a snapshot of approximately 2015 ~ 2018.

Data Analysis

Figure 1 shows the network of Tren de Aragua. We compiled a list of 25 members, ranging from leaders, prisoners, and other gang members to politicians and relevant community members. The red dots show the core group of the network and blue, black, and purple represent subgroups and peripheral figures.

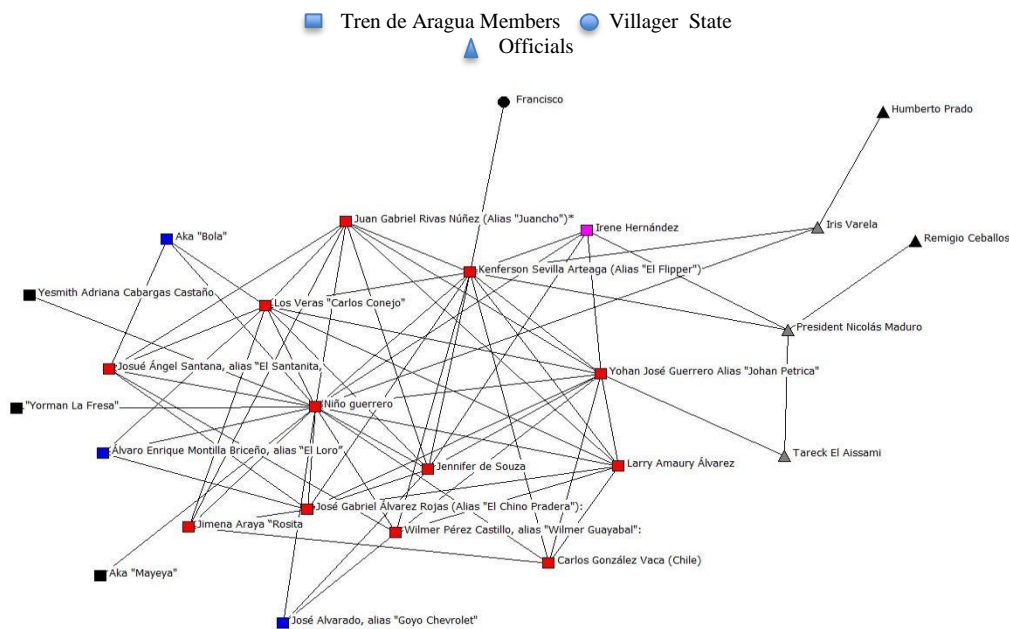


Figure 1. The Tren de Aragua Network

The central positioning and numerous connections of Tren de Aragua's core group suggest they are the key players in the network, potentially involved in decision-making processes, coordination, and dissemination of information. To better understand the structure of the network, we calculated the degree and normalized degree (Table 1). Niño Guerrero has the highest degree of 19, indicating a high level of direct connections in the network. The degree normalized gives a proportionate measure of connections relative to the network size. Niño Guerrero's normalized degree is 0.79, which is significant in a network of this size. Followed by Niño Guerrero, Kenferson Servilla Arteaga shows a degree of 13 and Yohan José Guerrero shows a degree of 11. While these nodes can be considered the central nodes that hold significant influence within the network, interesting is the amounts of peripheral figures in this network. Those actors have lower connectivity degrees, such as Iris Varela (Degree = 3), who was the then- prison minister (InSight Crime, 2020), or Yorman la Fresa (Degree = 1), who may take over specific or limited roles to ensure functionality of the network.

