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THE POWER BEHIND TRANSNATIONAL CRIMINAL ORGANIZATIONS: AN INSIDE LOOK AT MEXICAN DRUG CARTEL NETWORKS

by

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The ongoing drug epidemic fueled by Mexican Transnational Criminal Organizations (TCO) is a matter of national interest that the current presidential administration has addressed in its 2017 *National Security Strategy*. Mexican TCOs continue to expand their cross-border operations through robust distribution networks and shared relationships with gangs located within the United States. Efforts to prevent expansion and influence have been largely unsuccessful due to the application of inappropriate strategies and lack of intelligence-sharing products. This thesis examines the factors that make up powerful Mexican TCO networks through the application of visual analytics. Exploration of power factors such as territory, violence, and relationships will lead to determining how TCOs become powerful and how they maintain their power. Our findings highlight factors and vulnerabilities that U.S. interagency organizations can use to develop their own strategies for disrupting nefarious organizations involved in cross-border illegal activities and to add to our overall understanding of TCO networks.

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LIST OF ACRONYMS AND ABBREVIATIONS

BLO	Beltran-Leyva Organization
CBP	U.S. Customs and Border Protection
CJNG	Cartel Jalisco New Generation
DEA	Drug Enforcement Administration
DHS	Department of Homeland Security
DOJ	Department of Justice
DPS	Department of Public Safety
FBI	Federal Bureau of Investigation
LFM	La Familia Michoacana
NDTA	National Drug Threat Assessment
NGIC	National Gang Intelligence Center
NSS	*National Security Strategy*
ORA	Organizational Risk Analyzer
QGIS	Quantum Geographic Information System
SNA	Social Network Analysis
TCO	Transnational Criminal Organization
U.S.	United States

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EXECUTIVE SUMMARY

For the past decade, transnational criminal organizations (TCO) have been particularly responsible for the increased levels of drugs and violence throughout the United States and Mexico.[1] Mexican drug cartels dominate the intricate TCO network, costing the United States and Mexico thousands of lives and billions of dollars in their attempts to thwart TCOs. The drug cartels have stemmed from Mexico and expanded their power throughout the United States. In order to determine what attributes make TCOs powerful, different characteristics must be analyzed. This thesis examines relationships and violence to further understand what makes TCOs powerful.

Various theories suggest that a cartel's power comes from the territory it controls, the number of relational ties in the network, the violence it inflicts, the amount of money it possesses, the amount of land it has for drug cultivation, or any combination of these. The data gathered for this thesis was analyzed using social network analysis software, geospatial analysis tools, and temporal analysis.

The results of this research show that the TCO network is extremely decentralized, with no single organization having control over the entire network. Moreover, the results suggest that cartels control different clusters of territory that are widely dispersed throughout United States and Mexico, and serve as spatial indicators of cartel power. Finally, the amount of territory that a cartel dominates does not directly correlate with the number of collaboration ties within the TCO network.

[1] "The "New" Face of Transnational Crime Organizations (TCOs): A Geopolitical Perspective and Implications to U.S. National Security," Homeland Security Digital Library, March 2013, https://www.hsdl.org/?view&did=733208.

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I. INTRODUCTION

A. BACKGROUND

Mexican transnational criminal organizations (TCO) have become some of the most powerful, illicit organizations operating in the United States. According to the Drug Enforcement Agency's (DEA) 2017 *National Drug Threat Assessment* (NDTA), "Mexican TCOs maintain the greatest drug trafficking influence in the United States."[1] These TCOs are embedded in a complex network of cartels, cartel factions, and gangs that traffic illicit drugs and conduct other illegal activities in the United States. Due to their complex structure, the U.S. government has had to fight a war on two fronts. The first is against TCOs based in Mexico, and the second is against gangs in the United States. As Mexican cartels continue to expand their sphere of influence, bolster operations, and gain power, the United States is simultaneously witnessing an increase in the demand for drugs, overdose deaths, crimes, and gang activity.[2] Ongoing studies by the DEA and National Gang Intelligence Center (NGIC) illustrate that Mexican TCOs have extensive production and supply networks that are amplified through gangs in the United States.[3] These intricate networks contribute to the enormous amounts of drugs trafficked across the U.S.–Mexico border, which are bound for supply distribution hubs throughout the country and subsequently sold through local gangs.

TCOs have created an international crisis that has spread throughout the United States and Mexico. The epidemic spread of drugs and violence caused by TCOs has resulted in a $279.7 million increase in U.S. taxes and increased crime rates in both countries.[4] The DEA has also reported that,

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[1] U.S. Department of Justice, Drug Enforcement Administration, *2017 National Drug Threat Assessment, DEA-DCT-DIR-040-17* (Washington, DC: U.S. Department of Justice, Drug Enforcement Administration, 2017). https://www.dea.gov/sites/default/files/2018-07/DIR-040-17_2017-NDTA.pdf.

[2] Ibid., 1–2.

[3] Ibid.

[4] "Economics of Drug Policy and the Drug War: FY2018 Federal Drug Control Budget Request," Drug War Facts, accessed March 26, 2017, http://www.drugwarfacts.org/chapter/economics#budget.

> Drug poisoning deaths are the leading cause of injury death in the United States; they are currently at their highest ever recorded level. Every year since 2011, drug poisoning deaths have outnumbered deaths by firearms, motor vehicle crashes, suicide, and homicide. In 2015, approximately 140 people died every day from drug poisoning.[5]

In 2017, U.S. Customs and Border Protection (CBP) played a crucial role in the seizure of over 2.14 million pounds of narcotics, $96.8 million in unreported currency, and arrested 20,131 criminal aliens, 536 of whom had gang affiliations.[6] In 2017, the U.S. government spent $23.28 billion fighting the TCOs within U.S. territories and an additional $5.6 billion interdicting TCOs in Mexico.[7] Meanwhile, Mexican TCOs made approximately $29 billion in profit by trafficking drugs from Mexico into the United States.[8] Moreover, the violence in Mexico has reached record heights as organized crime groups fight to gain control over organizations and territory, fragmented by numerous arrests and deaths in leadership.[9] In 2017, Mexican cartels were responsible for approximately 29,168 murders throughout Mexico.[10] Researchers at the University of San Diego attribute the majority of the violence during 2016 and 2017 to deteriorating economic conditions in Mexico coupled with drug cartels fighting for territory and control over drug production and trafficking.[11]

While the U.S. government has experience fighting criminal activity within U.S. borders, it has less experience fighting criminal organizations rooted outside of the

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[5] U.S. Department of Justice, Drug Enforcement Administration, *2017 National Drug Threat Assessment*, v.

[6] U.S. Customs and Border Patrol, *CBP Border Security Report Fiscal Year 2017* (Washington, DC: U.S. Department of Homeland Security, 2017), https://www.cbp.gov/sites/default/files/assets/documents/2017-Dec/cbp-border-security-report-fy2017.pdf.

[7] Drug War Facts. "Economics of Drug Policy and the Drug War."

[8] Ibid.

[9] Kimberly Heinle, Octavio Rodriquez Ferreira, and David A. Shirk, *Drug Violence in Mexico: Data and Analysis through 2016* (San Diego, CA: University of San Diego, 2017), https://justiceinmexico.org/wp-content/uploads/2017/03/2017_DrugViolenceinMexico.pdf.

[10] "Drug Violence Blamed for Mexico's Record 29,168 Murders in 2017," *The Guardian*, January 21, 2018, https://www.theguardian.com/world/2018/jan/21/drug-violence-blamed-mexico-record-murders-2017.

[11] Ibid., 32–35.

country. The effects that TCOs have on the United States are so influential that in the 2017 *National Security Strategy* (NSS), President Donald J. Trump specifically addressed the security of U.S. borders as a top priority.[12] One of the NSS's aims is to combat and dismantle TCO networks both domestically and abroad.

> We will deny TCOs the ability to harm Americans. We will support public health efforts to halt the growth of illicit drug use in the United States.
>
> The United States must devote greater resources to dismantle transnational criminal organizations (TCOs) and their subsidiary networks. Every day they deliver drugs to American communities, fuel gang violence, and engage in cybercrime. The illicit opioid epidemic, fed by drug cartels as well as Chinese fentanyl traffickers, kills tens of thousands of Americans each year.[13]

According to multiple federal agencies, the most influential cartels operating in the United States and Mexico are the Cartel Jalisco New Generation (CJNG), Sinaloa, Los Zetas, Gulf, Juarez, Beltran-Leyva Organization (BLO), La Familia Michoacána (LFM), Tijuana, and Knights Templar cartels. To address the NSS's concerns, our thesis focuses on these nine cartels to better understand which characteristics provide them the ability to operate so effectively. Moreover, it will also identify potential vulnerabilities that authorities may be able to exploit.

B. PURPOSE

The current strategies in place seem to be a reaction to the ongoing opioid epidemic that is sweeping across the United States. However, efforts to prevent TCOs' expansion and influence have been largely unsuccessful due to the use of inadequate strategies and lack of intelligence sharing.[14] The current strategies fail to provide an in-depth understanding of a TCO's power and how it changes over time. Much of the

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[12] White House, *National Security Strategy* (Washington, DC: White House, 2017), https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.

[13] Ibid.

[14] U.S. Department of Justice, Office of the Inspector General, *Follow-up Review of the Drug Enforcement Administration's El Paso Intelligence Center* (Washington, DC: U.S. Department of Justice, Office of the Inspector General, 2017), https://oig.justice.gov/reports/2017/e1701.pdf.

current research has been unable to analyze multiple TCOs simultaneously through a variety of lenses. Therefore, a primary goal of this thesis is to fill the gaps in existing literature by exploring TCO networks located in the United States and Mexico. We use a variety of social network analysis (SNA) and visual analytics tools to analyze the TCO networks, which can allow us to begin understanding how TCOs achieve and sustain their power. Furthermore, our research incorporates geospatial analysis to provide insight into the relationship between criminal social networks and their geographic presence. Lastly, our analysis will expose network vulnerabilities, which may assist U.S. government and law enforcement agencies with new insights that can be used to disrupt TCO networks.

C. RESEARCH QUESTION

We define the power of a TCO as its capacity to influence others, inflict violence, and dominate strategic territories in order to maximize its benefits. With this in mind, this thesis examines the following question: What characteristics do powerful Mexican TCOs possess?

D. LITERATURE REVIEW

To understand TCOs better, we researched interactions among state actors, non-state actors, violent extremist organizations, and gangs. We draw upon insights from existing literature regarding international relations, transnational extremist organizations, and gang networks to serve as frameworks for this research. We focus on the interactions between state actors, non-state actors, violent extremist organizations, and gangs to better understand the TCO network dynamics and power. Our assumption is that how TCOs and gangs interact across the U.S.-Mexican border may be similar to the interactions of other organizations across the world that fight for power due to porous borders, resources, or opportunities. First, we explore how international state actor relational ties increase or decrease an actor's power and how positive and negative relationships affect one's power. Second, we examine case studies of the relationships between non-state actors and violent extremist organizations competing for limited resources, assuming that their interactions will be similar to those between TCOs and gangs. Furthermore, we believe they will provide insight into the attributes (characteristics) that correlate with TCO

intergroup and intragroup violence. Lastly, we believe this data will provide insight into how geography affects organizational power.

1. International Relations

Many theories exist about what defines organizational "power," what drives state actors to war, and how alliances form. Understanding the different types of interactions between state and non-state actors in the international arena can be useful in understanding TCO networks because, like TCOs, state and non-state actors share many of the same motives to use violence, form alliances, and develop enemies. One recurring theme is that states that belong to a larger organization, such as an international government organization (IGO), are embedded in a dense network that influences their foreign policy and use of power. For example, Emilie Hafner-Burton and Alexander Montgomery used SNA to examine IGOs and interactions between state actors. They concluded that IGO membership provides a relative status of power within the international arena and that a state's power increases as its number of ties with the international community increases.[15] Additionally, IGO membership status dictates that a state's power and behavior are not only driven internally, but also influenced by shared characteristics with other states in similar networks.[16] Therefore, external factors that influence state actors in one IGO network can also influence the behavior of state actors in another network.

Analyzing international relations between state actors may also serve as useful guides for understanding the motives behind TCO relationships. Maoz et al. explain that conflicts in a network increase through the presence of "strategic rivalry, opportunism and exploitative tendencies, capability parity, and contiguity."[17] This notion is indicative

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[15] Emilie M. Hafner-Burton and Alexander H. Montgomery, "Power Positions: International Organizations, Social Networks, and Conflict," *Journal of Conflict Resolution* 50, no. 1 (2006): 13, https://doi.org/10.1177/0022002705281669.

[16] Ibid.

[17] Zeev Maoz et al., "What Is the Enemy of My Enemy? Causes and Consequences of Imbalanced International Relations, 1816–2001," *The Journal of Politics* 69, no. 1 (2007): 100, https://doi.org/10.1111/j.1468-2508.2007.00497.

of state actors, much like TCOs, that seek to take advantage of certain situations by forming alliances or rivalries for temporary profits. Conversely, conflicts decrease "when international state actors shared joint democracy, economic interdependence, and IGO membership."[18] According to Maoz et al., state actors that collaborate are more likely to achieve political, economic, and security benefits when they collaborate with each other.[19] They suggest this results in one type of "balanced" relationship (triad), such that your friend's friend is likely to be your friend as well.[20] This additional friendship can potentially ensure the power and benefits that you are trying to achieve through the first alliance. An example of this small network in which all three ties are positive is shown in relationship #1 in Figure 1.

Maoz et al. suggest another benefit from collaboration could be an alliance against a common enemy, which is the result of "balance-of-power logic [that] causes states to form alliances and cooperate against common enemies."[21] This is another example of a balanced relationship, which follows its own logic of power. Specifically, it occurs when your ally's enemy is also your enemy because your ally may intentionally or unintentionally be drawn into a conflict that will require your support. Similarly, the same proportion of alliances and conflicts can occur when an actor views "allies of enemies as potential enemies, because they perceive themselves as potential targets of alliances forged by their enemies."[22] The perception of being seen as a potential target follows the balance-of-power model of Maoz et al., such that two actors with less resources could combine their power to form a critical alliance to overthrow or at least stalemate, a larger actor with relatively more resources than other individual actors.[23]

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[18] Ibid.

[19] Ibid., 103.

[20] Ibid., 102.

[21] Ibid.

[22] Ibid.

[23] Ibid., 100.

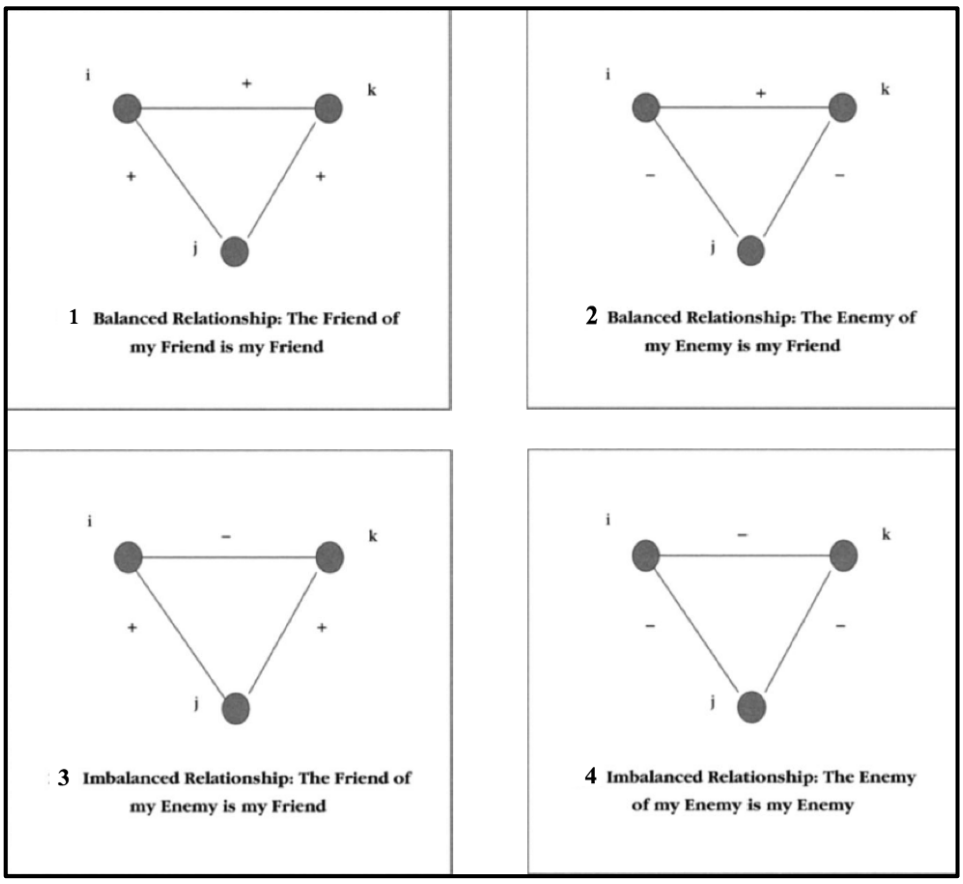

Figure 1. Examples of Balanced and Imbalanced Relationships[24]

Maoz et al. argue that some organizations form alliances with other organizations but are still cautious of being exploited by their allies.[25] They note that organizations can potentially have a "perception or anticipation of hostility based on a history of past militarized conflict," which can quickly turn a collaborative relationship into a rivalry, which they classify as a friendship paradox.[26] The dynamics between actors that cause friendship paradoxes contribute to "imbalanced" relationships (see Figure 1). These triads are imbalanced because they fail to exhibit inconsistencies "with the expectation of

[24] Source: Maoz et al., "What Is the Enemy of My Enemy?," 105.

[25] Ibid., 102.

[26] Ibid.

balance between indirect and direct relations."[27] The first type of imbalanced triad occurs when the ally of your enemy is somehow your ally. In this situation, the actor with two allies has the majority of the power because all of the resources must flow through them, thereby giving them the most control over the network.[28] The second type of imbalanced triad occurs when the enemy of your enemy is also your enemy.[29] In this type of relationship, all actors in the triad in an equally comparable position with respect to power. These types of relational analyses have been studied through international actors, but have yet to be to be integrated in to the study of current dark networks, such as the Mexican TCO network.

Alliances among TCOs can be seen as being based on different levels of trust. As Mark Granovetter notes, trust between organizations can derive from various sources, such as (1) knowledge or calculation of interests of the other, (2) personal relationships including kinship, (3) membership in groups and networks, (4) institutional sources, and (5) norms.[30] And while Granovetter's focus differs from this thesis's, there is no reason to suspect that trust does not occur on multiple levels among TCOs as well.

2. Transnational Extremist Organizations

The connection between power, geography, and relationships among violent groups is another focus that may help explain TCO power. Walther and Miles, for example found that geography and boundaries play a critical role in how insurgent groups exploit and destabilize their neighbors through violence to obtain their goals.[31] The collected works in their edited volume illustrate that state and non-state actors vie for power and cross into neighboring territories for a variety of reasons, including assisting

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[27] Ibid., 113.

[28] Ibid., 114.

[29] Ibid., 114.

[30] Mark S. Granovetter, *Society and Economy: Framework and Principles* (Cambridge, MA: Belknap Press of Harvard University Press, 2017), 59–72.

[31] Walther, Olivier J., and William F. S. Miles. 2017. "Introduction: States, Borders and Political Violence in Africa." Pp. 1–13 in *African Border Disorders: Addressing Transnational Extremist Organizations*, edited by Olivier Walter and William F. S. Miles (New York, Routledge), 1.

an ally, greater self-autonomy, and increased control of natural resources.[32] For instance, Cunningham et al. note that conflicts between groups in a dark network are likely to be attributed to geospatial and social processes.[33] Similarly, Szayna et al. explore the dynamics of inter-group violence using geospatial analysis. In particular, they note that intrastate violence is more likely to occur in states with small and less-disciplined security forces, economic inequalities, and exploitable natural resources such as illicit drugs.[34]

Despite many similarities among TCOs, non-state actors, and insurgent groups, there are at least two gaps in our understanding of the power of TCOs. One is that there is a limited amount of research highlighting the factors that relate to violence and geography among Mexican TCOs. A second is a lack of understanding in the causes of violence within Mexican TCO networks and the impacts violence has on the network. Understanding these will increase our understanding of what a powerful TCO looks like.

3. Gang Interactions

Studies of gangs and gang violence can contribute to our understanding of TCO networks, in particular, their intricate social and geographical ties, as well as their characteristics. Papachristos, Hureau, and Braga, who use SNA to examine the interaction between violence, gangs, and neighborhoods, argue that violence directly influences an actor's level of power and cross-border reach.[35] Papachristos also found that, similar to epidemics, gang violence spreads throughout social networks as they

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[32] Oliver J. Walther and William F.S. Miles, *African Border Disorders: Addressing Transnational Extremist Organizations* (New York: Routledge, 2017).

[33] Daniel Cunningham, Sean F. Everton, and Kristen Tsolis, "Exploring the Spatial and Social Networks of Transnational Rebellions in Africa," in *African Border Disorders: Addressing Transnational Extremist Organizations,* ed. Oliver J. Walther and William F.S. Miles (New York: Routledge, 2017), 40.

[34] Thomas S. Szayna et al., *Understanding Conflict Trends: A Review of the Social Science Literature on the Causes of Conflict* (Santa Monica, CA: RAND, 2017), https://www.rand.org/pubs/research_reports/RR1063z1.html.

[35] Andrew Papachristos, David Hureau & Anthony Braga, "The Corner and the Crew: The Influence of Geography and Social Networks on Gang Violence," *American Sociological Review* 78(3) (2013): 419.

reciprocate violence.[36] While violent acts may be a function of geographic factors such as proximity, they also occur due to competing interests in the hierarchical structure of the organization or limited resources, such as drugs, money, and territory. Not only do different types of drugs correlate to various levels of violence, but, as Papachristos, Hureau, and Braga mention, social interactions also have a large influence on the levels of violence.[37]

Papachristos and his colleagues made several distinct findings based on studying gang violence in Boston and Chicago from 2005 to 2009.[38] One is that a gang is more likely to commit an act of violence in retaliation, after it is attacked.[39] A second is that violence does not result in a hierarchical pecking order between gangs.[40] A third is that relationships play an important and under-examined role in inter-gang violence. They also demonstrate the utility of using geospatial analysis to analyze gang violence; in particular, they found that it is not only based on geographic borders but also the geographic proximity of gangs to one another.[41] Radil et al. study of the Hollenbeck Gang based in Los Angeles, California and concluded that without the use of both SNA and geospatial analysis, it would be difficult to identify the overall patterns of violence throughout the network or understand the relational ties formed solely based upon geographical attributes.[42] Contrary to Papachristos findings, however, they found that

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[36] Andrew Papachristos, "Murder by Structure: Dominance Relations and the Social Structure of Gang Homicide," *American Journal of Sociology* 115, no. 1 (2009).