Even though there are channels of communication with peripheral actors, these are distributed between different members of the core group. These connections are a fundamental characteristic of criminal organizations as they need to protect the leadership of the group by creating layers of members around the core as a protection mechanism. This layout is a strategic design commonly employed by clandestine organizations to safeguard their leadership (Lynn, 2005). By wrapping layers of members around the core, the organization creates buffers that ensure the leadership remains insulated and less vulnerable to external threats. The analysis also uncovers that the number of connections a node has does not necessarily correlate with its influence or control over the network. This is exemplified by figures like Jennifer de Souza and Larry Amaury Álvarez, who, despite being part of a secondary echelon within the hierarchy, occupy strategic positions. Jennifer de Souza, supposedly the spouse of a key figure Kenferson Sevilla Arteaga, known as "El Flipper," administers Barrio JK, a non-profit entity that ostensibly provides social services but is alleged to function as a façade for Tren de Aragua's criminal operations (Insight Crime, 2021). The intricate roles and functions of such entities, including Barrio JK, require further examination to fully comprehend their contribution to the network's objectives and their impact on its operational dynamics.

Is the Tren de Aragua a scale-free network?

In the next step, we examined if the Tren de Aragua is a scale-free network. In a scale-free network, a small number of nodes have a very high degree, while the majority of nodes have a low degree. One way to test for this is by applying the 80/20 rule: if the top 20% of nodes account for at least 80% of the total ties (edges), the network can be considered scale-free.

*Table 1. Degree and Normalized Degree
Values of first 5 actors*

	Name	Degree	Nom Deg
1	Niño Guerrero	19.000	0.792
2	Kenferson Sevilla Arteaga	13.000	0.542
3	Jennifer de Souza	8.000	0.333
4	Larry Amaury Álvarez	8.000	0.333
5	Yohan José Guerrero	11.000	0.458

- The total sum of edges is 134
- The number of unique edges (ties) is 67 (calculated as half of the total degree sum)
- The top 20% of actors amounts to 5 (from a total of 25 actors)
- The sum of the ties for the top 20% of actors is 61
- These top 20% of actors hold approximately 45.52% of the ties in the network

Since 45.52% is less than 80%, the network does not meet the 80/20 rule in order to be considered a scale-free network. This means that even though we have a few nodes with relatively high degrees (e.g., Niño Guerrero & Kenferson Sevilla Arteaga) and many nodes with low degrees (e.g., Yesmith Adriana Cabargas , Yorman La Fresa, or Tareck El Aissami), the high-degree nodes do not stand out as clear hubs in the network. Another way of testing this is examining if the degree distribution follows a power-law. If the network is scale-free, we should see a relatively straight line when plotting the data points on a log-log scale. In the Tren de Aragua network, we used the `powerLaw` package in R to fit the degree distribution to a power-law model, which uses normalized values for the fitting process. The resulting plot (Fig 2) shows the degree distribution with a fitted power-law line. Although the network exhibits some characteristics of a scale-free network, such as a few nodes with high degrees, the data points do not align perfectly with the red fitted power-law line, particularly for higher degrees. This indicates that the degree distribution does not strictly follow the power-law distribution, and the high-degree nodes do not stand out as significant hubs. This confirms that the Tren de Aragua network is not a scale-free network. Moving on to the centrality measures, we can provide a more detailed analysis of each actor's role within the Tren de Aragua network. In the Tren de Aragua network, the centrality measures reveal a clear hierarchy of influence, with Niño Guerrero at the apex. Niño Guerrero's closeness centrality score of 0.03 indicates that he is relatively close to all other actors in the network.