[37] Papachristos, Hureau and Braga, "The Corner and the Crew."

[38] Ibid., 422.

[39] Ibid., 419.

[40] Papachristos, "Murder by Structure."

[41] Ibid.

[42] Steven M. Radil, Colin Flint, and George E. Tita, "Spatializing Social Networks: Using Social Network Analysis to Investigate Geographies of Gang Rivalry, Territoriality, and Violence in Los Angeles," *Annals of the Association of American Geographers* 100, no. 2 (2010): 307–26. https://doi.org/10.1080/00045600903550428.

gangs were less likely to commit acts of violence when they shared borders with other gangs.[43]

In another study, Adams et al. examine spatial and social network analysis and describe what occurs when the two methods interact.[44] They discuss how the propinquity effect best explains outcomes within formal organizations.[45] The propinquity effect refers to the relationship between geographic proximity and the increased likelihood of developing a positive or negative relational tie. Adams et al. argue that despite the number of independent studies conducted on an actor's social network, geographic location, and proximity to another actor, additional research is required to fully understand the relationship between an actor's proximity and how social or geographic distance influence interactions. Finally, they conclude that a key element missing from the studies is the concept of time, relationships within a network must be analyzed over some period of time to better understand how they change.[46]

The previous case studies about gangs provide us with a basic understanding of violence, relationships, and territory. They also demonstrate the utility of using geospatial analysis, which we draw on in the third chapter. What they do not do is provide an understanding of how complex networks such as TCOs interact and change over time. The case studies also do not address how gangs obtain and exert power.

E. DATA SOURCES

Dark networks' dynamic relationships, inherent characteristics, and desire to remain undetected lead to significant gaps in data.[47] Throughout our research, we

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[43] Ibid.

[44] Jimi Adams, Katherine Faust, and Gina S. Lovasi, "Capturing Context: Integrating Spatial and Social Network Analyses." *Social Networks* 34, no. 1(2012):1-5. https://doi.org/10.1016/j.socnet.2011.10.007.

[45] Ibid., 1.

[46] Ibid., 4.

[47] Sean F. Everton. *Disrupting Dark Networks*. (New York: Cambridge University Press, 2012), loc. 445 of 10222, Kindle; Cass R. Sunstein, "The Law of Group Polarization," *Journal of Political Philosophy* 10, no. 2 (December 2002).

identified gaps in attribute and spatial data, which helped us set the boundaries of which TCOs and what years to include in our analysis. Our base data set is comprised of 173 different actors and spans a six-year period: 2010–2015. Each actor is either a gang, cartel faction, or drug cartel whose primary headquarters were geographically located in the United States or Mexico. While our research initially focused on all 173 actors, there was limited data pertaining to specific gangs and cartel factions, therefore not all actors are present each year. This is not to say that the missing actors did not collaborate, but we found no sources indicating that they did collaborate in that particular year. Therefore, we narrowed our focus to nine drug cartels that appeared in multiple DEA reports as having the most influence in drug trafficking. The DEA stated that the Sinaloa, CJNG, Juarez, Gulf, Los Zetas, BLO, Tijuana, LFM, and Knights Templar cartels held "the greatest drug trafficking impact on the United States."[48] Our research centered on these nine cartels, not only because of a lack of relational data on gangs and cartel factions, but we also realized there was a trend in multiple reports surrounding gang activities. These reports often noted that there was a relational tie to at least one of the nine cartels located in Mexico.

We relied on United States and Mexican-based news sources and government produced reports to compile our data. The DEA, DPS, FBI, and NGIC are the primary federal agencies who track TCOs, and therefore provide the bulk of data used in this analysis; however, their publications are based on reports from multiple sources that often have gaps in their reporting. Open-source data from Stratfor Worldview, the United Nations Office Drugs and Crime (UNODC), Mexican online narcotics information database (NarcoData), and Uppsala Conflict Data Program (UCDP) supplemented government-derived data to fill in some necessary gaps and to facilitate the analysis of drug seizures and inter-cartel violence. Much of the aforementioned sources have maps, literature, and statistical reports, but the data have not been combined into a single-source document and had to be structured for our analysis.

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[48] U.S. Department of Justice, Drug Enforcement Administration, *2017 National Drug Threat Assessment.*

Our relational data are broken down and categorized into collaboration, enemy, and violence networks. Appendix A provides the definitions of these relationships. In terms of geospatial data, we use the DEA and NGIC data sources as guides to identify cartel dominance at the state-level. Stratfor's article "Special Report: Mexico's Cartels Will Continue to Erode in 2016," supplements the DEA and NGIC data sources.[49] Furthermore, we collected data on each cartel's age and home base (location where organization was established) to add an additional layer to the analysis.

F. METHODS AND APPROACH

This thesis combines social network, geospatial, and temporal analysis to obtain a comprehensive picture of power within the Mexican TCO network. It employs both exploratory and confirmatory statistical techniques to analyze this. In terms of SNA, we utilize both network topography and centrality metrics, balance theory, and stochastic actor-oriented models to examine power within the TCO network. Network topography refers to a network's overall structure, and it can highlight how power is distributed through a network. A helpful starting point is to examine the entire network, which is displayed in Figure 2, which includes every actor that collaborated with another actor at any point in time. Each green dot represents a criminal organization (e.g., gang, TCO), while line color indicates the year in which two organizations collaborated. Organizational Risk Analyzer (ORA) was used to visualize the network and highlight the different years of actors within the network.[50] Furthermore, this network is undirected, which means that although we consider the source and recipient of each tie, we do not know who initiated the relationship. It is not unusual when examining dark networks, which work hard to keep their interactions undetected.

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[49] Omar Torres, "Special Report: Mexico's Cartel Will Continue to Erode in 2016," Stratfor Worldview, last modified January 25, 2016, https://worldview.stratfor.com/article/special-report-mexicos-cartels-will-continue-erode-2016.

[50] Kathleen M. Carley, *Organizational Risk Analyzer (ORA),* Pittsburgh, PA, 2011, accessed October 2, 2018. http://www.casos.cs.cmu.edu/projects/ora/download.php.

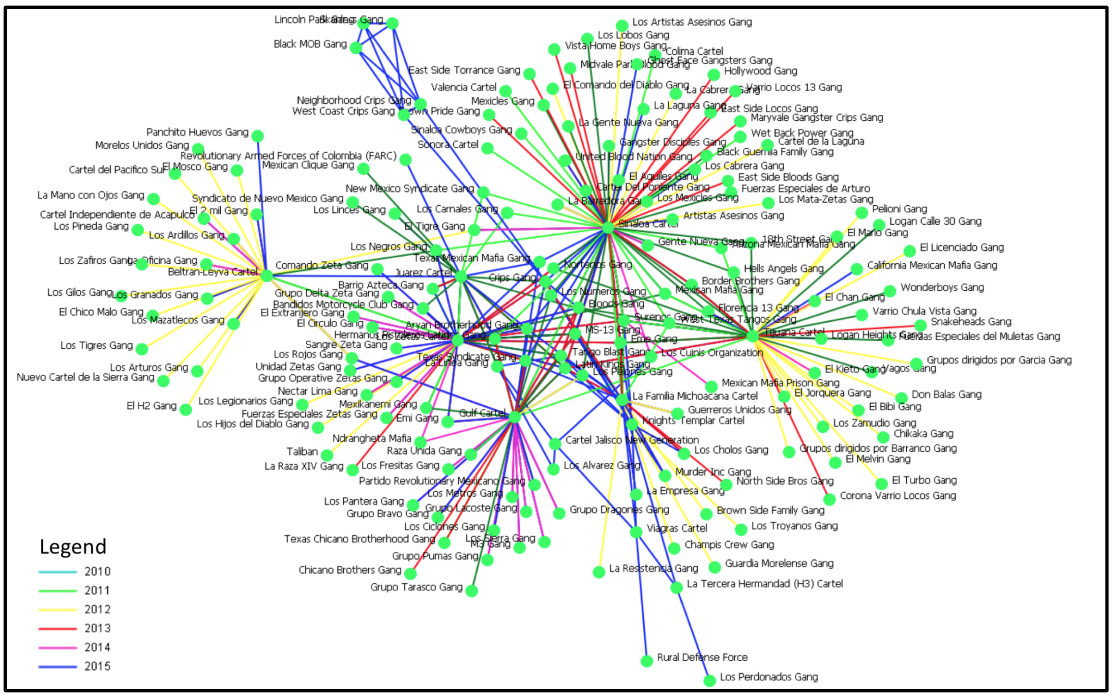

Figure 2. Combined TCO Collaboration Network, 2010–2015

One topography measure is network size, which indicates how many actors there are in a network. A second is centralization. Network centralization scores range from 0.00 to 1.00, with higher scores suggesting that a single actor is more likely to be extremely central (and likely powerful) as compared to the other actors.[51] A third is average degree, which describes the average number of ties among all of the actors within the network and is often used to capture how interconnected a network is.[52]

Centrality measures provide an indication of an actor's social power based on their position within the network. Degree centrality counts the number of ties an actor has in a network and can be seen as an actor's relative power via its ability to connect with many others. Eigenvector centrality assumes that ties to well-connected actors are more important than ties to peripheral actors; therefore, it weights an actor's ties by the number of ties of its neighbors. In this context, an organization with a relatively high eigenvector

51 Everton, *Disrupting Dark Networks*, loc. 8397–8399.

52 Ibid.

centrality would be one that has power through its numerous connections to other "powerful" organizations. Closeness centrality measures how close, on average, each actor is to all other actors in a network based on path distance.[53] Organizations that maintain positions in the network that are close to many others, especially as it pertains to collaboration-based ties, are more likely to have access to information and resources. Finally, betweenness centrality measures the extent to which each actor lies on the shortest path between all other actors in a network.[54] In the case of the TCO network, high betweenness centrality may indicate organization's ability to control the flow of information and resources through the TCO network.

Actors that are considered brokers typically have a high betweenness centrality value, which places them in a position with a great deal of power within a network. For purposes of this study, a broker is an organization that can serve as a liaison or gatekeeper between two other organizations or components, while a bridge is the tie between the broker and another actor.[55] Either removing these brokers or severing the bridges can cause the network to fragment into separate components.[56] As an example, Figure 3 shows that the Tijuana, Sinaloa, and LFM cartels are considered brokers, while the dashed lines represent the bridges in the network. If we cut the bridge between the LFM cartel and the Bloods gang, then we can somewhat disrupt the flow of resources throughout the network because the MS-13 gang will now have to be conduit between the Bloods gang and the LFM cartel. However, if we remove one of the brokers or cut the tie between the Tijuana and the LFM or Sinaloa cartel, there would be absolutely no flow of resources from the component on the left to the component on the right.[57] Consequently, this gives the Tijuana, LFM, and Sinaloa cartels high values of betweenness centrality and relatively more power within the network.

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[53] Ibid., 8402.

[54] Ibid., loc. 8397–8399.

[55] Ibid., 925.

[56] Ibid., 4057.

[57] Ibid., 926.

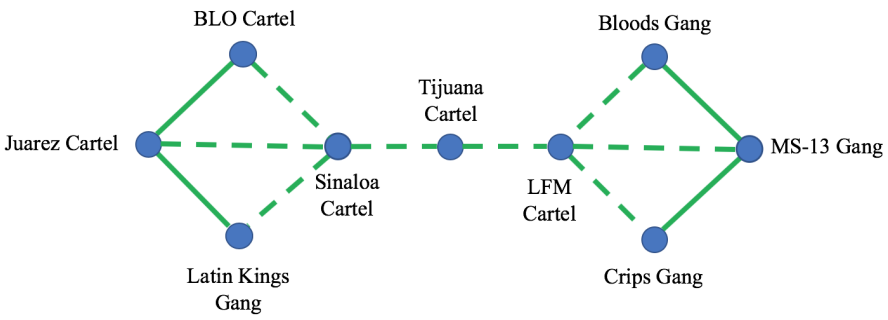

Figure 3. Network Bridge and Broker Example[58]

In addition to network topography and centrality, we draw on balance theory to examine the role that multiplex relationships have on power dynamics. As described in the literature review, balanced and imbalanced relationships exist throughout the Mexican TCO network. Therefore, we use the SNA program, UCINET,[59] to convert the networks in order to apply a mathematical algorithm included in the SNA program, Pajek,[60] to identify which actors are involved in balanced and imbalanced relationships, as well as the number of times these relationships occur. We used the algorithms to identify actors within the network that have the most enemies allied against them (Figure 1, Relationship #2) and which actors have allies that are enemies (Figure 1, Relationship #3). The former triad corresponds to an actor without or in the process of losing power, while the latter corresponds to an actor's ability to maintain power.

Finally, we employ a stochastic actor-oriented model (SAOM) to tease out relational power dynamics among the cartels. SAOMs assume that social networks are built upon local structures (e.g., reciprocity) that can be modeled in order to help account for the overall structure of the observed network. With regards to the TCO network, we can use SAOMs to see if certain patterns indicative of organizational power appear at a

[58] Data compiled using sources outlined in this chapter.

[59] Stephen P. Borgatti, Martin G. Everett, and Linton C. Freeman. 2002. *UCINET for Windows: Software for Social Network Analysis*. Harvard, MA: Analytical Technologies.

[60] Vladimir Batagelj and Andrej Mrvar. 2018. *Pajek 5.05*. Lubjlijana, Slovenia: University of Ljubljana.

rate greater than one would expect in a random network of the same size with the same number of ties.

Geospatial analysis helps researchers examine human behavior in terms of geography.[61] Geographical characteristics such as territorial dominated, locations of violent acts, and locations of significant activity, allow us to use spatial analysis to understand an actor's level of power within the TCO network. When we combine it with temporal data, we can identify patterns and trends in our data, which, in turn, can highlight changes in behavior among TCOs and allow us better understand the relationship between geography and a TCO's power. Nonetheless, we only employ exploratory analysis techniques to examine the network spatially.

[61] Manfred M. Fischer and Arthur Getis, eds., *Handbook of Applied Spatial Analysis: Software Tools, Methods and Applications* (Heidelberg: Springer-Verlag Berlin Heidelberg, 2010), 3.

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II. SOCIAL NETWORK ANALYSIS

A. THE TCO NETWORK

In any social network, some actors have more social power than others based on a multitude of characteristics. In a dark network comprised of gangs and drug cartels operating inside the United States and Mexico, an organization's power may be attributed to a number of traits. This section will focus on the collaborative and enemy ties among TCOs dating from 2010 to 2015, shown in Appendix B. These ties among TCOs and other organizations capture how different types of relationships affect and contribute to a TCO's power within the network.

B. TCO COLLABORATION NETWORK

In order to fully understand the actors within a network, we start by examining the network as a whole, which includes utilizing network topography measures. This macro-level view of the network helps us identify patterns in the network before we analyze the individual actors themselves. Looking at Table 1, we see that the size of the TCO collaboration network doubled from 45 in 2010 to 90 in 2015, which is indicative of a network that is expanding and recruiting additional members. This data illustrates that as the TCOs expand their networks, they increase the number of ties with more actors. These findings suggest that TCOs recruit more gangs and factions to conduct illicit operations, which probably results in a more powerful TCO network.

The declining centralization scores suggest that the network became less centralized over the five years, which could mean a number of things. First, it might suggest that the network was originally more centered around a single cartel in 2010, while in 2015 the network encompassed several central actors. If this is indeed the case, then we would see some evidence of this in the individual centrality scores, discussed later in the next section. We should also see a positive coefficient for the star configuration in the stochastic actor-oriented model (SAOM) that we estimate in Table 1.

Table 1. TCO Collaboration Network Topography Measures

Year	Network Size	Centralization	Average Degree	Density
2010	45	0.218	2.667	0.03
2011	28	0.281	2.929	0.054
2012	65	0.139	1.785	0.014
2013	43	0.165	2.791	0.033
2014	53	0.101	1.849	0.018
2015	90	0.131	3.156	0.018

A network that is decentralized is typically difficult to disrupt and allows the network to survive even if key actors are removed.[62] Table 1 shows that the TCO collaboration network centralization scores increased from 2010 to 2011 and then decreased through 2015. One possible cause is that the Sinaloa cartel lost one of its high-ranking lieutenants, Manuel Torres Félix, during this time. Prior to his death, he was the right-hand man to Ismael Zambada Garcia, the second-in-command, who worked directly for Joaquin "El Chapo" Guzman Loera, the leader of Sinaloa.[63] Félix oversaw the majority of the Sinaloa narco-trafficking operations from South America into Mexico.[64] At the time, the Sinaloa cartel was the largest TCO in the network. This is not to say that Sinaloa controlled the entire TCO network, but its disruption had an impact on the larger network.

Understanding the network's level of cohesion, as indicated by average degree, is important since it allows us to see if the network is resistant to disruption and able to

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62 Everton, *Disrupting Dark Networks*, loc. 511–512; Ori Brafman and Rod A. Beckstrom, *The Starfish and the Spider: The Unstoppable Power of Leaderless Organizations* (New York, NY: The Penguin Group, 2008).

63 "Regional Leader's Death Is Blow to Sinaloa Cartel: Officials," InSight Crime, October 06, 2017, accessed November 02, 2018, https://www.insightcrime.org/news/brief/regional-leaders-death-is-blow-to-sinaloa-cartel/.

64 México and Compañia Periodística Nacional, "Sedena Confirma Muerte De El M-1 En Sinaloa," El Universal, August 20, 2015, accessed November 02, 2018, http://archivo.eluniversal.com.mx/notas/876530.html.

maintain its power.[65] A network with an average degree of 2.0 or higher can be difficult to disrupt because of its level of redundancy built into the network. This score shows us that, on average, every actor has ties with two or more actors. As an example, if you have two or more ties in a network and one of your ties is cut or removed, you still have at least one other actor that you can collaborate with to remain connected to the whole network. This shows that the arrest or removal of an actor will not likely fragment or collapse the network, but it may lead to "the apprehending of remaining network participants."[66]

C. CENTRALITY MEASURES

Actors who have more social power in a network have relatively higher measures of centrality, which are indicative of different levels of social power. In our research, we focus on four centrality measures to analyze the TCO network: degree, eigenvector, closeness, and betweenness centrality. In this section, we analyze the results of the four centrality measures, listed in Appendix C, and draw perspectives on the measures of each actor.

1. Degree Centrality

Actors with relatively higher degree centrality scores tend to be more powerful within the network.[67] Figure 4 illustrates how nine Mexican cartels dominated the collaboration network from 2010 to 2015. The Sinaloa cartel had the highest degree centrality from 2010 to 2011, but then its scores dropped and became similar to those of the two other major cartels (Los Zetas and Gulf cartels). This is consistent with the decline in network centralization previously noted and our claim that over time the network has begun to take on the characteristics of an oligopoly. An oligopoly is a market

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65 Everton, *Disrupting Dark Networks,* loc. 3484.

66 Leopele S. Raabe and Gary S. Blount, "Embedded Efficiency: A Social Networks Approach to Popular Support and Dark Network Structure" (master's thesis, Naval Postgraduate School, 2016), 15, https://calhoun.nps.edu/handle/10945/48582.

67 Everton, *Disrupting Dark Networks*, loc. 3599.

situation in which "few producers affect but [do] not control the market."[68] This also shows us that the network became less centralized over time, and therefore, it appears to be more characteristic of an oligopoly, especially after 2012. With respect to the TCO network, we can see that, by 2015, the Sinaloa, Gulf, and Los Zetas cartels have the highest degree centrality scores at the same time that the network has a relatively low centralization score, which indicates that these few actors affect the entire network. This further suggests, as previously mentioned, that the network used to be centered around one TCO, but is now centered around a few.

For the past decade, the Sinaloa cartel has been one of the more "established drug trafficking organizations in Mexico" and continues to maintain a stronghold on the TCO network.[69] An organization that sustains a relatively high degree centrality value can be seen as an established, structurally powerful actor.[70] For five of the six years, the Los Zetas and Gulf cartels managed to stay in the top three rankings for degree centrality. While the Gulf cartel initially used the Los Zetas cartel as its armed wing for inflicting violence, the two organizations split after Los Zetas yearned for more power to overthrow the Gulf.[71] Despite this rivalry, Los Zetas maintained its high rank largely because they maintained a collective involvement with other criminal organizations.[72] On the other hand, the Gulf cartel has maintained its high rank through multiple alliances formed to deter their rivals, the Los Zetas cartel, from completely overpowering them.[73] In the TCO collaboration network, Sinaloa's relatively high degree centrality demonstrates that

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68 "Oligopoly," *Merriam-Webster,* accessed November 12, 2018. https://www.merriam-webster.com/dictionary/oligopoly.

69 U.S. Department of Justice, Drug Enforcement Administration, *2017 National Drug Threat Assessment*, 2.

70 Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson, *Analyzing Social Networks* (London: Sage, 2018), loc. 192, Kindle.

71 Ibid.

72 "Zetas," InSight Crime, April 06, 2018, https://www.insightcrime.org/mexico-organized-crime-news/zetas-profile/.

73 "Gulf Cartel," InSight Crime, March 10, 2017, https://www.insightcrime.org/mexico-organized-crime-news/gulf-cartel-profile/.

it is in a position to influence other actors in the network. It also suggests that Sinaloa has been relatively more active in the TCO network than other actors, which has probably provided them the potential to spread or obtain information or resources to maximize their benefits.[74]

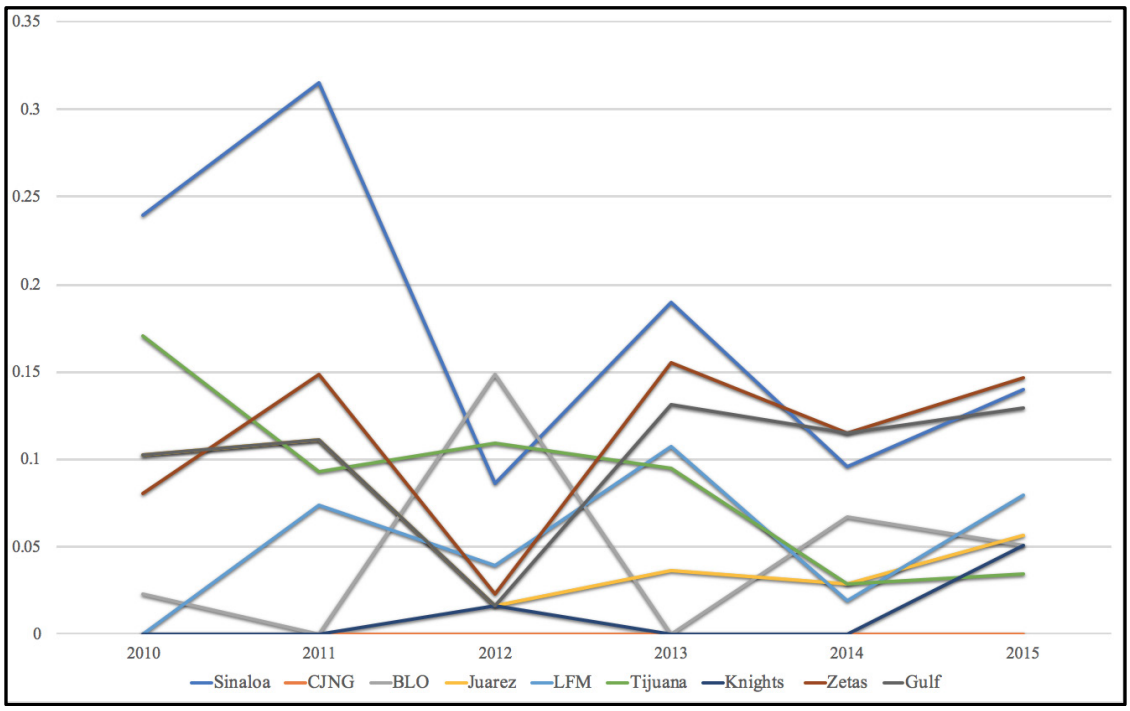

Figure 4. Degree Centrality Over Time

2. Closeness Centrality

Closeness centrality indicates which actors are closer in terms of path distance to other organizations within the network and thus "can potentially reach" or access information and/or resources "very quickly."[75] This can lead to the seamless flow of illicit resources and critical information from other actors.[76] Figure 5 shows the TCO

[74] Daniel Cunningham, Sean F. Everton, and Philip Murphy, *Understanding Dark Networks: A Strategic Framework for the Use of Social Network Analysis* (Maryland: Rowman & Littlefield, 2016), loc. 146–147, Kindle.

[75] Borgatti, Everett, and Johnson, *Analyzing Social Networks*, loc. 199.

[76] Ibid.

collaboration network closeness centrality scores of the top nine TCOs from 2010 to 2015. We can see there is a notable increase in the scores of the Tijuana, Gulf, and LFM cartels in 2011 followed by a significant decrease in 2012. This suggests they were in a great position to collaborate with others in 2011 but then gradually became socially distant from other cartels over the next few years. There is also a slight increase in the scores of the Juarez and Los Zetas cartels from 2010 to 2011, which, according to Cunningham et al., indicates that these TCOs can access information and resources through actors not only directly around them, but also indirectly from other actors.[77] The closeness scores begin to taper off between 2012 and 2013, but we can see that the powerful TCOs based on closeness are the Sinaloa, Gulf, and Los Zetas cartels.

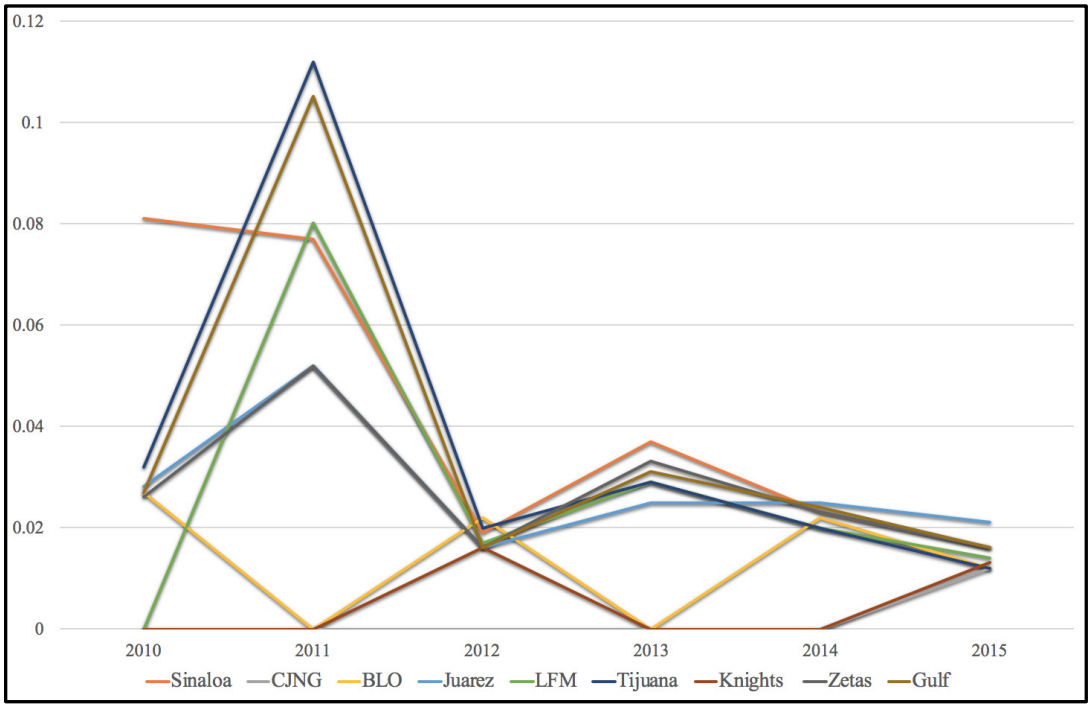

Figure 5. Closeness Centrality Over Time

[77] Cunningham, Everton, and Murphy, *Understanding Dark Networks*, loc. 149.

3. Betweenness Centrality

An actor with a high value of betweenness centrality possesses "the potential for controlling flows through the network."[78] Put differently, such actors can filter the information or resources before it passes the information on to another. This ability to filter puts that actor in a potentially powerful position within the network. In principle, actors with high betweenness can threaten the other actors of stopping the flow of any information or resources through the network. However, that the threat only works if the other actors cannot create or use other ties to go around the stubborn actor.[79]

Figure 6 presents the betweenness centrality scores of the top nine drug cartels in the TCO network. We see that the Sinaloa cartel has the highest score in 2011, but falls thereafter, while Los Zetas rose in 2013 and maintains the highest betweenness centrality until 2015. The drop in Sinaloa's betweenness centrality in 2012 could be attributed to increase fragmentation of the LFM cartel, which was followed by a rise of the Los Zetas cartel in 2013. These indicators represent that, on average, the Sinaloa, Los Zetas, and Gulf cartels had the highest betweenness values and thereby the most power within the TCO network.

[78] Borgatti, Everett, and Johnson, *Analyzing Social Networks*, loc. 201.

[79] Ibid., 202.

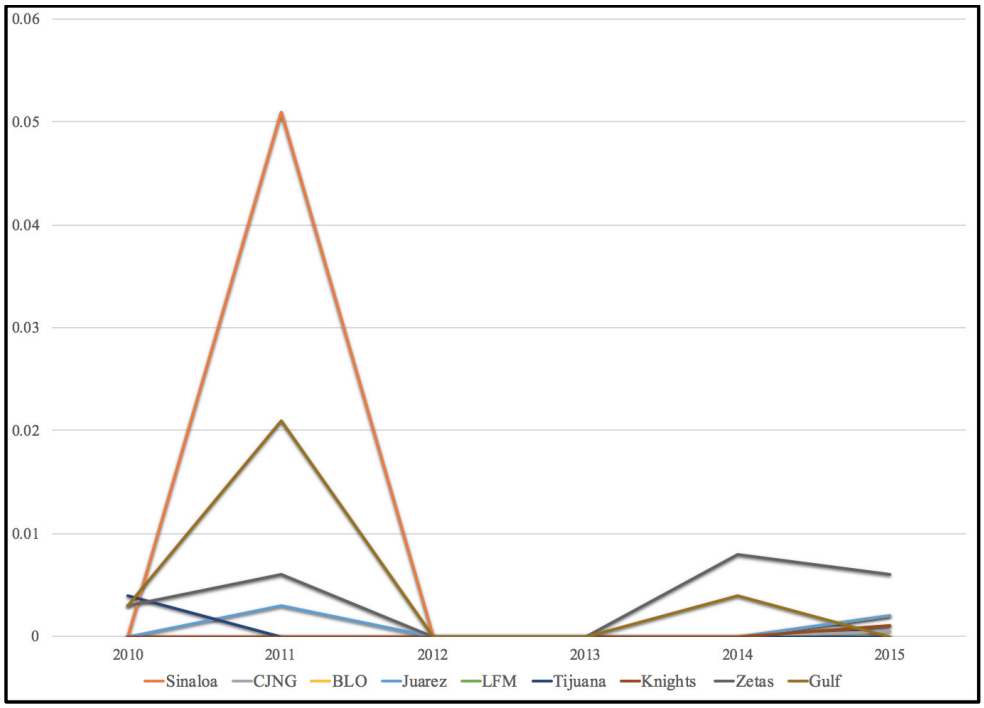

Figure 6. Betweenness Centrality Over Time

4. Eigenvector Centrality

Eigenvector centrality helps identify which actors have ties to other "powerful" actors in the network. Conceptually, it is similar to measuring popularity within a network "in the sense that a node with high eigenvector centrality is connected to nodes that are themselves well connected."[80] If an actor has a relatively high eigenvector score, then it has the potential to influence (or be influenced by) the network through direct and indirect ties. An actor with high eigenvector can potentially influence its ties to other central actors to influence the rest of the network. Put differently, actors scoring high in terms of eigenvector centrality are in a position of indirect power within the network.[81]

Figure 7 presents the eigenvector centrality scores of the nine major TCOs. We see that the Sinaloa cartel scores the highest until 2011, drops significantly in 2012, and then oscillates afterwards. We also see that BLO rises significantly in 2012 but then

[80] Borgatti, Everett, and Johnson, *Analyzing Social Networks*, loc. 194–195.

[81] Ibid., 203; Cunningham, Everton, and Murphy, *Understanding Dark Networks*, loc. 148.

drops back to 0.00, which can be a result of the failed attempt of the BLO allying with Los Zetas in 2011. Additionally, we see that in 2012 and 2014, the majority of the nine cartels had an eigenvector value of 0.00, which is due to several different gangs rising among the rankings throughout the years. This shows that the nine major cartels were consistently in the top nine, but dropped out from time to time.

In Figure 7, we also see in 2012 a dramatic rise in Los Zetas score, which remains relatively high through 2015. Los Zetas' high scores likely resulted from their increased dominance in the network through additional alliances with other major gangs in 2013 (MS-13, Surenos, and Latin Kings) and then with other highly central Mexican TCOs the following years. These alliances put Los Zetas in a highly influential and indirectly powerful position in the network and allows for the manipulation of the network through its direct ties. Furthermore, Figure 7 shows that only six of the nine cartels previously mentioned are among the top nine actors in eigenvector centrality with three additional U.S.-based gangs. The Latin Kings, Surenos, and MS-13 gangs have relatively high eigenvectors that can be attributed to their collaborative ties with highly central Mexican TCO. This also puts them in an indirectly powerful position within the network. Interestingly these are U.S.-based gangs that potentially have indirect power within a Mexican TCO network.

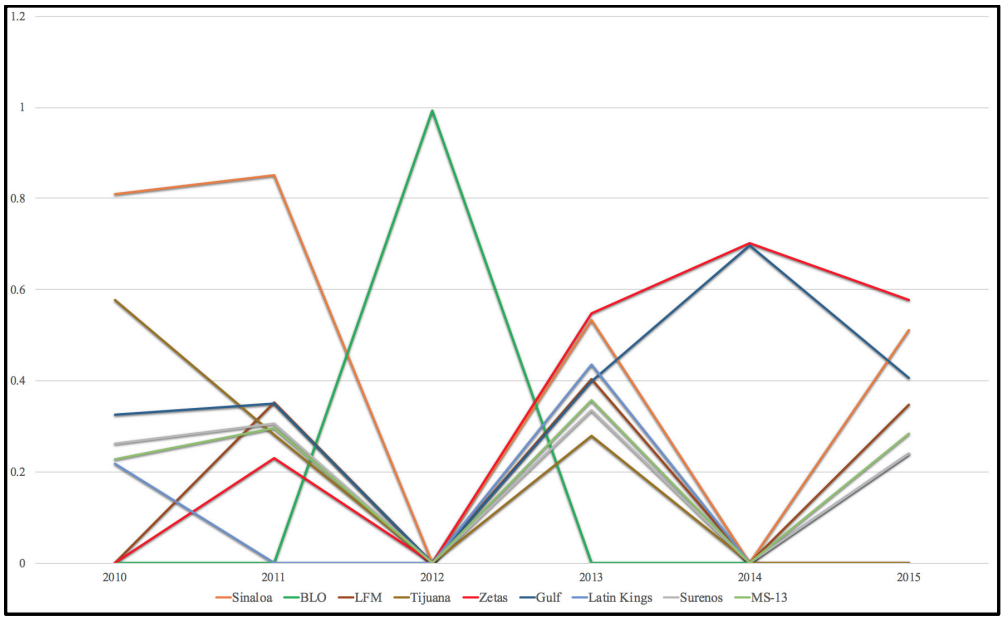

Figure 7. Eigenvector Centrality Over Time

D. TCO ENEMY NETWORK

Analyzing the TCO enemy network, or any network containing negative ties, necessitates a different approach than analyzing one with positive ties. With respect to power, different types of ties can influence actors to make conflicting choices or decisions that could jeopardize their positive ties.[82] Because of the difficulty of interpreting some of the centrality measures on negative-tie networks, we draw our attention only to degree centrality since actors with high degree are those with relatively more rivals than others. This relationship can be seen in two ways; the first is when an actor is being attacked simultaneously by others. The second is when an actor is simultaneously attacking others to gain more power and dominate the network.

1. Degree Centrality

Figure 8 shows the top nine TCOs with degree centrality in the TCO enemy network. Here we see that the top two actors in degree are the Sinaloa and Los Zetas cartels. Initially, this can seem to counter the degree centrality results from the

[82] Cunningham, Everton, and Murphy, *Understanding Dark Networks*, loc. 67.

collaboration network. One would assume that if an actor had the most allies in a network, then that same actor would have the least number of enemies in the same network. While Sinaloa and Los Zetas ranked as the top two actors in degree in the collaboration network in 2011, 2013, and 2015, they also ranked in the top two actors in degree in the enemy network for the same years. We believe this indicates their ability to obtain and maintain power through the dynamics by which they use their alliances and rivalries. These relationships ebb and flow each year and are difficult to track; however, by analyzing the collaboration and enemy networks simultaneously, we can gain a better understanding of some of these paradoxes.

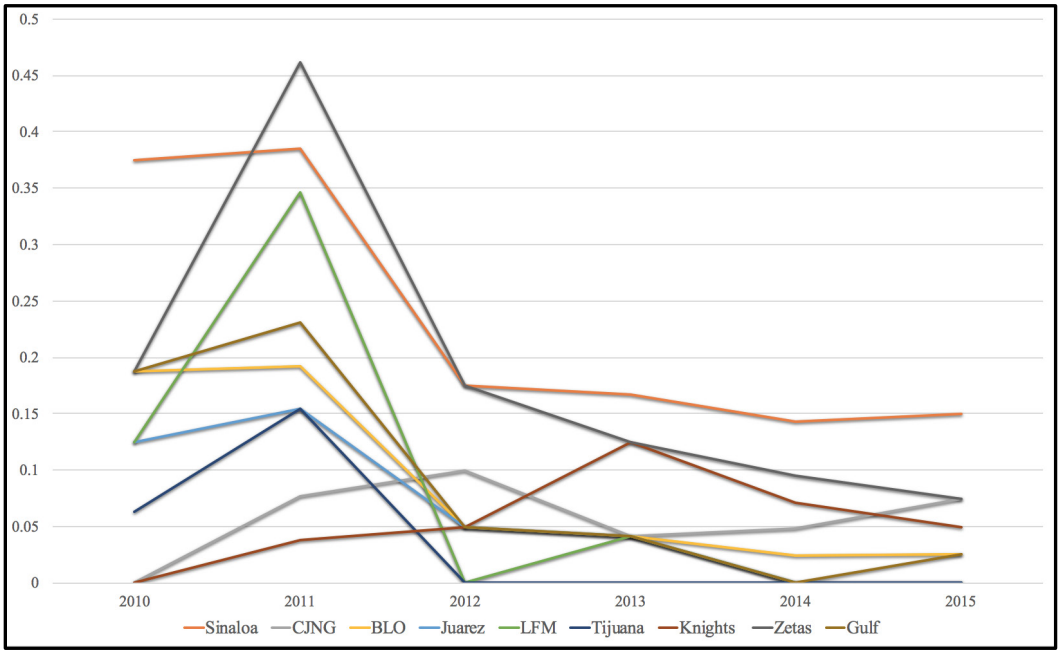

Figure 8. TCO Enemy Network Degree Centrality Over Time

E. RELATIONAL TRUST AND BALANCE

Based on multiple DEA reports, the most dominant TCO between 2010 through 2015 is the Sinaloa cartel.[83] Although it had the greatest number of collaboration ties

[83] National Drug Intelligence Center, *National Drug Threat Assessment 2010,* Report No. 2010-Q317-00 (Washington, DC: U.S. Department of Justice, 2010), https://www.justice.gov/archive/ndic/pubs38/38661/38661p.pdf.

with other criminal organizations within the network, it had a relatively large number of enemies as well. For example, it tended to collaborate with TCOs one year and become its rivals in another year when it suited its interests. This reflects the tendency among powerful TCOs to vary how they relate to other TCO over time in order to maximize their profits. They manipulate their relationships with other actors through trust, by creating alliances, and through threats, by creating enemies. This section focuses on how the ability to manipulate these relationships allows these TCOs to garner power within the TCO network.

1. Trust among TCOs

In the TCO network, TCOs use a variety of measures to develop trust among other actors to obtain and maintain power within the TCO network. It can be extremely difficult for organizations to ensure that others align with their interests; therefore, they often use tactics to incentive them. As an example, in December 2009, Los Zetas was positioned to gain control over much of Gulf territory in Mexico, which included the Mexican states of Nuevo Leon, Hidalgo, and Tabasco. However, in early 2010, Gulf leadership reached out to its main rivals, the leaders of Sinaloa and LFM, for help in pushing back Los Zetas. The successful alliance resulted in newly owned territory by the trio of cartels in major areas, including the city of Monterrey and the Mexican states of Nuevo Leon, Hidalgo, and Veracruz.[84] In this move, Gulf manipulated Sinaloa and LFM by convincing them to encapsulate Gulf's interests in order to increase their power within the network. This is illustrated in Figure 9, where red indicates enemy ties and green collaborative ties.

[84] "Mexico and the Cartel Wars in 2010," Stratfor Worldview, December 16, 2010, https://worldview.stratfor.com/article/mexico-and-cartel-wars-2010.

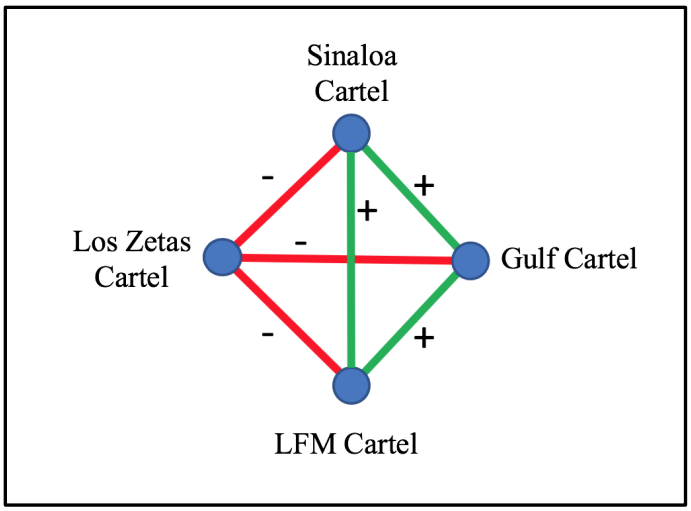

Figure 9. 2010 Alliance and Rivalry

It also appears that at least some relationships within the network are built upon trust-based relations, while others are built from necessity. In December 2008, the Tijuana cartel split into two factions because of a dispute between Eduardo "El Teo" Simental, a high-ranking lieutenant, and Fernando Arellano, a nephew of the Arellano Felix brothers who previously took over the Tijuana cartel. Shortly thereafter in January 2009, the El Teo faction allied with Sinaloa's kingpin, Joaquin Guzman, and quickly established dominance over the Arellano faction until Simental was arrested in 2010.[85] Although the arrest delivered a heavy blow to the Simental faction, Sinaloa maintained its alliance with the Simental faction and the rest of the Tijuana cartel, despite the vacuum in leadership. The result was a new pact between Arellano's faction, Simental's fragmented faction, and Sinaloa, thereby reviving Tijuana's solidarity along the western coast of the United States and Mexico.[86] This reflects the notion of trust based on membership in that Sinaloa trusted both factions despite their change in leadership.

Another form of trust within the TCO network is based on institutional sources. This type of trust can increase a relatively weak actor's power and security within a network because an actor at risk can create an agreement with a more powerful actor

[85] Stratfor Worldview, "Mexico and the Cartel Wars in 2010."