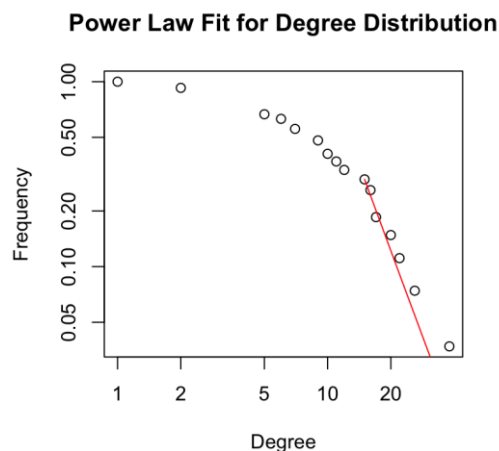


Figure 2. Tren de Aragua Degree Distribution

This measure signifies that on average, he can communicate directly or indirectly with all other nodes in the network more quickly than others. In the context of the Tren de Aragua, this suggests that Niño Guerrero may play a critical role in operational efficiency, as he can potentially disseminate information or exert influence rapidly across the entire network. This important role is further emphasized by his high betweenness centrality of 167.15. This high score implies a significant degree of control over the flow of information. In a criminal network like Tren de Aragua, an actor with high betweenness centrality could be seen as a gatekeeper, having the power to facilitate or hinder communication between various parts of the network. Such a position can be advantageous for coordinating complex operations or for exercising control by granting or restricting access to information. His eigenvector centrality of 1.00 confirms his

connections to other highly influential members. This shows his connections are not just numerous; they are also powerful. In the dynamics of a criminal organization, such a node would be incredibly valuable and likely well-protected, as they are both influential and embedded within the core of the network's power structure.

Table 2. Centrality Measures (5 first cases)

Actor	Closeness	Betweenness	Eigenvector
Niño Guerrero	0.03125000	167.15301663	1.00000000
"El Flipper"	0.02564103	75.14444824	0.84127926
Jennifer de Souza	0.02173913	4.08124098	0.64671784
Larry Amaury Álvarez	0.02173913	1.65555556	0.68028047
Yohan José Guerrero	0.02380952	30.98466811	0.78490659

Kenferson Sevilla Arteaga (El Flipper), with a closeness centrality of 0.02564103, is also notably central but less so than Guerrero. His betweenness centrality of 75.14444824, while substantial, is less than half of Guerrero's, suggesting he has influence but is not as significant for the information flow. Sevilla was controlling the San Vicente neighborhood in Maracay and his main job was managing the foundation, "Fundación Somos El Barrio JK," which received resources and material support from the Government, specifically the state of Aragua ("Tren de Aragua," 2021). His eigenvector centrality of 0.84127926, is high. This indicates influential connections; however, again, he does not match Guerrero's reach. Jennifer de Souza and Larry Amaury Álvarez, with closeness centralities of 0.02173913, are less directly connected within the network, indicating more specialized roles. Their betweenness centralities (4.08124098 for de Souza and 1.65555556 for Álvarez) suggest they have some influence in information flow but are not key gatekeepers. Their eigenvector centralities (0.64671784 for de Souza and 0.68028047 for Álvarez) show they are connected to influential members, but their reach is narrower compared to Guerrero and Kenferson Sevilla Arteaga (El Flipper). These centrality measures align with information from Insight Crime (2020), which noted that Larry was one of Niño Guerrero's most trusted lieutenants, and Jennifer de Souza was El Flipper's wife. Both individuals are linked to the core group, but their roles within the organization may be more specialized and focused.

Peripheral figures like Jimena Araya "Rosita" and Aka "Mayea" have lower centrality scores across all measures, indicating more isolated roles within the network. "Rosita" was allegedly a romantic partner of Niño Guerrero (Carabobo, 2013), and Aka "Mayea" is known to be operating in Colombia, but he is a trusted person of Niño Guerrero (Trujillo, 2023). Their positions suggest they are not central to the network's operations or communication channels. In essence, the network is structured with Niño Guerrero as a central figure, closely followed by Kenferson Sevilla Arteaga and Niño Guerrero's trusted allies. Guerrero and Arteaga have significant influence, but Guerrero's role is more central and controlling. Other actors like de Souza and Álvarez play important but more focused roles, while peripheral figures like Araya and Mayea, despite their lesser centrality, fulfill specific functions within the network's broader structure. This tiered hierarchy illustrates a complex and multifaceted organization, with Guerrero's position being crucial for the overall coordination and strategic direction of the Tren de Aragua. The centrality of key actors supports our second hypothesis, suggesting that the strength and multiplicity of internal ties empower the Tren de Aragua's convergence with governmental systems. Although there are central actors that concentrate most of the relations, they are surrounded by hubs that act as a protection circle but also as a compartmentalization chain. In this regard, the connection between Tren de Aragua and the government is through the foundation Barrio JK which allows an environmental connection with the Government without exposing directly any of its internal members. We will explore broadly this idea in the next section.