[86] Ibid.

which in turn is economically beneficial for both parties. As an example, Tijuana dominates the territory along the western coast of the U.S.–Mexico border, which includes well-developed hidden routes from Tijuana, Mexico to San Diego, U.S. to smuggle drugs across the border into the United States.[87] However, when Tijuana split into two factions, Arellano's faction made an agreement with Sinaloa to allow Arellano to maintain control of the territory, which included well-developed smuggling routes.[88] The trust between Sinaloa and Tijuana can be seen as a trust based on institutional sources to create peace and establish a system by which Sinaloa pays Tijuana to use their smuggling routes along the West Coast. Furthermore, while Tijuana maintains the smuggling routes, the Sinaloa provides protection in exchange for access to routes. This mutual agreement results in an increase in power for both TCOs.

Granovetter's fifth form of trust reflected here is one based on norms and the act of reciprocity formed around group membership.[89] Within any alliance of two or more actors, a group is formed and norms of behavior are eventually established. In the previously mentioned example between Tijuana and Sinaloa, norms were established in terms of monetary transactions where Sinaloa pays Tijuana for use of the latter's smuggling routes, while Tijuana reciprocates by providing safe passage and freedom of maneuver through the routes. These norms allow the two cartels to maintain an established agreement over time, despite changes in territory, leadership, and resources. These forms of trust can change throughout the course of any alliance between two or more actors to obtain and maintain power within the network.

2. Relational Balance and Imbalance

In order to illustrate the changes in the TCO network, as well as the relational balances and imbalances within the network, we compare the collaboration and enemy networks. If we look at the different networks throughout the years and compare them to each other, we see that four types of friendship paradoxes exist; that is, organizations that

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87 Ibid.

88 Ibid.

89 Granovetter, *Society and Economy: Framework and Principles*, 70.

maintain both enemy and collaborative ties. Figure 10 presents an example of a "type #1 balanced triad." All three actors have a positive relationship to one another; that is, they are all allied with one another (i.e., "a friend of my friend is also my friend").

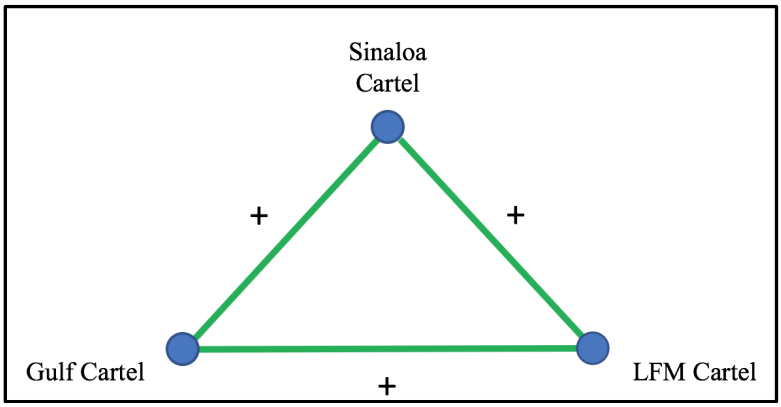

Figure 10. Example of Balanced Friendship #1

Figure 11 shows the number of times actors are involved in type #1 balanced triad. An actor involved in relatively more of these types of triads can be seen as a powerful actor within the network due to the large number of group alliances. In 2010, both Sinaloa and Tijuana had the greatest number of this type of triad; however, we can also see that in 2015, the actors with the greatest number #1 type triads are the Crips, Skanless, Lincoln Park, and Black Mob gangs, which demonstrates that not only are the most powerful TCOs involved in these types of triads, but so are a number of U.S.-based gangs, which appear to be forming as many alliances as possible to increase their own power (and probably security) within the network.

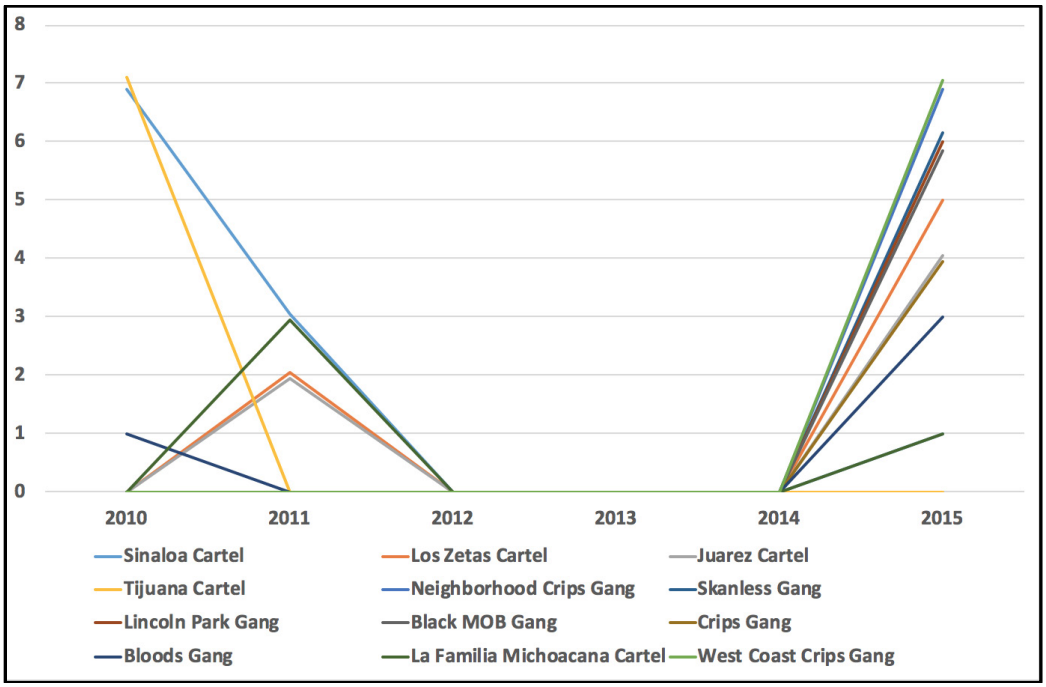

Figure 11. TCO Friendship #1; 2010–2015

A second type of balanced triad is presented Figure 12. Here, an actor has two enemies, but both enemies are allies with each other (i.e., the "friend of my enemy is also my enemy"). As an example, Los Zetas rivals the LFM and Gulf, both of which are allied with each other. Looking at Figure 13, we can see which actors had the greatest number of type #2 balanced triads over time. Not only does this show which actors had the most enemies that were simultaneously allied against them, it also indicates that several actors were involved this type of relationship in 2010 and 2011 and that Sinaloa topped the charts in 2015. This also shows which actors were targeted the most by other actors that had formed an alliance. These two actors could have formed an alliance with the intent of increasing their power by overthrowing another relatively more powerful actor. On the other hand, this type of triad also shows the powerful actors that have the power and resources to attack two other actors simultaneously, in an attempt to destroy the relatively weaker actors.

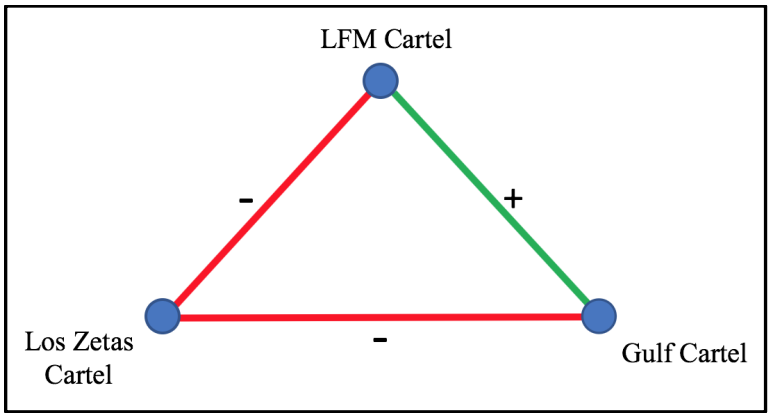

Figure 12. Example of Balanced Friendship #2

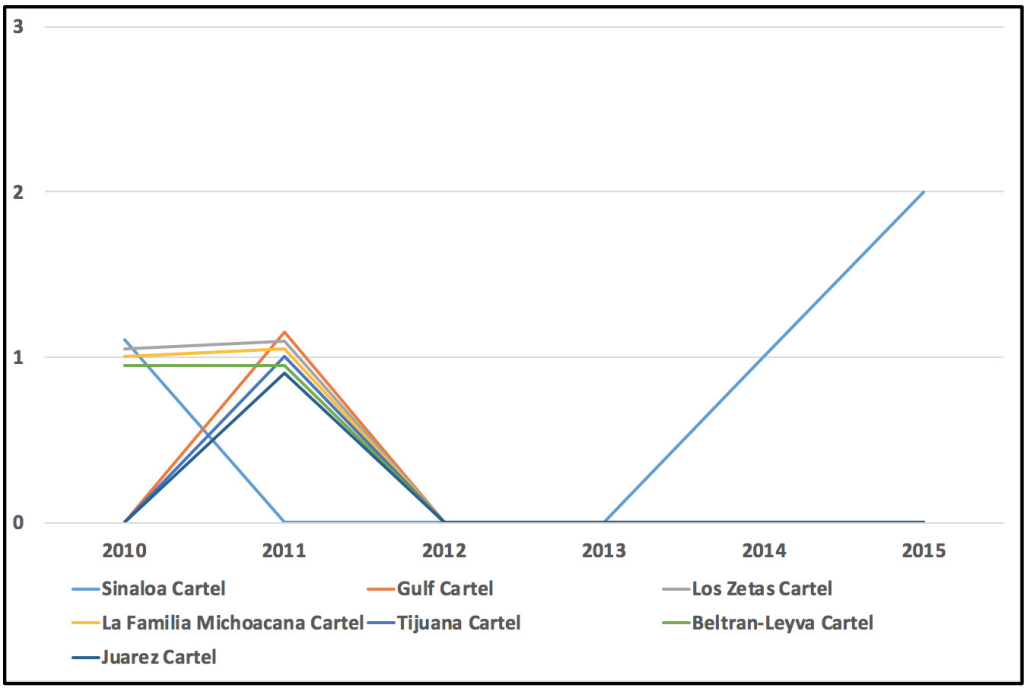

Figure 13. TCO Triad Type #2; 2010–2015

The third type of triad is the imbalanced relationship illustrated in Figure 14. It is considered paradoxical and out of balance because an actor's two allies are enemies of one another rather than being allies (i.e., "the enemy of my friend is also my friend"). For example, in Figure 14 Los Zetas is allied with the Gulf and Beltran-Leyva cartels, but Gulf and Beltran-Leyva are rivals rather than allies. In this triad, Los Zetas holds all of

the power. If there is a need for any resources within the triad, Los Zetas can play Beltran-Leyva and Gulf off one another and thus manipulate and influence their behavior.

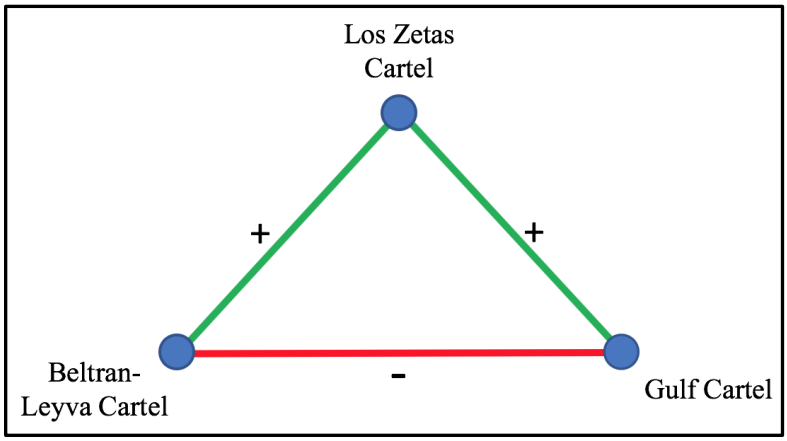

Figure 14. Example of Imbalanced Friendship #3

Figure 15 shows which actors were involved in the greatest number of type #3 triads from 2010 to 2015. It indicates that both the Latin Kings and MS-13 gangs were involved in a total of six type #3 triads throughout this time-span. Furthermore, every time this type of triad occurred, we noted that the actors with a negative tie in the triad were among the top nine TCOs of interest. This shows that powerful gangs do not necessarily have any form of alliance with one particular cartel over another. Instead, they are willing to collaborate with any TCO to maintain or grow their illicit operations in the United States as another way to increase their power within the network.

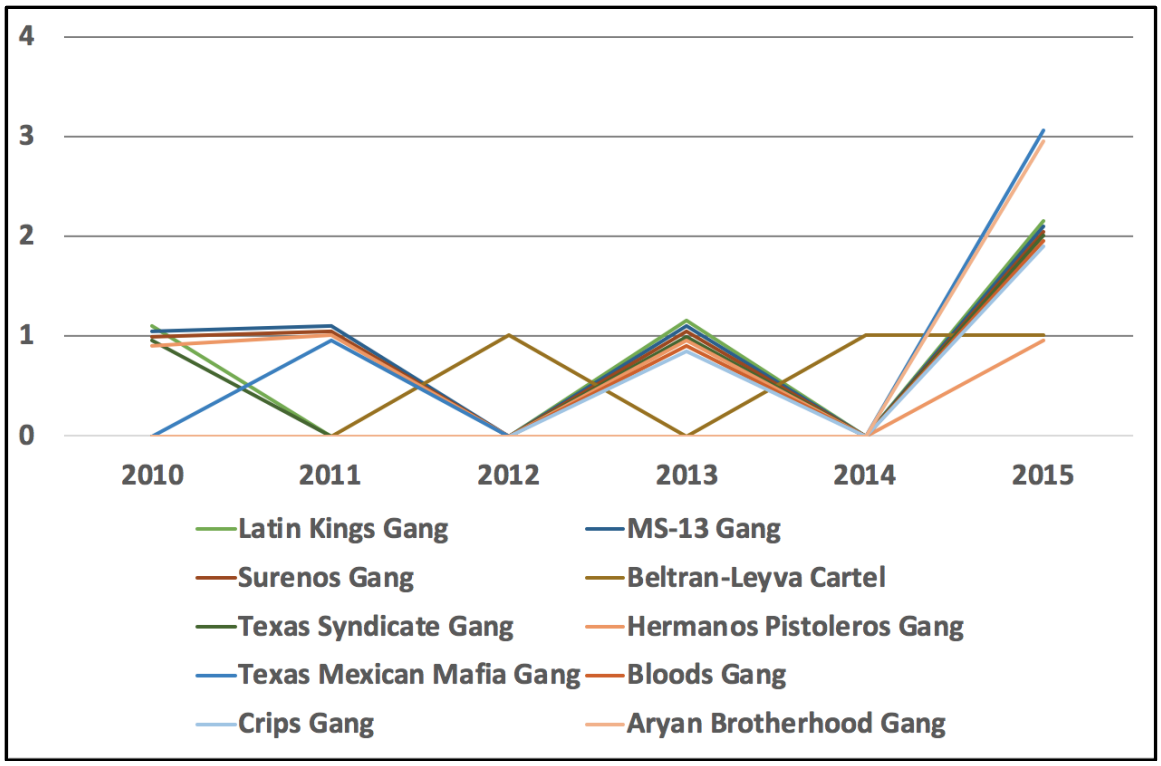

Figure 15. TCO Relationship #3; 2010–2015

The second type of an imbalanced triad is one where each actor is a rival of the others. This only occurred a total of five times over the span of the six years, and consequently there was little to learn from these types of triads. The most relevant data comes from understanding relationship #2 and #3; however, a better analysis of the data stems from understanding how these relational ties relate to their geographic locations.

F. STOCHASTIC ACTOR-ORIENTED MODEL

We now turn to estimating a series of SAOMs as a further test of our earlier claim that the TCO network increasingly took on the trappings of an oligopoly. SAOMs are a type of model that represent network dynamics on the basis of empirical longitudinal data.[90] Similar to exponential random graph models, observed networks primarily serve as dependent variables and researchers can develop models that incorporate network

[90] Tom A. B. Snijders and Mark Pickup, "Stochastic Actor Oriented Models for Network Dynamics," *Oxford Handbooks Online*, 2017, https://doi.org/10.1093/oxfordhb/9780190228217.013.10

dynamics as driven by different tendencies, such as micro-mechanisms like homophily or diffusion, which are implemented as independent variables. As such, SAOMs permit researchers "to test hypotheses about these tendencies, and to estimate parameters expressing their strength, while controlling for other tendencies (which in statistical terminology might be called 'confounders')" models are capable of analyzing and modeling the evolution of networks and behavior, separately, or at the same time.[91]

Based on our current understanding of the collaboration network as trending toward an oligopoly over time, we anticipate that the coefficient for an "alternating star pattern" (Figure 16), which captures nodes with numerous ties, will be positive and statistically significant. Such a result would be consistent with our finding that over time, power became distributed among a handful of TCOs with numerous ties relative to other ties in the network. In addition to this, we also included variables that capture transitivity (the propensity for a friend of a friend to become a friend), the age of each TCO, and whether the home base (country) of a pair of TCOs differs. Each model controls for network density, which is analogous to the intercept in traditional multivariate regression models.[92] Finally, in order for our models to converge, shown in Table 2, we need to estimate models from 2009 to 2016 (rather than 2010–2015); this led to the inclusion of seven additional actors, bringing the total network size to 180 actors.

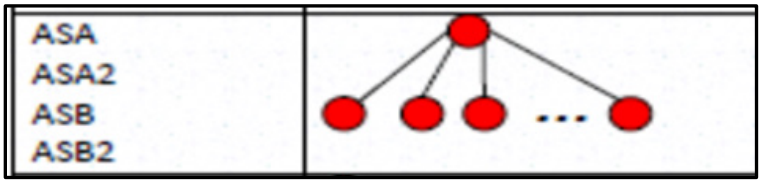

Figure 16. Alternating Star Pattern[93]

[91] Ibid., 2.

[92] Cunningham, Everton, and Murphy, *Understanding Dark Networks*, loc. 270

[93] Source: Peng Wang, Garry Robins, and Philippa Pattison, MPNet: Program for the Simulation and Estimation of Exponential Random Graph Models, Melbourne, AUS, 2009, accessed October 3, 2018. http://www.melnet.org.au/pnet/.

Table 2. Estimated Coefficients for Stochastic Actor-Oriented Models

	Model 1	Model 2	Model 3
Variables			
Degree (Density)	-2.043*	-2.104*	-4.174*
Transitivity	1.245	1.335	0.810
Shared Country	0.000		
Age of TCO		-0.018	
Alternating Star			0.206*
Rate Function			
Rate period 1	0.210	0.213	0.212
Rate period 2	0.399	0.405	0.438
Rate period 3	0.251	0.253	0.253
Rate period 4	0.015	0.016	0.018
Rate period 5	0.101	0.098	0.104
Rate period 6	0.121	0.122	0.125
Rate period 7	0.164	0.164	0.164
Overall convergence	0.028	0.079	0.068

Note: * indicates coefficient is statistically significant

Table 2 presents the results of our models. Two sets of parameters are presented: The variable effects parameters in the upper half of the table, and the rate function parameters in the bottom half. The latter are the estimated expected frequencies of the opportunities that actors have to form or sever ties between successive periods. In other words, the rate parameter for the first period is the estimated frequencies of opportunities to form or sever ties between 2009 and 2010, the parameter for the second period is the

estimated frequencies between 2010 and 2011, and so on. As the results indicate, the opportunities for tie formation were substantial in the first few years, then they slowed down, and then sped up again toward the end of the time periods we examine here. More importantly for our purposes, the alternating star coefficient is positive and statistically significant, which as previously noted, is consistent with our argument that over time the TCO network trended toward becoming an oligopoly.

III. GEOSPATIAL ANALYSIS

It is important to understand how geography and violence influence power within the TCO network. Cartels seek to dominate territory in the United States and Mexico for strategic purposes, such as control of territory for drug production and distribution to the United States, which ultimately increases their relative power. To understand this relationship, we focus at the macro and micro levels on 2010 and 2015 because five years allows enough time to identify significant changes and patterns in cartels' activities. We first examine each cartel's level of "dominance," defined as the amount of territory it controls, at the macro and micro levels in the United States and Mexico and then analyze micro and macro levels of violence in Mexican states.[94] Macro-level examinations focus on regional patterns and trends, whereas the micro-level analysis focuses on individual actors' geographic dominance and levels of conflict. Our analysis is based on the dominance that each cartel holds relative to other cartels in each state. This subsequently reveals that areas near the U.S.–Mexico border and other strategic areas that are valuable for drug cultivation, production, or trafficking are more likely to spur conflict and have higher levels of violence, which cartels use to acquire and preserve power.

A. TCO DOMINANCE IN THE UNITED STATES AND MEXICO

1. TCO Dominance at the Macro Level, 2010–2015

There are significant changes in dominance over this period as cartels compete for power throughout the United States and Mexico. As Figure 17 shows, there was an overall decrease in territory where cartels operate, coupled with the diversification and expansion of different cartels. Specifically, the number of states with cartel presence decreased from 78 to 68. Change only occurred within the United States, however, where

[94] We focus solely on violence in Mexican states because UCDP does not provide data on violent acts committed by cartels in the United States. Mexico is also the epicenter of inter-cartel violence.

cartel presence decreased from 49 to 39,[95] while in Mexico, the number of states with cartel presence remained at 29.

[95] We recognize that it is possible these changes are due to better tracking and reporting mechanisms by U.S. federal agencies.

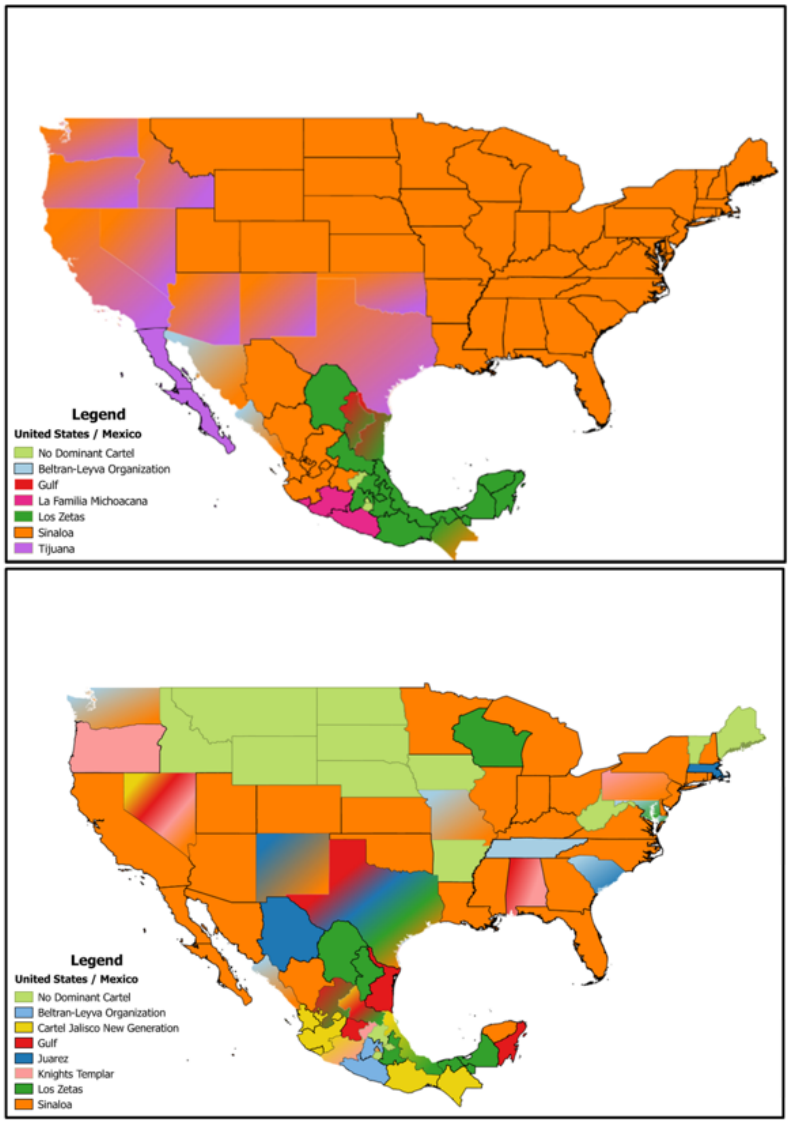

Figure 17. Dominant Cartels by State, 2010 (top) and 2015 (bottom)[96]

Throughout the five-year period, the power of some cartels increased while others decreased due to a reduction of geospatial dominance. In 2010, the only two cartels with a dominant presence in the United States were the Sinaloa and Tijuana cartels, whereas, in 2015, the BLO, Gulf, Juarez, Knights Templar, and Los Zetas cartels expanded their

[96] Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System, version 2.82, accessed October 4, 2018, https://qgis.org/en/site/index.html.

area of influence and control throughout several U.S. states. As a result, Sinaloa displayed the greatest loss in territorial dominance, from 47 to 31 states. This reduction, coupled with the expansion of the overall TCO network, caused the number of contested states to increase from 14 to 16 states across both countries. One of the reasons for this may have been the 2014 arrest of "El Chapo," which led to Sinaloa's fragmentation. These events created a power vacuum in which other cartels began to fight for power, as well as control of territory and drug routes.

2. TCO Dominance at the Micro Level in the United States, 2010

Sinaloa is the most dominant and powerful cartel in the United States and only shares it with the Tijuana cartel. As shown in Figure 18, Sinaloa dominates in 40 states, predominantly throughout the Midwest, Northeast, and Southeast. However, in the Southwest, there are nine contested states, where Sinaloa and Tijuana compete for dominance. Interestingly, four of these nine states lie along the U.S.–Mexico border, which is the most strategic and widely used point of entry for smuggling illegal drugs into the United States.[97] Because they control most of the drug-smuggling routes into the United States and therefore are probably responsible for receiving and distributing most of the drugs in the United States., it is easy to see why they are the U.S.'s most powerful TCOs.

[97] "U.S. Senate Caucus on International Narcotics Control Washington, D.C.," Federal Bureau of Investigation, May 5, 2010, https://archives.fbi.gov/archives/news/testimony/drug-trafficking-violence-in-mexico-implications-for-the-united-states.

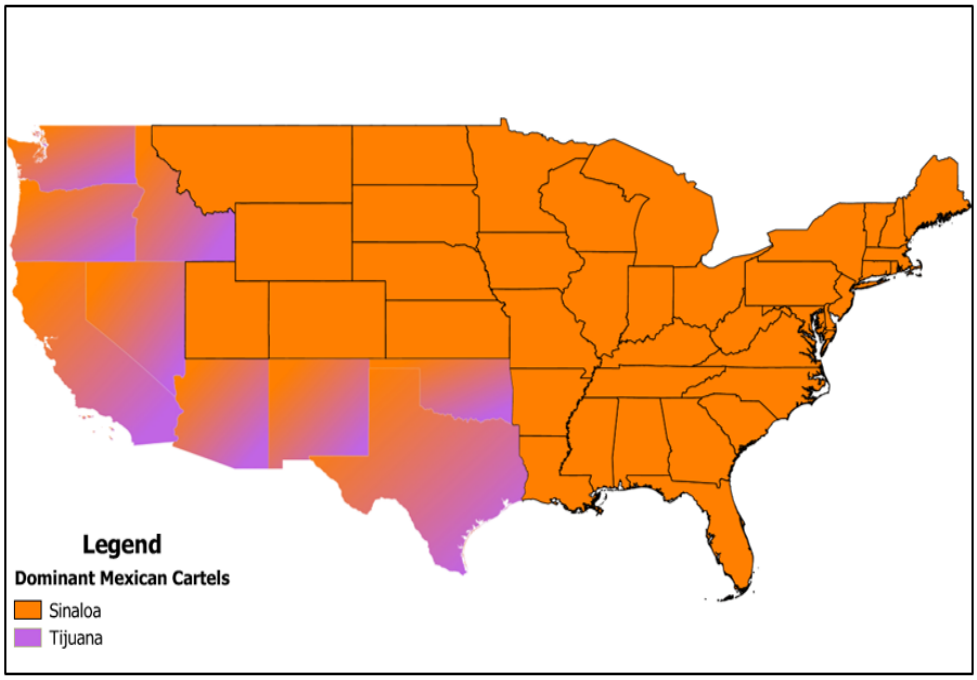

Figure 18. Dominant Cartels by State in the U.S., 2010[98]

3. TCO Dominance at the Micro Level in the United States, 2015

By 2015, the United States had experienced a major increase in the presence of cartels contending for territorial dominance. Sinaloa maintained its stronghold, dominating in 26 states. BLO and Juarez also increased their presence, ranking second and third behind Sinaloa. In Figure 19, we can see that Sinaloa gained control of a majority of the states previously controlled by the Tijuana cartel. Additionally, we can see that by 2015 several other cartels had gained some control of New Mexico and Texas, the other states that the Tijuana cartel had controlled.

The number of contested states remains the same. However, the diversity of dominance increased to include seven different cartels, which gained more power as they expanded their networks. The biggest change occurred in Texas, which is now occupied by four cartels: Gulf, Juarez, Los Zetas, and Sinaloa. Despite the introduction of six new

[98] Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

cartels from 2010, Sinaloa managed to maintain a dominant presence in five of the nine contested states. Additionally, Sinaloa dominates in the five most populous states, including California, Texas, Florida, New York, and Illinois.[99] Furthermore, it held on to its strategic advantage of access to the United States by controlling California and Arizona and maintaining a dominant presence in New Mexico and Texas.

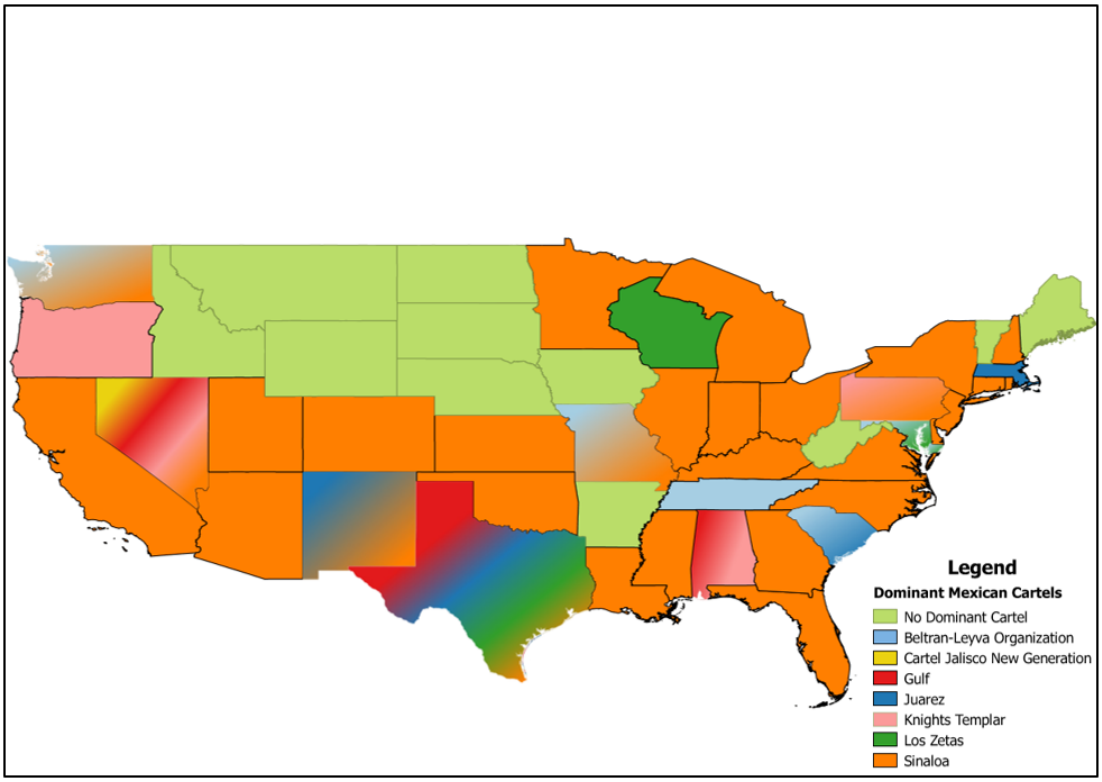

Figure 19. Dominant Cartels by State in the U.S., 2015[100]

In other words, the findings show that the Sinaloa cartel was the most powerful because it maintained an overall advantage over other cartels through the control of strategic territory and the control of heavily populated states. Despite the many changes

99 "North Carolina Becomes Ninth State with 10 Million or More People, Census Bureau Reports," United States Census Bureau, December 22, 2015, https://www.census.gov/newsroom/press-releases/2015/cb15-215.html.

100 Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

that occur throughout the country during this time span, our geospatial analysis illustrates that the Sinaloa cartel remains the most dominant and powerful cartel in the United States.

4. TCO Dominance at the Micro Level in Mexico, 2010

South of the U.S. border, Los Zetas and Sinaloa dominate the majority of the country, which gives them the ability to control drug production and smuggling routes from Mexico and into the United States. Figure 20 shows that Los Zetas exhibits the largest provincial control, with 12 Mexican states, stretching from the southeastern *Tamaulipas* region to the U.S.–Mexico border. Sinaloa dominates in seven states, extending from the northwestern *Tierra Caliente* region and north throughout the *Sinaloa* region to the U.S.–Mexico border along Arizona, New Mexico, and southwestern Texas.

In 2010, this border was identified as a top threat to border security due to the amount of drug trafficking and violence associated with access to port-of-entry sites to the United States. As Figure 20 shows, the Sinaloa and BLO cartels shared control of Sonora and Sinaloa, and the Tijuana cartel controlled Baja and Baja Sur, all of which border the Gulf of California and are near or adjacent to the U.S.–Mexico border. Additionally, news sources reported that the Gulf of California was widely used by smugglers using maritime vessels and speedboats to transport drugs to the United States.[101] As the macro analysis noted, Sinaloa and Tijuana dominate every U.S. state along the border. For these reasons, in 2010, the Sinaloa, Tijuana, and BLO cartels are almost certainly the most powerful TCOs since they control the most strategic states. This is extremely beneficial for operating drug smuggling routes across the U.S.–Mexico border by land and along the California coastline by water.

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101 "How Do Mexican Drug Cartels Traffic Through the Sea?," *Maritime Herald*, May 28, 2018, http://www.maritimeherald.com/2018/how-do-mexican-drug-cartels-traffic-through-the-sea/; Leslie Berestein, "Baja Smugglers' use of Boats Rising Rapidly," *The San Diego Union Tribune*, January 25, 2010, http://www.sandiegouniontribune.com/sdut-baja-smugglers-use-boats-rising-rapidly-2010jan25-story.html.

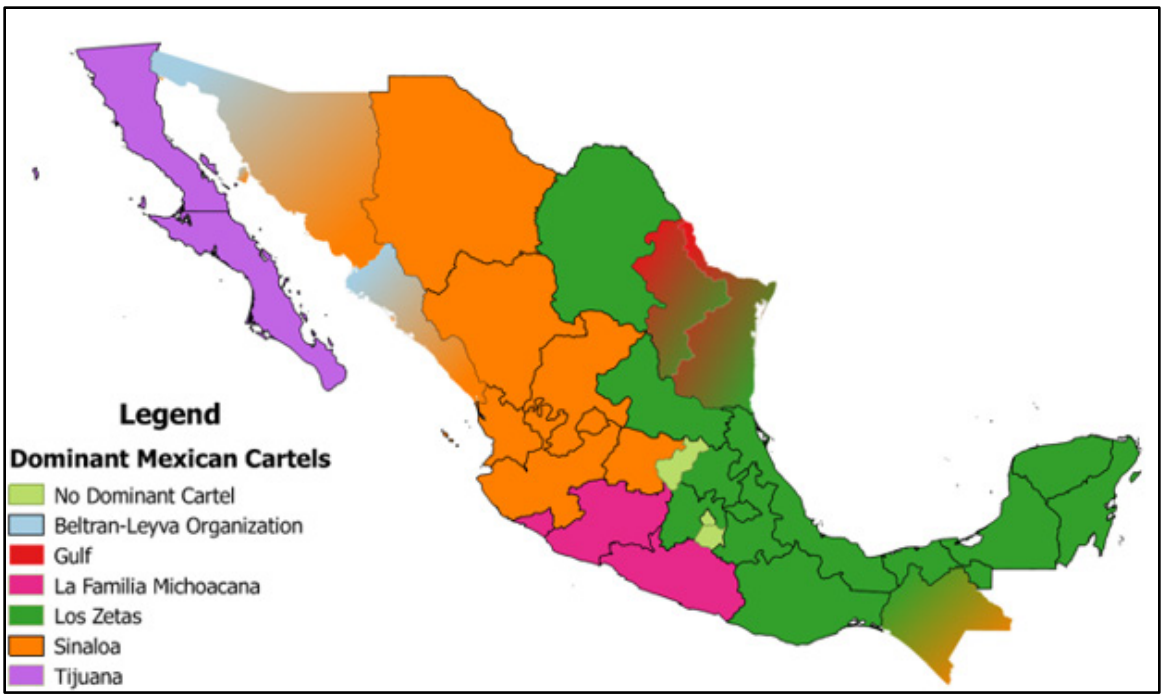

Figure 20. Dominant Cartels by State in Mexico, 2010[102]

5. TCO Dominance at the Micro Level in Mexico, 2015

In Mexico, there were substantial changes in cartel dominance over the five-year period. First, the number of contested states increased from five to seven states. This was most likely due to the fracturing of the Sinaloa and LFM cartels, which was then followed by the uprising of new power actors, such as the CJNG and Knights Templar cartels. Figure 21 shows that by 2015, the CJNG controlled the *Tamaulipas* and *Tierra Caliente* regions, which Los Zetas and LFM dominated in 2010. This reflects CJNG's rapid rise, which initially formed as an armed wing of Sinaloa to fight the Los Zetas but later broke away.

[102] Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

Figure 21. Dominant Cartels by State in Mexico, 2015[103]

Despite our findings that show the network is decentralized, our analysis shows that hierarchical structures exist within the network and subnetworks. After El Chapo's first arrest in 2010, Sinaloa began to fracture, which is the main cause of CJNG breaking out on its own. CJNG also fought against LFM to gain control of the *Tierra Caliente* region, known as a major operating hub for the receiving and transportation of illegal drugs.[104] Its rapid expansion and rise to power is a result of extremely violent tactics against their rivals and the acquisition of strategic territory. However, in spite of CJNG's rise, in 2015 Los Zetas and Sinaloa continued to dominate Mexico, while maintaining a significant presence in five states. At the same time, the number of dominant cartels in Mexico increased from six to seven, largely because the LFM cartel disbanded in

103 Ibid.

104 "Jalisco Cartel New Generation (CJNG)," InSight Crime, March 30, 2018, https://www.insightcrime.org/mexico-organized-crime-news/jalisco-cartel-new-generation/.

2011.[105] With the removal of many cartel leaders, these organizations continued to fracture and form new factions that competed for power.

Our analysis indicates that the diversification and expansion of cartels in Mexico had a ripple effect, which was also seen in the United States. For example, BLO, CJNG, Gulf, Juarez, and Knights Templar increased their dominance in Mexico from 2010 to 2015, which led them to "acquire" several U.S. states. Our analysis suggests that as cartels gained more power in Mexico, their capacity to establish dominance in the United States increased by acquiring greater access to drug smuggling and trafficking markets, which in turn increased their overall power.

B. TCO VIOLENCE IN MEXICO

Cartels inflict violence on other organizations in the U.S. and Mexico for a multitude of reasons. In this section, we examine the relationship between geography and conflict among Mexican cartels as an indicator of power and dominance of strategic territory. We first examine the macro level to identify how the geospatial landscape changed in terms of violence. Next, we examine conflict at the micro level to identify the dominant cartels involved and examine how their rivalries relate to geography.

1. TCO Violence in Mexico at the Macro Level, 2010–2015

Figure 22 highlights how from 2010 to 2015 every state along the U.S.–Mexico border experienced cartel-related conflict. Notably, these states, along with those in the *Tierra Caliente* region, experienced the greatest amount of conflict. This supports our previous findings that cartels fight for control over these strategically important locations for drug trafficking and production. Moreover, states suffering from cartel-related conflict tend to share a border with another state suffering from conflict. As TCOs fracture, factions and other cartels seek to empower themselves by acquiring or retaking territory from weakened organizations. As Hannah Croft notes, conflict emerges and

[105] "Familia Michoacana," InSight Crime, November 17, 2015, https://www.insightcrime.org/mexico-organized-crime-news/familia-michoacana-mexico-profile/; "Tijuana Cartel," InSight Crime, February 13, 2018, https://www.insightcrime.org/mexico-organized-crime-news/tijuana-cartel-profile/.

spreads through geographical regions that have strategic value in territory or resource production and trafficking of illict narcotics.[106]

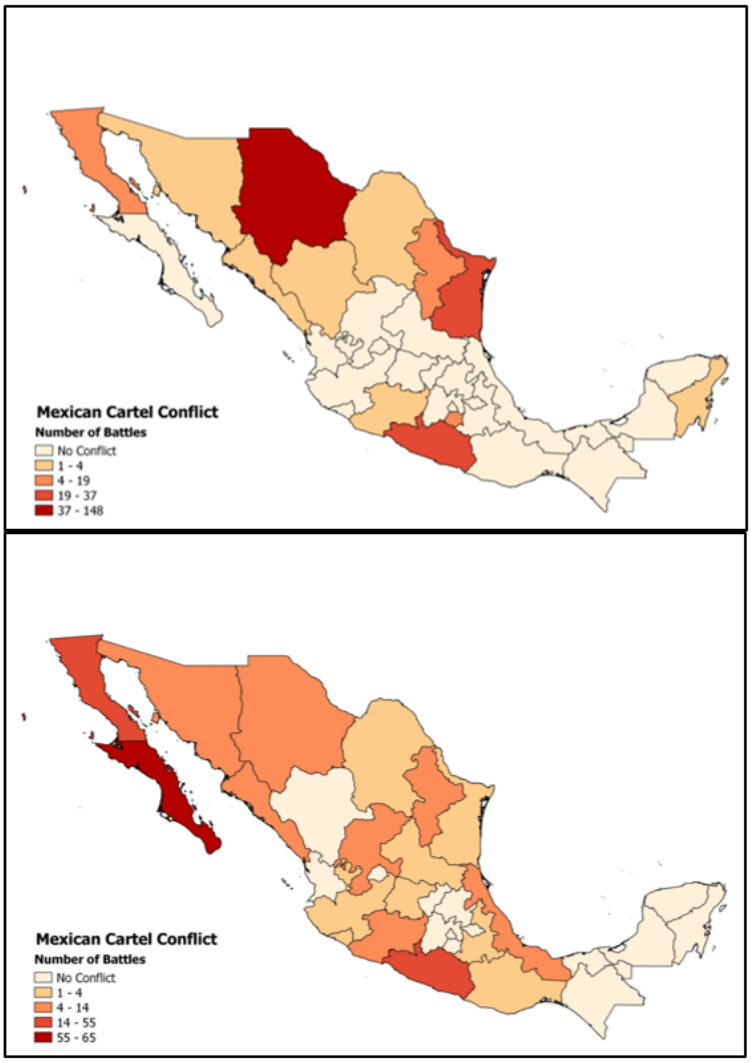

Figure 22. Mexican Cartel Battles by State in Mexico, 2010 (top) and 2015 (bottom)[107]

106 Hannah Croft, "Operation Jalisco: The Rise of The Jalisco New Generation Cartel and Peña Nieto's Militarised Security Strategy," *Small Wars Journal*, no. 2 (September 2015), http://smallwarsjournal.com/jrnl/art/operation-jalisco-the-rise-of-the-jalisco-new-generation-cartel-and-peña-nieto's-militarise.

107 Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

The one exception to this trend occurred in Mexico's capital region, which appeared to remain stable although nearby states experienced conflict. These findings correlate with the preceding discussion on dominance, where the capital region has tended to have little to no cartel presence, which is possibly due to the presence of a greater number of government security forces and because the region holds lesser strategic value to cartels. In fact, throughout Mexico states with little strategic importance experience no cartel-related conflict. Taken together, these results indicate that cartel violence is linked to the dominance of strategic geography, which is vital for powerful actors in the TCO network.