Tren de Aragua's Political Network

Lastly, throughout our extensive research, we found several state authority figures directly or environmentally linked to Tren de Aragua. The connections between some Venezuelan government officials and the Tren de Aragua gang, though indirect, are facilitated through social organizations supported by both entities. Government-backed organizations like the Consejos Comunales and Comité Local de Abastecimiento y Producción (CLAP), promoted by Nicolás Maduro's administration, have been instrumental in this interaction. Notably, women linked to Tren de Aragua play significant roles in these organizations. According to Transparencia Venezuela (2022), CLAP collaborated with Barrio JK in delivering public services, food support, and managing public resources. Another notable organization is the Unidades de Batalla Hugo Chávez, a defense unit tied to the United Socialist Party of Venezuela (PSUV) that is focused on promoting Bolivarian (Chavista-left). Insight Crime (2023) reported that Unidades de Batalla were a strategic in Tren de Aragua's expansion. This aligns with our first hypothesis as Barrio JK, the CLAP, and Unidades de Batalla are organizations that are neither part of Tren de Aragua nor the Venezuelan government. They act as channels of communication that allow the interaction of both sides without interfering with their own domains. Additionally, the use of these "civic organizations" confirms hypothesis three by showing the level of sophistication

of the network. Besides more traditional networking with businesses and corruption of government officials, Tren de Aragua's relations are characterized by the use of civic space as a way of interaction while maintaining its status as a separate entity. This approach also serves as a mechanism for legitimization. Besides these organizations, several government officials have been mentioned concerning Tren de Aragua's growth. Tareck El Aissami, Governor of Aragua in 2012, is one such figure. During his tenure, the gang reportedly expanded its presence, partly due to the establishment of "peace zones" and the weakening of local police forces (Insight Crime, 2023). While no direct link between El Aissami and Tren de Aragua members has been established, the number and relevance of links suggest an environmental connection. The next political actor is Iris Varela, the Minister of Penitentiary Services in 2017, who is another significant figure. She has been photographed with members of Barrio JK, with whom she launched the "Ecosocialist project Peace House" (Unit, 2023). These relationships highlight the complex interplay of governance and criminality, creating avenues for resource exchange between state actors and criminal groups while maintaining the group's internal identity and secrecy.

Discussion

Studying Tren de Aragua's network structure provides valuable insights into the intersection of criminal organizations and the government. It highlights the complexity of the relationships that result from this convergence. Our first hypothesis, which suggests that *criminal organizations and the State converge by utilizing covert connections to interact without diluting their borders*, finds strong support in the analysis. Within the network, there is an evident use of covert connections, and interactions between the criminal organization and non-criminal entities, such as Barrio JK, CLAPs, and Unidades de Batalla. At the same time, these organizations are highly connected to criminal and political figures (see Figures 1 & 3). However, proving the depth of these connections remains challenging due to missing data (which is possibly due to deliberate strategies employed by the organization).

Nevertheless, the presence of intermediaries like non-profit organizations exemplified by "Barrio JK", demonstrates a calculated approach to establishing connections with political and social actors. This aligns with the idea that covert connections are utilized to facilitate convergence between criminal organizations and the government. The second hypothesis, which suggests that the ability of Tren de Aragua, or any comparable criminal organization, to converge with the government is influenced by the strength and multiplexity of its internal and external ties, finds strong support in the analysis. Within the Tren de Aragua's network, a clear hierarchical structure is evident, with central figures like Niño Guerrero holding significant influence and control. This internal hierarchy appears to empower the organization to engage with governmental systems, potentially for mutual benefit. The strength of internal ties, as exemplified by the high degree of centrality of key members, plays a crucial role in facilitating these connections. It suggests that the organization's internal cohesion and coordination are key drivers in its ability to converge with the government.

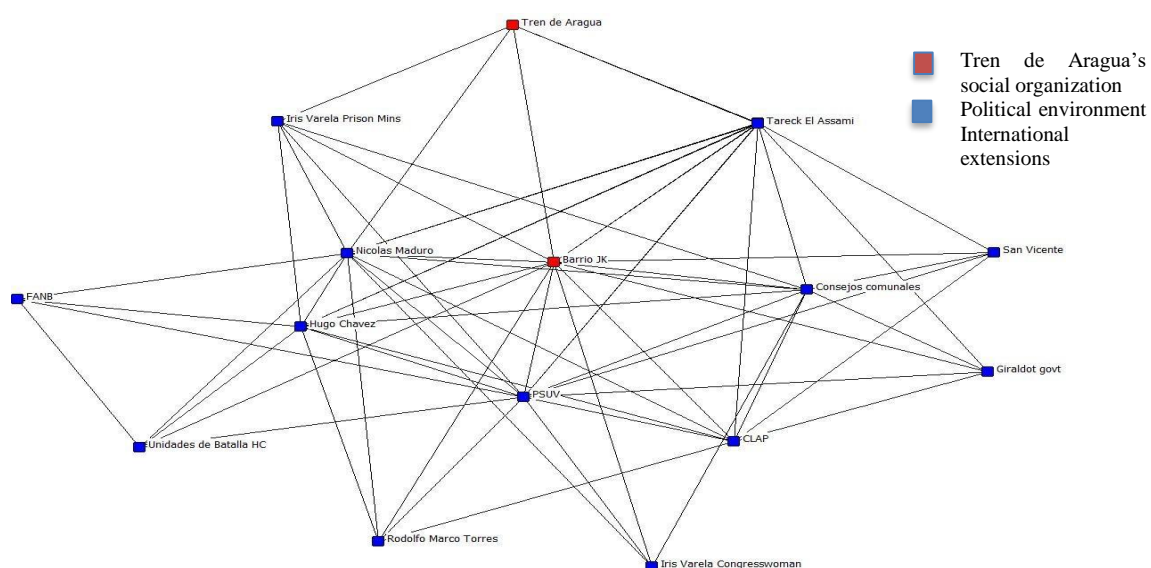


Figure 3. Tren de Aragua – Politician Map

Lastly, the third hypothesis posits that the social network will present ties to other systems (hubs) besides the government and criminal organizations. The analysis provides intriguing insights into the broader web of relationships within the

Tren de Aragua's network. While the focus is on connections between criminal organizations and political or government-related entities, the analysis hints at the existence of additional ties to various social and possibly economic systems. For example, Figure 1 highlights the connection to Francisco the villager. This shows that the gang has also ties to the local community (Risquez, 2023; Insight Crime, 2023). Moreover, going back to Barrio JK, this organization acts as an intermediary and implies a more complex network with connections beyond the traditional government-criminal dichotomy. These connections to other systems underscore the multifaceted nature of the criminal organization's interactions with broader societal systems. However, it is essential to acknowledge the limitations of this analysis. The difficulty in mapping criminal organizations due to limited data access is a significant constraint. The covert nature of these connections, as well as potential security concerns, can hinder comprehensive data collection. Additionally, the reliance on open-source information may not provide a complete picture of the organization's activities. Despite these limitations, the analysis provides valuable insights into the convergence of criminal entities with the government and the intricate dynamics within such networks.