2. TCO Violence in Mexico at the Micro Level in 2010

Strategically important states experience higher levels of cartel-related conflict as cartels fight for power and control. On average, border states, which serve as smuggling corridors, as well as states that cultivate or produce illicit drugs, experience greater amounts of conflict. Figure 23 shows that Chihuahua, Tamaulipas, and Guerrero are the three states with the greatest amount of conflict, and they are either along the border or in drug production areas. In Chihuahua, the Juarez and Sinaloa cartels engaged in 148 conflicts with each other, resulting in 2,515 deaths. These findings reflect Stratfor's 2010 annual report on Mexico's drug cartels, which found that the Sinaloa and Juarez cartels fought for control of the Juarez drug-smuggling corridor, which is located in Chihuahua. Figure 23 further illustrates that states with the greatest amount of conflict border other states with moderate to high levels of conflict. The one exception to this was the state of Quintana Roo, which lies along the southeastern border of Mexico and is possibly of strategic value for smuggling drugs from Central America. Nevertheless, as Figure 23 illustrates, states that experienced conflict almost always bordered a state that also experienced conflict as cartels contest each other for supremacy of these areas.

Another key finding is that states populated by cartels in the midst of breaking apart tended to have higher levels of conflict compared to those that did not. For example, Figure 23 illustrates that Baja California had higher levels of conflict where the Tijuana Cartel battled the El Teo Faction for control of territory providing access to the

United States. Stratfor's 2010 annual report also found that El Teo was a Sinaloa.[108] Likewise, the states of Guerrero and Morelos had moderate to high levels of conflict because the BLO cartel fought the Valdez Villareal Faction for control of Tierra Caliente, an important region for drug cultivation and production. The latter eventually lost and ultimately dissolved.[109] This evidence suggests that fracturing cartels are likely to contest each other in order to rise to power and gain control of resources and territory from vulnerable actors in the TCO network.

Figure 23. Dominant Cartel Battles by State in Mexico, 2010[110]

We attribute most of the 2010 cartel conflict to the increased dominance of different TCOs in territories with economic value. This likely led to rivalry, which motivated further violence, wherein TCOs fought to protect their ownership rights or gain

[108] Stratfor Worldview, "Mexico and the Cartel Wars in 2010."

[109] Ibid.

[110] Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

control of strategic territory they could use to increase their power. We can see from Figure 23 that Sinaloa was not only engaged in the greatest number of conflicts, but also they were the most geographically widespread. In fact, "the Sinaloa Federation continue[d] to be the largest and most cohesive of the Mexican cartels. Run by Joaquin 'El Chapo' Guzman Loera, Sinaloa continue[d] its expansion into Durango, Mexico D.F., Guerrero and Michoacán… as well as its fight to take over the plazas in Juarez and Chihuahua City."[111] As Figure 23 illustrates, it fought against the most dominant cartels for control of strategically valuable areas along Mexico's northern and southern borders, which provide passage for drug-smuggling operations, as well as access to *Tierra Caliente*. These further reinforce our argument that both border proximity and geographic space influence levels of conflict.

3. TCO Violence in Mexico at the Micro Level in 2015

We see again in 2015 that as cartels vied for power, and states with strategic importance or fracturing cartels were more likely to experience greater levels of conflict. Figure 24 illustrates that Baja California Sur, Baja California, and Guerrero experienced the greatest amount of conflict. All three states had fracturing cartels, including Sinaloa, BLO, and Knights Templar. The Council on Foreign Relations notes that the capture of El Chapo in 2015 "created a power vacuum within one of the most powerful cartels in Mexico and has led to increased violence as rival factions contest for power and control of territory."[112] Moreover, InSight Crime explains that the Guerrero Unidos and Los Rojos gangs are splinter groups that formed from the fracturing of BLO, which subsequently fought each other for control of the drug routes through Guerrero.[113] The violence in the strategically valuble S*inaloa* and *Tierra Caliente* regions was greater in

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111 "Mexican Drug Wars Update: Targeting the Most Violent Cartel," Stratfor Worldview, July 21, 2011, https://worldview.stratfor.com/article/mexican-drug-wars-update-targeting-most-violent-cartels.

112 "Criminal Violence in Mexico," Council on Foreign Relations, accessed September 6, 2018, https://www.cfr.org/interactives/global-conflict-tracker?marker=20#!/conflict/criminal-violence-in-mexico.

113 "Guerreros Unidos," InSight Crime, April 8, 2015, https://www.insightcrime.org/mexico-organized-crime-news/guerreros-unidos-mexico/.

2015 than in 2010 because tensions increased as larger TCOs fractured and new cartels emerged and competed for territorial dominance.

Figure 24. Dominant Cartel Battles by State, 2015[114]

This resulted in two findings: (1) the Sinaloa was again involved in the most battles with its rivals due to the power vacum created by "El Chapo's" arrest; and (2) CJNG and Los Zetas cartels were in the most widsepread conflict as they fought for territorial dominance. CJNG and Los Zetaz conflict spread throughout seven states as they sought additional power through control over states along the southeastern U.S.–Mexican border and in the Tierra Caliente region, as shown in Figure 24. This correlates with their increase in dominance from 2010 to 2015, when, as noted earlier, they expanded into these areas to increase their territorial dominance. Accordingly, Jeremy Bender's article on cartel violence elaborates that the CJNG emerged from the Sinaloa

[114] Data compiled using sources outlined in Chapter I; QGIS Development Team, QGIS A Free and Open Source Geographic Information System.

cartel in 2010, after the death of a high-ranking leader and has become one of the deadliest and fastest-growing drug trafficking organization in Mexico.[115] Bender identifies a faction of the CJNG, known as the Mata Zetas or Zetas killers, whose primary objective is to eliminate the Los Zetas cartel.[116] These results collectively show that CJNG and Los Zetas amount of violence to aquire and control resource-rich territory is an indicator of their quest for power.

Overall, areas with higher levels of conflict tend to be located around regions strategically important to the cultivation, production, or trafficking of illicit drugs, such as U.S.-Mexican border states and the *Tierra Caliente*. Moreover, we find that states with violence border other states with violence as conflict spreads through interstate organizations. These findings illustrate that the cartels' power is linked to illict drug resources and that extreme amounts of violence will be used whenever necessary to gain control over valuable geographical locations.

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115 Jeremy Bender, "This is the Rising Mexican Drug Cartel that Just Pulled Off the Deadliest Attack Against Mexican Security Forces in Years," *Business Insider*, April 8, 2015, https://www.businessinsider.com/rising-mexican-cartel-jalisco-new-generation-2015-4.

116 Ibid.

IV. CONCLUSION

The power of Mexican TCOs and their related illicit activities routinely receive national-level attention due to their impact on the security of the United States and Mexico.[117] The increasing number of drugs entering the United States and the rise in violent crimes along the border have led to a massive war on drugs and Mexican TCOs. Prior to undertaking our analysis in this thesis, we assumed that TCOs gained power predominantly through drugs, violence, and other illicit activities. Our research here, however, shows that TCO social communities and geographic locations play extremely important roles in a TCO's structural power.

Our results may prove important to understanding Mexican TCO networks and the power behind them; in particular, they can potentially highlight vulnerabilities that authorities can exploit. To examine this important topic, we used SNA, spatial analysis, and temporal analysis to determine the traits of powerful Mexican TCOs. Chapter I provided background information articulating the necessity for this research, social network theories and methods, and gaps in current literature regarding Mexican TCO networks. Chapter II offered an in-depth, exploratory analysis of collaboration and enemy-based social structures at the individual actor (i.e., TCO) and whole network levels. Chapter III provided geospatial analysis of TCO activity in the United States and Mexico, including a focused view of the violence and conflicts within Mexico. Though these chapters offered new understanding into the TCO networks and their spatial dominance of key areas, it is the combination of these approaches that provided key insight to the problem of TCO power.

Taken together, the tools and ideas used in each chapter reveal that powerful TCOs possess three main characteristics: relatively high levels of structural power (centrality scores); inflict relatively high levels of violence onto other TCOs; assert geographic dominance of strategic areas along the US-Mexico border. This final chapter describes the three main characteristics of powerful TCOs and offers two possible

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[117] White House, *National Security Strategy.*

courses of action to disrupt the Mexican TCO network. This chapter closes the discussion by providing recommendations for future research pertaining to Mexican TCOs' power.

A. CHARACTERISTICS OF A POWERFUL TCO

We find that the structure of Mexican TCO networks resembles an oligopoly, in which a handful of actors appear to dominate the network but do not necessarily control it. The network constantly fluctuates due to its inherently hostile environment "where actors are constantly making alliances, severing ties, and dropping out of the network."[118] While it is commonly known that each TCO has some effect on the social network, our findings show that only a few exert a powerful influence, thereby indicating their relatively high structural power over the network. It is important to keep in mind that the entire TCO network is spatially and socially distributed (decentralized), but there are three main actors that possess relatively more structural power than the other six actors.

The Sinaloa, Los Zetas, and Gulf cartels appear to maintain the greatest levels of structural power within the Mexican TCO network. While these three cartels have the greatest number of "friends" within the network, they also have the greatest number of enemies. It seems rational that if an actor with the greatest number of friends in a social structure should be able to influence the network relatively easily. As indicated by our degree centrality measures in the collaboration network, the Sinaloa, Los Zetas, and Gulf cartels appear to serve as hubs within the network, which provides them with structural advantages in terms of disseminating and receiving information and resources, thereby affording them more structural power compared to others. Furthermore, their high eigenvector results suggest that the same three cartels have easier access to information and resources through other well-connected TCOs.

By 2015, Los Zetas' high eigenvector score reflects its unique level of structural power because the friends that it was directly tied to had, on average, the greatest number of friends in the network. This provided Los Zetas with a level of indirect structural

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[118] Cunningham, Everton, and Murphy, *Understanding Dark Networks*, loc. 294.

power which was applied through its popular friends. The high eigenvector score also indicates that any resources or information within the network can be quickly disseminated to or collected from the rest of network, which gives Los Zetas an additional form of structural influence. This supports the initial discussion in Chapter I that suggested that the effects of IGO membership, such that Los Zetas will not only have influence on its cluster of allies to which it is directly tied, but also the external networks in which its allies are embedded.

This access to information and resources in the network is tied to Los Zetas' high levels of brokerage potential. In 2015, the Los Zetas' relatively strong ability to broker information and resources among other cartels offered them additional structural power, such that relatively more information and resources in the network had to pass through them before reaching other actors. This provided Los Zetas with a relatively high level of brokerage power, thereby giving them the ability to filter information and control resources that pass through them before it reached the rest of the network.

While popularity and brokerage indicate a relatively straightforward form of structural power, it appears that possessing numerous enemies is also an indicator of structural power. At first, this might sound counterintuitive, but if an actor with a lot of enemies has the resources to threaten other actors, then it can influence the social structure through threats of violence, restricting resources, or other various forms of coercion. The Sinaloa's and Los Zetas' high degree centrality scores in the enemy network offers them the ability to amass more power and attack or threaten multiple organizations at the same time. This relates to our analysis of the balanced relationship shown in Figure 12, which indicates an actor has two enemies that are allied against them. This further suggests that TCOs in this position have structural power because they are capable of defending against or attacking two actors simultaneously. For instance, in 2015, Sinaloa had an abundance of resources that other actors would be willing to team up and fight for, but it also shows that Sinaloa had the ability to readily attack two enemies at the same time. These attacks can either be threats of force or other forms of threats previously mentioned. However, we need to consider that this structural power

does not always come from the mere threat of force, it also comes from following through by actually using violence against their enemies.

Powerful TCOs that have a large number of enemies are usually involved in large number of violent conflicts, depending on their geographic proximity to other actors. Due to the dynamic and hostile environment in which TCOs operate, they are often forced to defend their resources and they often have to inflict violence upon other cartels to acquire new resources and territory. One can see that if a TCO had more structural power, they could utilize their position in the network to attack another actor for a profit. Compared to the other TCOs, Sinaloa, Los Zetas, and Gulf are involved in more conflicts than the others. Our spatial analysis illustrates that being involved in more conflicts indicates an actor has more structural power, such that the powerful actors must defend or attack strongholds along the border.

The porous and vulnerable border between the United States and Mexico is of strategic importance because it is a major gateway for illicit trafficking.[119] It is easy to see why it is beneficial for TCOs to fight for control of territories on either side of the border, such as network expansion. Network expansion directly correlates to the fact that powerful TCOs in the network dominate the greatest number of states along the border. The spatial analysis illustrates that spatial location is an important indicator of TCO power. For instance, in 2010 the Sinaloa cartel controlled the greatest number of states along both sides of the border, while in 2015 Los Zetas joined them as the most dominant cartels in terms of spatial location. The control of these strategic states provided both TCOs with the ability to control activity along the border. When we consider this notion of spatial dominance with their structural power in the network, especially in terms of their number of collaborative connections with others and their ability to serve as brokers, one can see why these two cartels remained dominant during this timeframe. Looking at the characteristics that the Sinaloa, Los Zetas, and Gulf cartels portrayed between 2010 to 2015, we are able to identify that a powerful TCO is an organization that has three major

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[119] Laura Calderón, Octavio Rodríguez Ferreira, and David A. Shirk, *Drug Violence in Mexico: Data and Analysis through 2017* (San Diego, CA: University of San Diego, 2018), https://justiceinmexico.org/2018-drug-violence-mexico-report/.

characteristics: relatively high levels of structural power (centrality scores); inflict relatively higher levels of violence onto other TCOs; and assert geographic dominance of strategic areas along the US-Mexico border. Understanding these characteristics provides us with a deeper understanding of how the Mexican TCO network functions and what characteristics identify a powerful actor within the TCO network.

B. DISRUPTION STRATEGIES

It may seem that since we have socially and spatially mapped the Mexican TCO network and identified the powerful actors, as well as highlighted which actors influence the flow of information and resources, we can remove these specific organizations. However, this is one of a few options available that can potentially disrupt the Mexican TCO network. Other options exist that may "offer better alternatives when taking into account costs, human lives, and the consequences for affected communities," which can be taken into consideration by U.S. and Mexican government agencies.[120] These options can be broken down into two distinct categories: kinetic and non-kinetic. Kinetic measures involve offensive operations with the purpose of physically removing the actors while non-kinetic strategies involve methods of persuasion to reduce the effectiveness of the network and impair an actor's will to fight.[121] Through these categories and based on our analyses, we have outlined two approaches to consider in order to disrupt the Mexican TCO network: (1) kinetically target the top three powerful TCOs in the network, and (2) increase information operations to create distrust and confusion within the whole network.

1. Target Powerful Actors (Kinetic)

Current U.S. strategy has been centered on removing the "kingpins" from Sinaloa and Los Zetas; however, this tactic has produced a "hydra-effect," such that the removal of a kingpin causes a power vacuum, which further results in "the emergence of a new

120 Everton, *Disrupting Dark Networks*, loc. 1399.

121 Ibid.

[organization] that is just as dangerous, if not more so."[122] Therefore, our first proposed course of action is not to attack one cartel but to allocate resources to disrupt and degrade the three most powerful TCOs from the network. If the top three TCOs are successfully degraded, then we anticipate that the rest of the Mexican TCO network will be disrupted as well. However, we know that Sinaloa, Los Zetas, and Gulf are not comprised of an individual person located in a single city, but rather of thousands of connected individuals who span across Mexico and the United States.[123] Thus, one can easily see that the amount of resources required to capture or kill enough members of the three cartels to disband them, would be incredibly costly in money, manpower, and resources.

A layered approach would be a better approach for disrupting the TCO network. Such an approach should be focused on simultaneously removing numerous key leaders in each of the TCOs, attacking their financial infrastructures, and disrupting their flow of arms and drugs across the United States and Mexico. If one TCO is removed, the other two remaining powerful TCOs will quickly fill the power vacuum and expand their network. Therefore, the key to this strategy is to attack the three cartels simultaneously. If all three are simultaneously targeted physically and financially, then there is a better chance of disrupting the overall TCO network for a short period of time. These kinetic strategies are not the only methods for disrupting the TCO network, non-kinetic strategies are also available that can provide longer-lasting effects.

2. Information and Distrust (Non-Kinetic)

An alternative to kinetic operations are non-kinetic ones, which are less violent but often take longer to realize their effects.[124] These include: psychological operations (PSYOP), information operations (IO), institution building, and tracking and monitoring.[125] Due to the long duration, lack of news headlines, and vague metrics for

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[122] Calderón, Ferreira, and Shirk, *Drug Violence in Mexico: Data and Analysis through 2017*.

[123] InSight Crime, "Zetas."

[124] Sean F. Everton. *Disrupting Dark Networks: Structural Analysis in the Social* Sciences (Cambridge University Press, 2012), loc. 1399, Kindle; Cass R. Sunstein, "The Law of Group Polarization" (working paper, John M. Olin Program in Law and Economics no. 91, 2000).

[125] Ibid.

success, non-kinetic operations are often viewed as ineffective. The reality is that if implemented correctly, non-kinetic operations can have longer-lasting effects compared to kinetic ones. Given the social and spatial types of data and analyses, we construct a layered non-kinetic strategy through the use of tracking and monitoring, PSYOP, and IO, which should be executed via cooperation and partnership between the U.S. and Mexican governments.

Similar to the data used in our analysis, there are information gaps that need to be addressed. In order to adequately address these, our non-kinetic approach begins with a period of tracking and monitoring of stakeholders to better improve our overall knowledge of the network before conducting subsequent operations.[126] The results of our social and spatial analysis should serve as an excellent starting point for focusing this phase of this strategy.

The second phase, which includes a PSYOP campaign, can create disaffection and mistrust among members and groups within the TCOs. This would be an effective tactic to apply to the TCO network because, as previously discussed, hostilities between organizations can easily fester in a dark network, which includes the TCOs and their dynamic relationships. Due to their higher betweenness scores, we expect information and resources to flow faster and more efficiently through the Sinaloa, Los Zetas, and Gulf cartels, but psychological operations should be applied to all nine of the TCOs in the network to create distrust both internally and externally among actors. The mistrust and confusion between actors can potentially expose additional network vulnerabilities that can lead to additional targeting. In addition to PSYOP, a simultaneous IO effort should be conducted to complement the PSYOP campaign.

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[126] John Arquilla, *Worst Enemy: The Reluctant Transformation of the American Military*. (Chicago: Ivan R. Dee, 2008), 168.

IOs are heavily reliant on electronic warfare and computer network operations, which is helpful when dealing with networks that cross borders.[127] They are frequently used to disrupt illicit operations such as money laundering and drug trade, which we did not discuss in our analysis but are important attributes of TCOs. Additionally, IOs can serve as tools to confirm network ties and physical locations through the tracking of digital and electronic forms of communications.[128] Similar to our proposed PSYOP campaign, the IO efforts should target all nine TCOs simultaneously. As we alluded to earlier, the TCO network mirrors that of an oligopoly, which dictates that all nine need to be disrupted equally; otherwise, another cartel will simply fill the void. We believe the combination of these three broad non-kinetic approaches will help degrade Mexican TCO capabilities. All have valuable and unique characteristics such as duration, resources, and personnel involvement. To be sure, each has its weakness (e.g., money, time, and bloodshed), and it is unlikely that a single approach will suffice.

All this suggests the potential need for a mix of kinetic and non-kinetic tactics to be applied simultaneously and over time.[129] We believe that these initial strategies provide U.S. and Mexican politicians with the ability to control specific efforts, which is helpful for resource control and more importantly, it provides them with time to develop and implement other non-kinetic and enduring strategies, such as institution building.

We developed these kinetic and non-kinetic strategies only after thorough study and analysis of their social and geospatial attributes. It is important to stress that these strategies do not account for every possible TCO attribute and, therefore, are not all encompassing. This leads us to acknowledge that SNA or spatial analysis do not offer a 100% solution for disrupting the TCO network, but rather they need to be combined with other forms of analysis.

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[127] Sean F. Everton. *Disrupting Dark Networks: Structural Analysis in the Social* Sciences (Cambridge University Press, 2012), loc. 1399, Kindle; Cass R. Sunstein, "The Law of Group Polarization" (working paper, John M. Olin Program in Law and Economics no. 91, 2000).

[128] Ibid.

[129] Ibid.

C. AREAS FOR FUTURE RESEARCH

There has been a significant amount of research on the history of cartels throughout the United States and Mexico, including continuous reporting on cartel-related activities by numerous government organizations and news agencies. However, as identified in Chapter I, scant research has been conducted on Mexican TCOs and their network, especially using the software tools applied in this research. Continued examination of these dark networks allows researchers to have a better understanding of a Mexican TCO's power, and to increase the overall understanding of Mexican TCO networks. While examining TCOs, researchers can focus their analysis on a number of topics; we recommend the following areas to further understand how TCOs evolve to acquire and preserve power and to increase our overall understanding of TCOs.

1. Temporal Analysis

As TCOs continue to evolve, so do their networks. While our research focused on 2010–2015, we recognize that an updated time span would be beneficial, as it would provide an updated snapshot of the TCO network. Therefore, we recommend that researchers extend our data up to present day as much as possible. Due to the difficulty of obtaining a single and complete data set, we recommend researchers create a customized compilation of data from relevant news sources, interagency reports, and public databases. This will allow them to explore and test the strength of several attributes of TCOs over time and utilize our temporal analysis as a starting point to compare more recent data.

2. Attributes (Characteristics)

Our findings suggest that TCOs possess several important attributes, some of which include the organizations with which they collaborate, the specific resources they control, and their geographic locations. We demonstrated that changes in social environment directly and indirectly affects the actors and the overall network. Consequently, these changes affect the way TCOs gain and maintain power. The following list of attributes offers a few areas that future researchers should examine to supplement the body of knowledge provided by our research.

a. Drug Statistics

Further analysis should focus on examining data related to the amounts and types of drugs that TCOs cultivate, produce, and traffic into the United States. Additional research can determine if specific drugs give a TCO relatively more power compared to other TCOs in the network. Conceivably, the data will provide greater insight into how drug-related operations contribute to the power of a TCO and its network.

b. Human Trafficking

It is important to understand if TCOs are involved in human smuggling and how it relates to their power. Geospatial analysis has the ability to highlight strategic locations, routes, and access points along the U.S.-Mexican border. Researchers can then compare relational and geospatial findings to identify which TCOs are involved human smuggling and how those findings overlap with territorial dominance. Additionally, these types of operations can be compared to drug smuggling operations to see if trafficking routes and access points coincide with each other.

c. Money Laundering

TCOs conduct a range of illicit activities, often times disguised as legitimate business operations to convert illegal funds into enormous profits. Our study does not analyze money laundering data; however, we discover that money laundering is an important component of their operations that should be researched to understand the correlation between money laundering operations and a TCO's power. Understanding the financial network is as important as understanding the different types of criminal activities TCOs conduct because it could potentially highlight the types, locations, and number of businesses financed by TCOs, further adding to the list of actors within the TCO network.

3. Case Study on a Specific State or Region

In future studies on the characteristics of powerful TCOs and their networks, researchers could apply the same methodology and approach used in this project, or a combination thereof, to analyze a specific city, state, or region. This level of analysis

could provide additional indicators of a network's power, identify sub groups within the network, and identify additional attributes to further understand powerful TCOs. A series of studies focused on TCOs across distinct locations could identify additional relational ties, which can further illuminate other actors and attributes that contribute to the overall power of TCOs and their expansive networks.

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APPENDIX A. SNA CODEBOOK

Section 1: Relationships

This section outlines and describes the types of relationship ties between organizations. The description also notes the type of direction between the organization and nodes—specifically, whether the relationship tie is directed or undirected and by whom.

Organization-to-Organization (i.e., One-Mode) Relationship Categories

1. **Collaboration** (organization-to-organization) (undirected): Two or more organizations that are allies, assist each other, or participate together to achieve a common goal or interest. The affiliation may be through shared finances, resources, territories, or an alliance against other organizations.

2. **Enemy** (organization-to-organization) (undirected): Two or more organizations that are rivals, not allies, and are attempting to maximize their own profits, resources, and territories.

3. **Violent Event** (organization-to-organization) (undirected): A violent conflict between two or more organizations in which the purpose is to use deadly force against members of another organization to attain certain goals.

Section 2: Attributes

This section notes and defines the characteristics of organizations.

1. **Organization Location:** Describes whether an organization is conducting significant operations within the boundaries of a state. For example, if an organization is reported to have significant activity within one city in a state in the U.S. or Mexico, it will be classified with a weight of one (1). If a cartel is reported to have significant activity within two cities within the same state, it will be classified with a weight of two (2), and so on.

2. **Dominant Cartel:** Defined as an organization that conducts the greatest significant activity within a specific geographic area, such as a U.S. or Mexican state.

3. **Violence Location:** Describes whether an organization has conducted an event that results in behavior involving physical force intended to hurt, damage, or kill members of another organization. For example, if a drug cartel violently attacked another drug cartel, that gives the attacking drug cartel a value of one (1) for the attribute.

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APPENDIX B. TCO SNA VISUALIZATIONS

Figures in this appendix reflect TCO Networks. All data contained within these tables are compiled from sources outlined in Chapter I using the *SNA* package in *R.*