Conclusion and Future Research

We have delved deep into the intricate dynamics of criminal governance, with a particular focus on the case of Venezuela's Tren de Aragua. At the heart of our investigation were two critical research questions: How do prison gangs evolve into sophisticated criminal organizations? and what is the role of intermediary organizations in the evolution of Tren de Aragua? These questions have guided our inquiry and led us on a path to uncover the multifaceted relationships and networks that shape the evolution of prison gangs and their capacity to exert influence. Through the application of SNA, we not only provided valuable insights into the convergence of criminal organizations with socio-political organizations but also revealed the intricacies of relationships within this complex criminal entity by taking Tren de Aragua as a case study. Within the Tren de Aragua's network, a clear hierarchical structure emerges, with central figures like Niño Guerrero holding significant influence and control. This internal hierarchy appears to empower the organization and enable it to engage with governmental systems that eventually led to the takeover of the Tocarón prison. While the primary focus remains on connections between the criminal organization and political or government-related entities, the analysis hints at the existence of additional ties to various social and possibly economic systems. These multifaceted connections to other systems underscore the complexity of the criminal organization's interactions with broader societal systems and how covert interactions between the upper world and the underworld take place.

Current approaches to managing prison gangs and their expansion specifically in the US are varied and complex. Efforts include enhanced surveillance within prisons, stricter control measures, and improved inter-agency cooperation (NIJ, 2020; NCJRS, 2001). However, these measures in Venezuela will face significant challenges, such as corruption within the prison system, the adaptability and resilience of criminal organizations, and the socio-political contexts that facilitate the growth of such entities. Our research suggests a multi-faceted strategy to combat the influence of prison gangs like Tren de Aragua. First, more specific details about the operation of socio-political organizations such as Barrio JK, the CLAP, and Unidades de Batalla are essential to understanding how criminal organizations and criminal governance are evolving. Also, inter-institutional collaboration is essential to tackle the expansion. This includes enhanced data sharing, promoting the cooperation between national and international law enforcement agencies to share intelligence and coordinate actions. Also, targeted interventions such as implementing programs aimed at reducing gang recruitment within prisons, particularly in the educational and vocational aspects. Finally, systemic reforms that address the root causes of corruption and improve the management and oversight of prison systems. The National elections in 2024, along with the security policies implemented in Colombia and Chile aimed at countering Tren de Aragua's expansion, provide a valuable context to assess the explanatory capacity of our model. Specifically, these events allow for the evaluation of the State-criminal status. Current political events in Venezuela and Latin America present an ideal opportunity to test and experiment with our proposed model. First, the results of the elections in Venezuela will portray the role of Tren de Aragua in specific elements of converged governance, elections, and legitimacy. Second, the reaction of border countries such as Colombia and Chile to Tren de Aragua's international expansion will provide an opportunity to understand how the criminal's networking adapts to different political contexts. This real-world application will enable a nuanced analysis of the dynamics and interactions predicted by Social Network Analysis, offering insights into the model's practical implications and effectiveness.

Despite the potential benefits of the proposed solutions, several limitations exist, particularly within Venezuela's security institutions. The main one is related to the reliability of the Venezuelan government, which has struggled with systemic corruption, which undermines the integrity and effectiveness of its security operations. (Insight Crime, 2023, May 25; 2023, June 14). The clearest example is the takeover of Tocarón prison by the government of Venezuela. While the operation was posted as a major success, it failed to capture key leaders like Héctor Guerrero, leading to skepticism about its overall impact and suggesting that the gang's leadership was likely warned (Insight Crime, 2023, May 25). Additionally, the extensive transnational networks of Tren de Aragua and their ability to exploit local

conditions in various countries make it difficult for any single intervention to have a lasting impact without an international security approach (Insight Crime, 2023, May 25). The U.S. Department of the Treasury's designation of Tren de Aragua as a significant transnational criminal organization underscores the gang's extensive criminal reach and the necessity for coordinated international efforts to address this threat (U.S. Department of the Treasury, 2023, July 26). Our research has provided profound insights into the evolution of Tren de Aragua into sophisticated criminal organizations, their convergence with the government, and the intricate web of relationships that characterize their existence.

The application of Social Network Analysis has been instrumental in shedding light on these intricate dynamics. As we reflect on the multifaceted nature of the Tren de Aragua's network and its connections to various societal systems, we gain a deeper understanding of the complexities inherent in criminal governance. This work contributes significantly to the field by advancing our understanding of the intricate landscape of criminal governance in modern contexts.

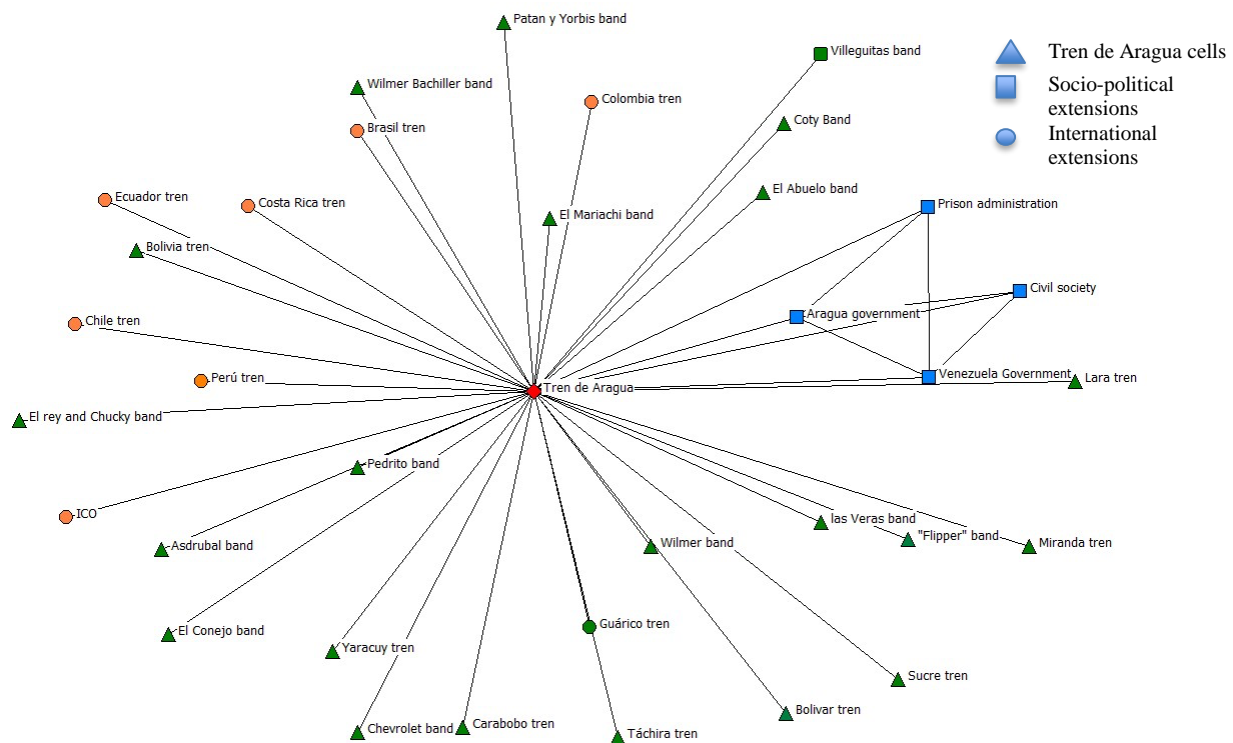


Figure 4. Tren de Aragua Local-International Connections

Lastly, during our research, we found several other criminal organizations that have ties to Tren de Aragua. Figure 4 visually represents these connections, with international ties marked in orange and local ties to other Violent Non-State Actors (VNSAs) highlighted in green. This discovery opens up a promising avenue for future research aimed at creating a comprehensive global network of criminal organizations.

Appendix: Databases can be accessed through the next link:

https://docs.google.com/spreadsheets/d/1CczMrm5AwjJS11_Hc0UrTuApSxxG_FLOiRwKik9evv0/edit?usp=sharing

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