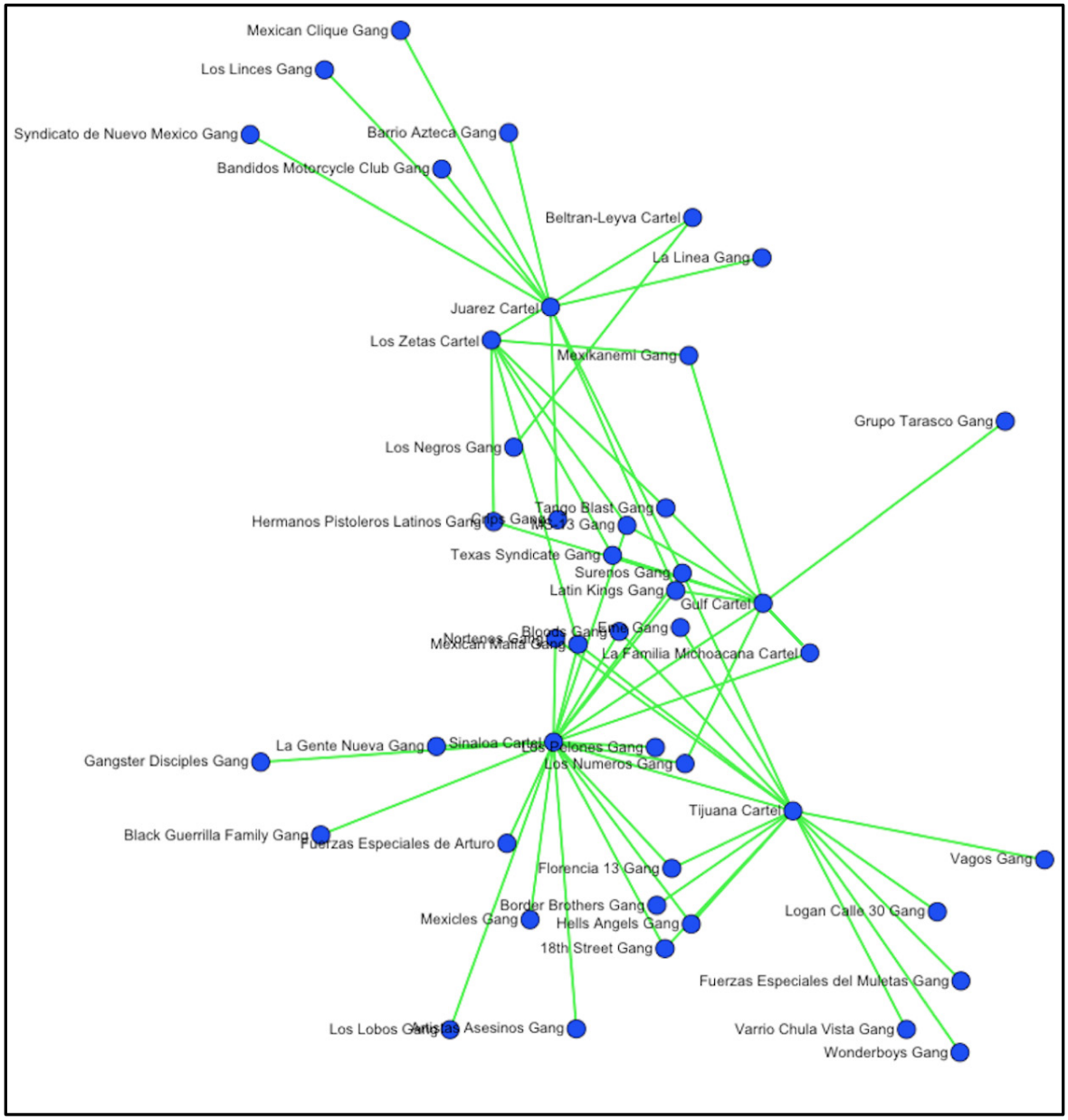

Figure 25. TCO Collaboration Network 2010

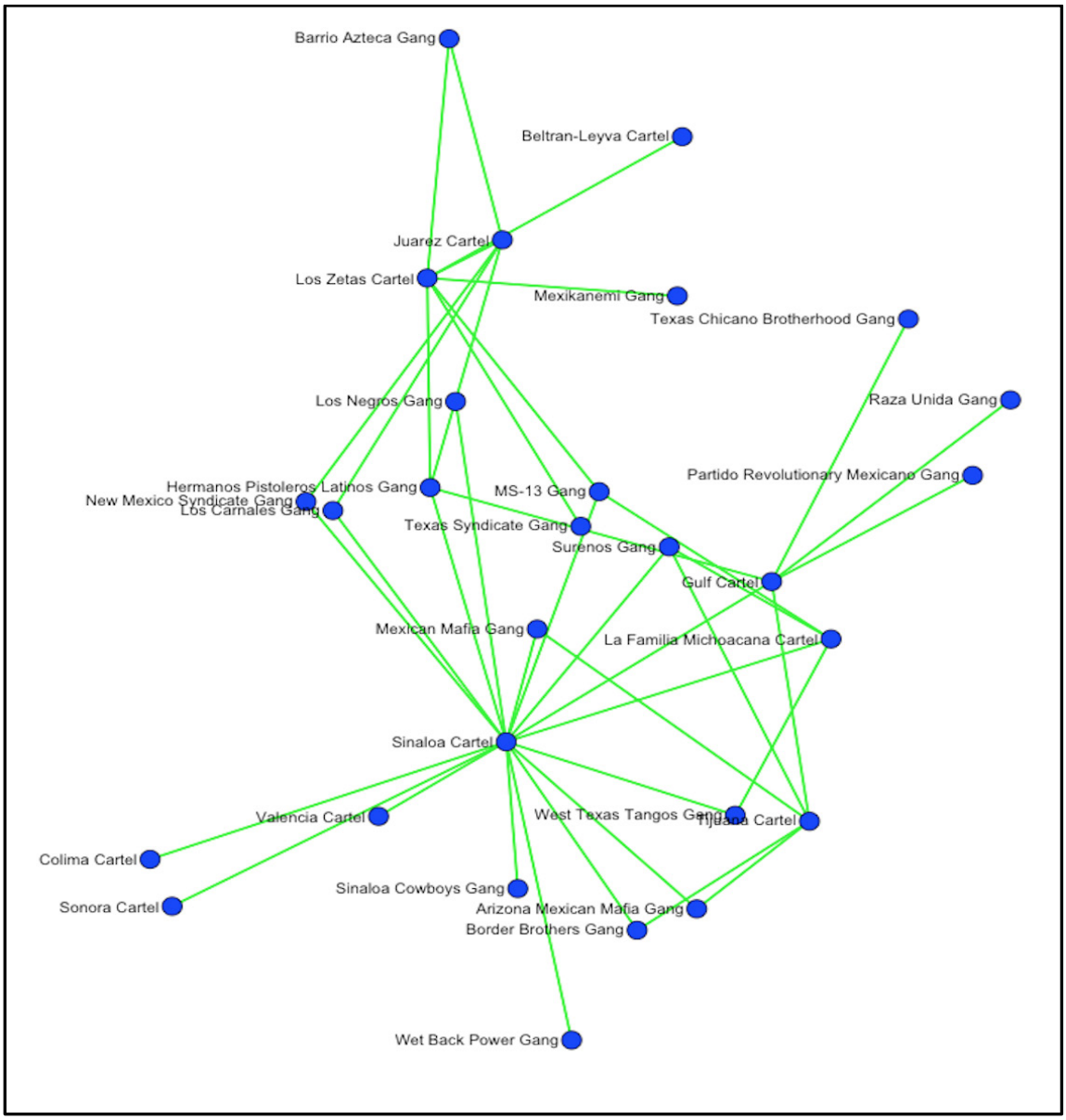

Figure 26. TCO Collaboration Network 2011

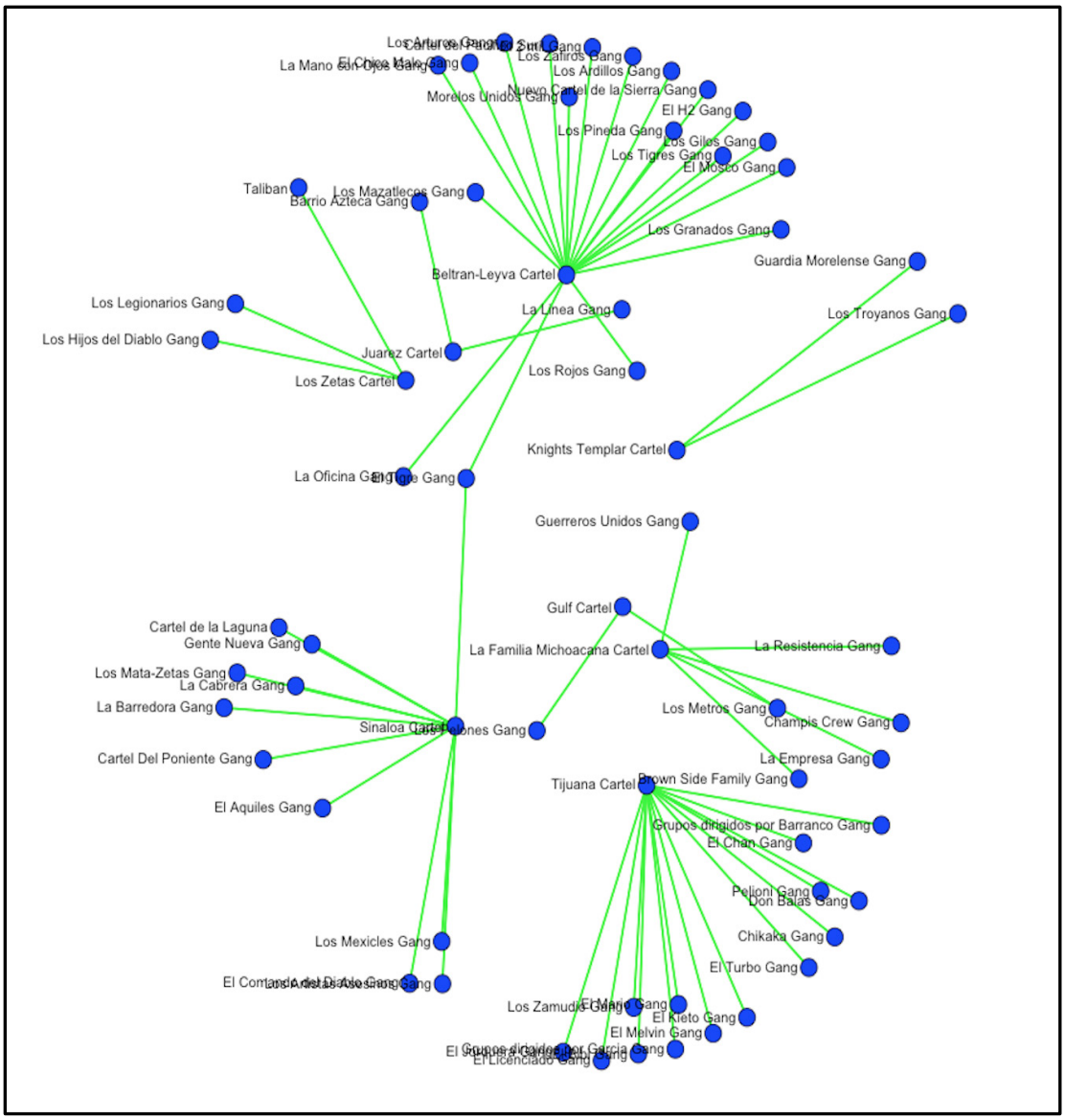

Figure 27. TCO Collaboration Network 2012

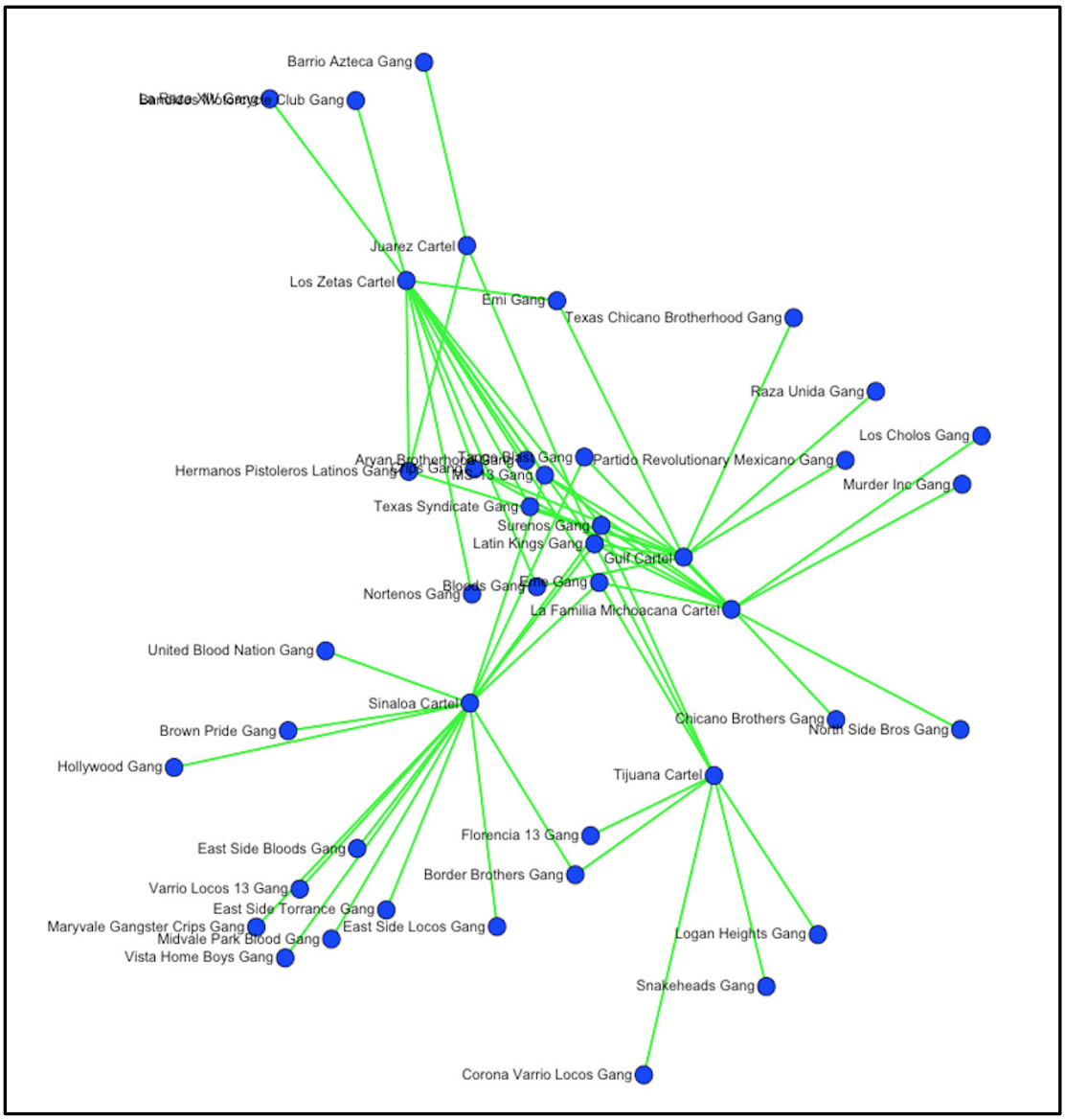

Figure 28. TCO Collaboration Network 2013

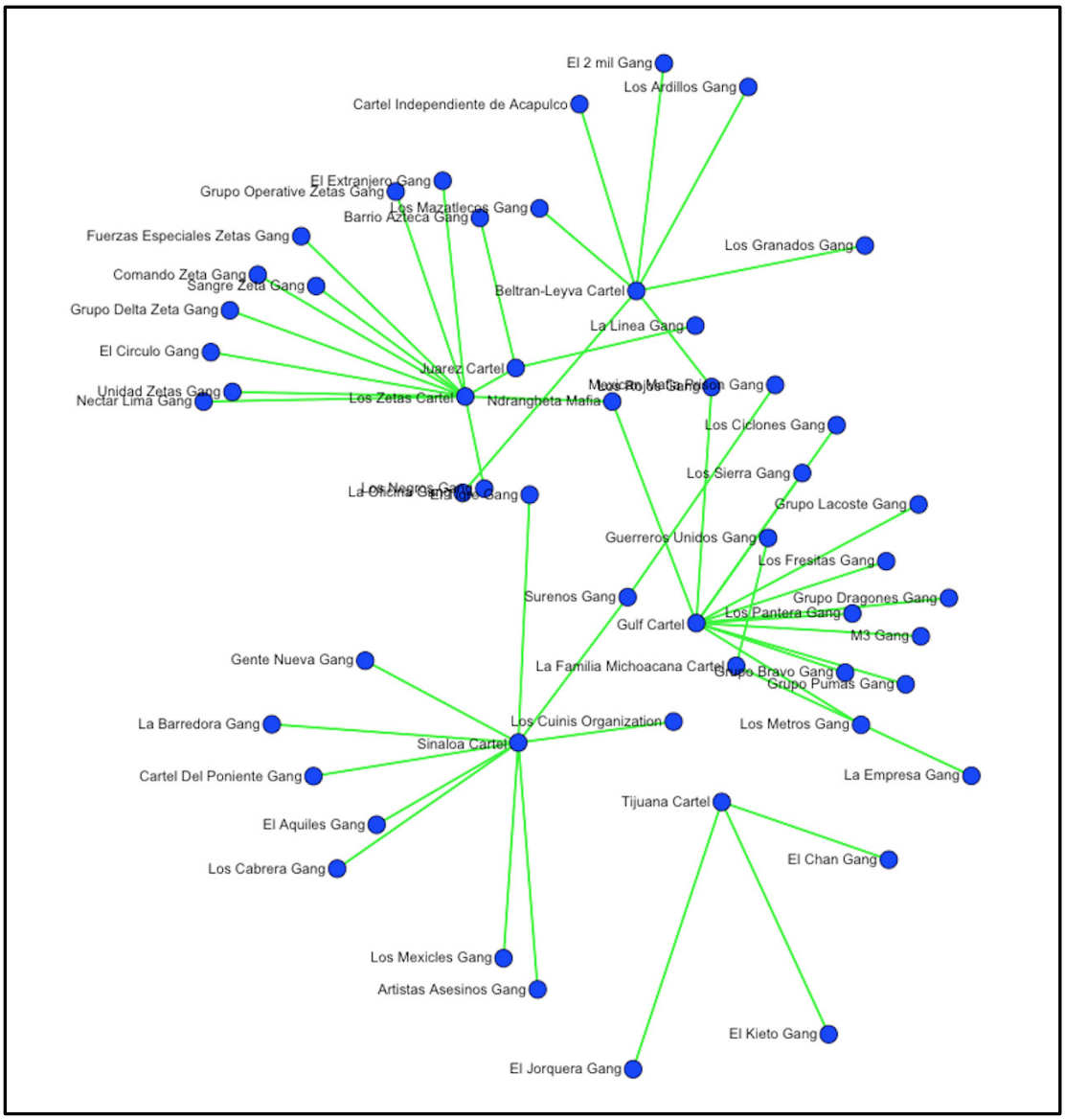

Figure 29. TCO Collaboration Network 2014

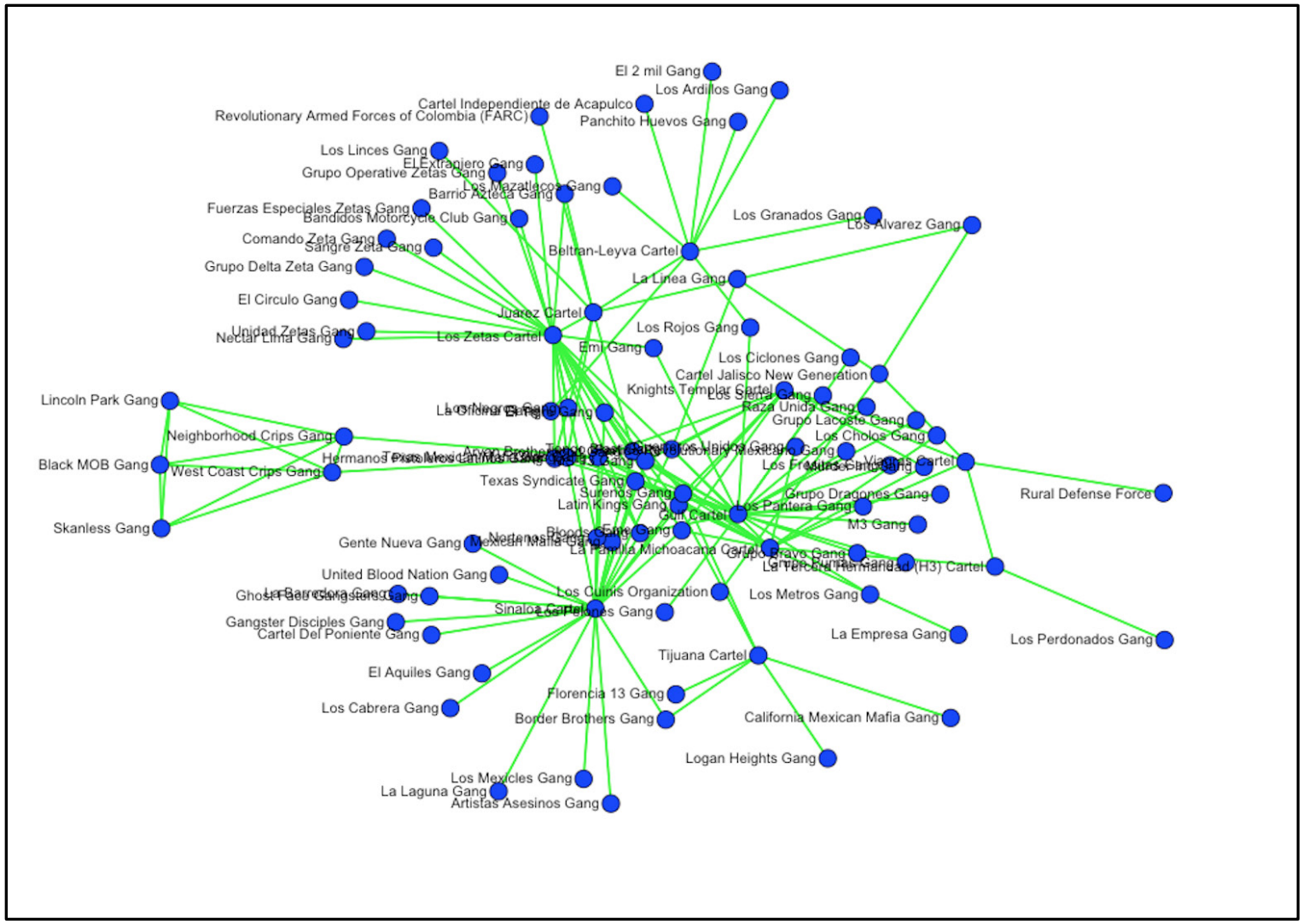

Figure 30. TCO Collaboration Network 2015

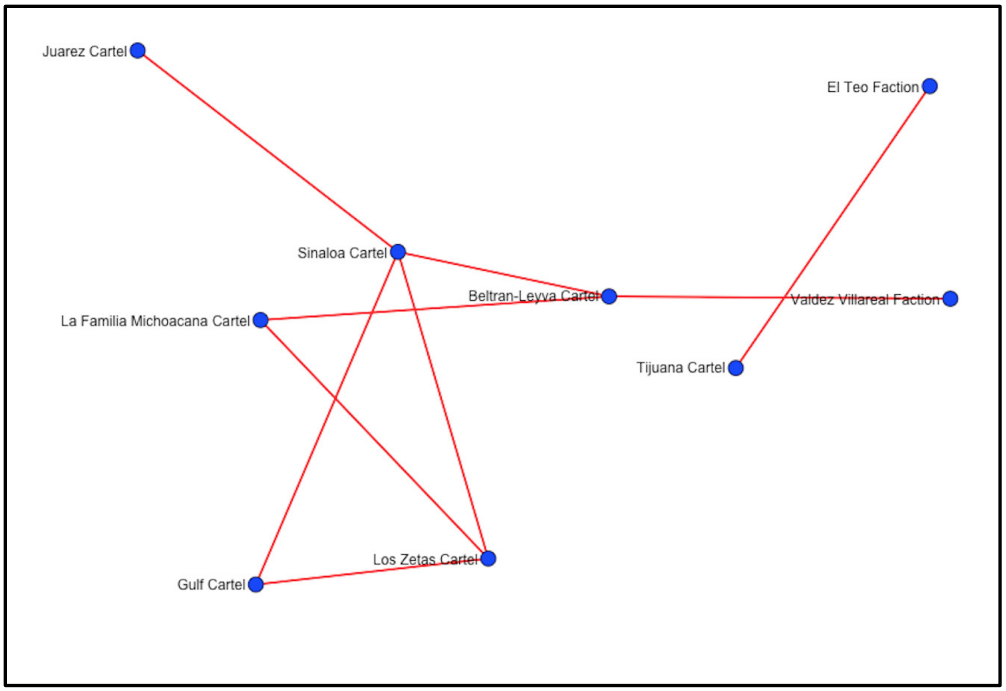

Figure 31. TCO Enemy Network 2010

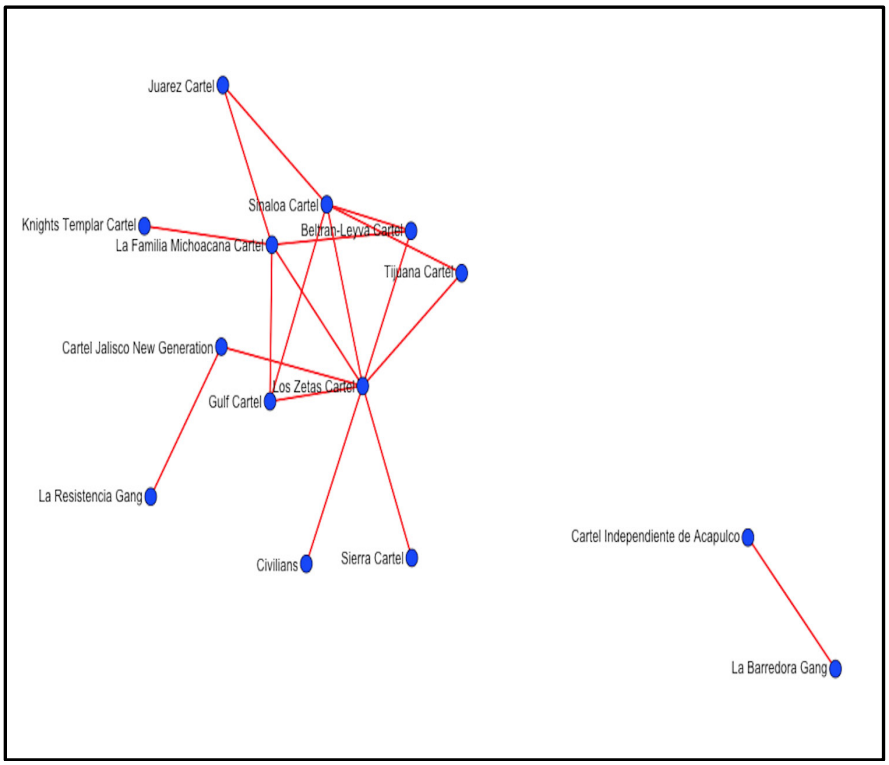

Figure 32. TCO Enemy Network 2011

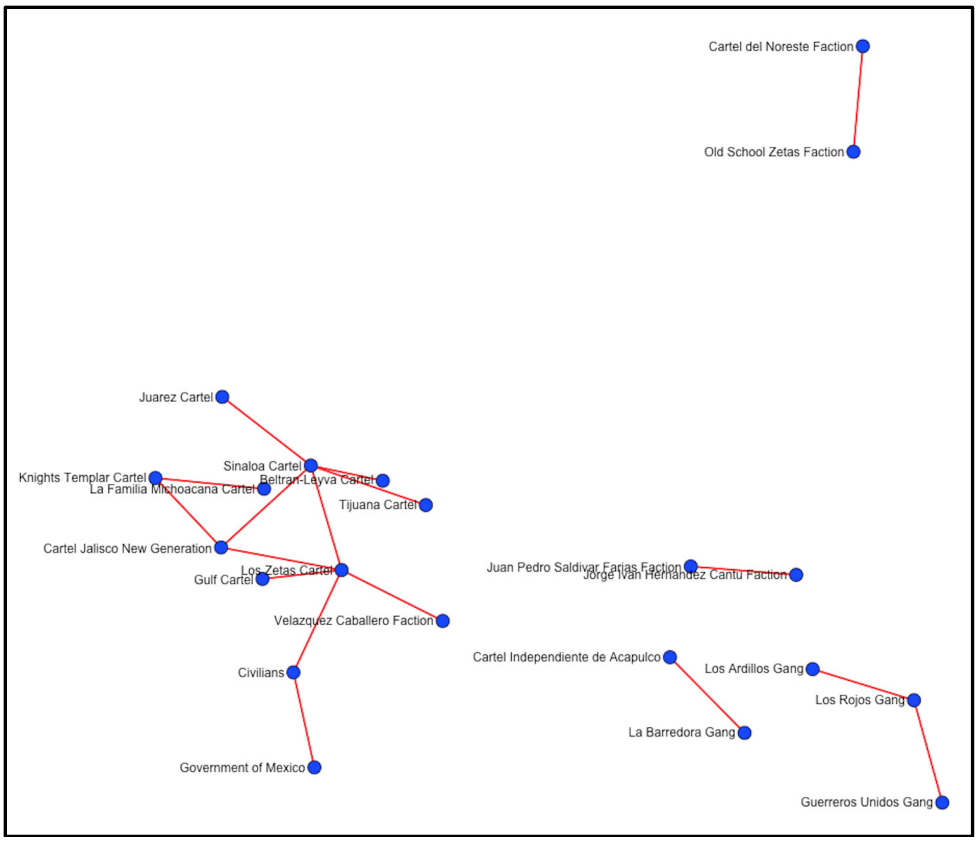

Figure 33. TCO Enemy Network 2012

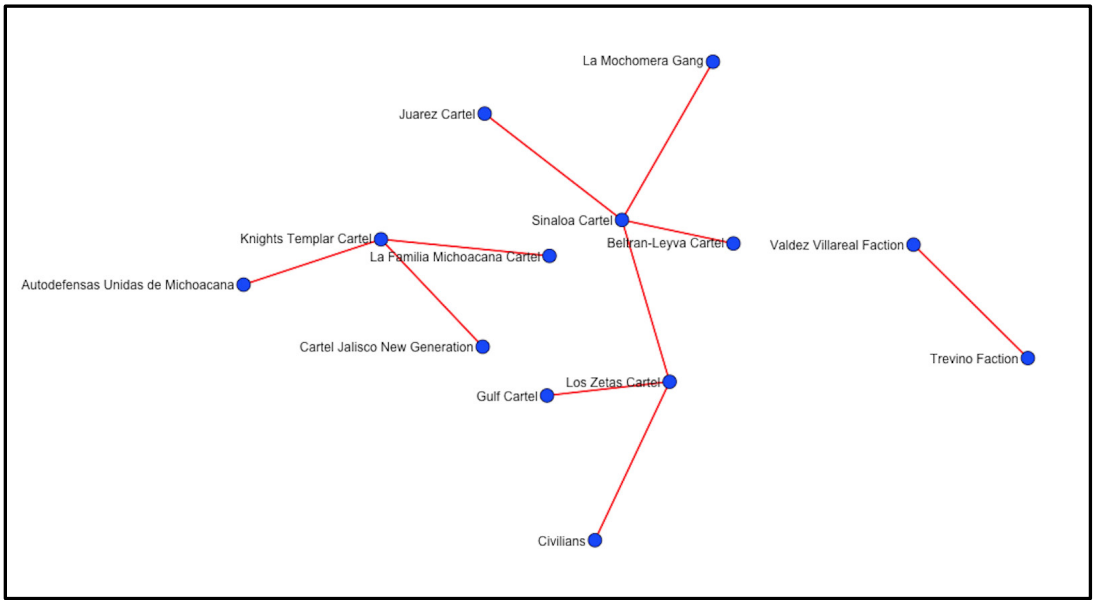

Figure 34. TCO Enemy Network 2013

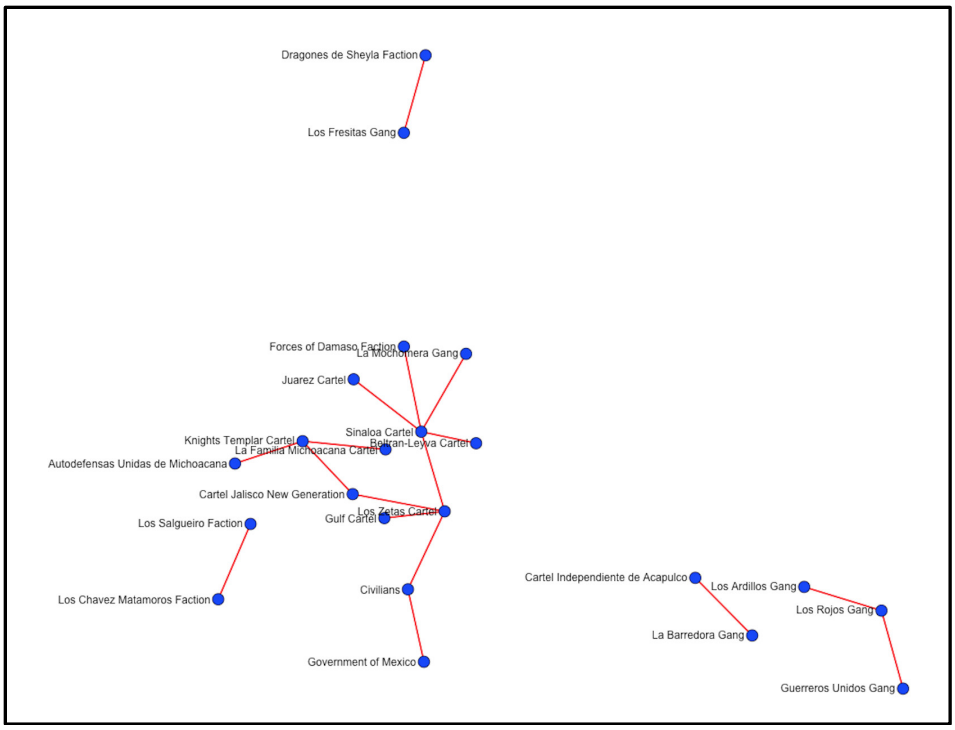

Figure 35. TCO Enemy Network 2014

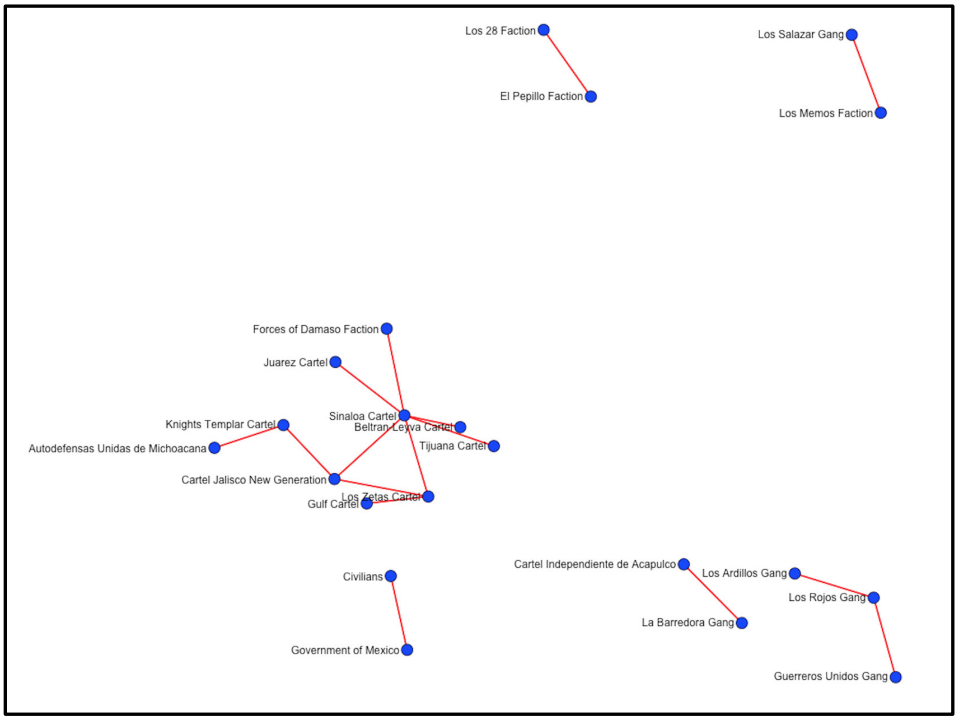

Figure 36. TCO Enemy Network 2015

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APPENDIX C. TCO SNA MEASURES AND RESULTS

Tables in this appendix reflect top five ranked organizations of Mexican TCO collaboration, enemy, and violence networks by normalized centrality scores / unscaled scores (scores in parentheses). All data contained within these tables are compiled from sources outlined in Chapter I in estimated using Organizational Risk Analyzer (ORA).

Table 3. 2010 TCO Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.429 / 21.000)	**Sinaloa Cartel** (0.808 / 0.571)	**Sinaloa Cartel** (0.175 / 0.004)	**Sinaloa Cartel** (0.476 / 559.752)
Tijuana Cartel (0.306 / 15.000)	**Tijuana Cartel** (0.577 / 0.408)	**Tijuana Cartel** (0.168 / 0.003)	**Tijuana Cartel** (0.276 / 324.700)
Gulf Cartel (0.184 / 9.000)	**Gulf Cartel** (0.327 / 0.231)	**Gulf Cartel** (0.164 / 0.003)	**Juarez Cartel** (0.244 / 287.500)
Juarez Cartel (0.184 / 9.000)	**Mexican Mafia Gang** (0.272 / 0.192)	**Surenos Gang** (0.163 / 0.003)	**Gulf Cartel** (0.168 / 197.548)
Los Zetas Cartel (0.163 / 8.000)	**Surenos Cartel** (0.263 / 0.186)	**Latin Kings Cartel** (0.162 / 0.003)	**Los Zetas Cartel** (0.131 / 153.500)

Table 4. 2010 Enemy Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (ranks 1 -7 same)	Betweenness
Sinaloa Cartel (0.082 / 4.000)	**Sinaloa Cartel** (0.778 / 0.550)	**Sinaloa Cartel** (0.023 / 0.000)	**Sinaloa Cartel** (0.007 / 8.000)
BLO (0.061/ 3.000)	**Los Zetas Cartel** (0.675 / 0.477)	**BLO** (0.023 / 0.000)	**BLO** (0.005 / 6.000)
Los Zetas Cartel (0.061 / 3.000)	**Gulf Cartel** (0.548 / 0.388)	**Los Zetas Cartel** (0.023 / 0.000)	**Los Zetas Cartel** (0.002 / 2.000)
LFM (0.041 / 2.000)	**BLO Cartel** (0.545 / 0.386)	**LFM** (0.023 / 0.000)	**LFM** (0.001 / 1.000)
Gulf Cartel (0.041 / 2.000)	**LFM** (0.460 / 0.326)	**Gulf Cartel** (0.023 / 0.000)	**N/A**

Table 5. 2010 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (ranks 1–10 same)	Betweenness
Sinaloa Cartel (0.116/ 154.000)	**Sinaloa Cartel** (1.000 / 0.707)	**Los Zetas Cartel** (0.001 / 0.000)	**Sinaloa Cartel** (0.194 / 7.000)
Juarez Cartel (0.111 / 148.000)	**Juarez Cartel** (0.999 / 0.706)	**Sinaloa Cartel** (0.001 / 0.000)	**Los Zetas Cartel** (0.167 / 6.000)
Los Zetas Cartel (0.047 / 63.000)	**Gulf Cartel** (0.038 / 0.027)	**Civilians** (0.001 / 0.000)	**Civilians** (0.111 / 4.000)
Gulf Cartel (0.046 / 61.000)	**Los Zetas Cartel** (0.028 / 0.020)	**Government of Mexico** (0.001 / 0.000)	**N/A**
BLO **Valdez Villareal Faction** (0.034 / 45.000)	**Civilians** (0.001 / 0.001)	**Gulf Cartel** (0.001 / 0.000)	**N/A**

Table 6. 2011 Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.500 / 17.000)	**Sinaloa Cartel** (0.826 / 584)	**Sinaloa Cartel** (0.119 / 0.003)	**Sinaloa Cartel** (0.403 / 226.362)
Los Zetas Cartel (0.206 / 7.000)	**Gulf Cartel** (0.426 / 0.301)	**HPL** (0.115 / 0.003)	**Los Zetas Cartel** (0.155 / 86.700)
Gulf Cartel (0.206 / 7.000)	**LFM** (0.422 / 0.299)	**Gulf Cartel** (0.115 / 0.003)	**Gulf Cartel** (0.188 / 66.000)
LFM **Juarez Cartel** **Tijuana Cartel** (0.147 / 5.000)	**HPL** (0.336 / 0.238)	**LFM** (0.114 / 0.003)	**HPL** (0.110 / 61.733)
HPL (0.118 / 4.000)	**Surenos Gang** (0.307 / 0.217)	**MS-13 Gang** (0.113 / 0.003)	**MS-13 Gang** (0.059 / 33.200)

Table 7. 2011 Enemy Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (2-12 same scores)	Betweenness
Los Zetas Cartel (0.235 / 8.000)	**Los Zetas Cartel** (0.759 / 0.537)	**Los Zetas Cartel** (0.042 / 0.001)	**Los Zetas Cartel** (0.066 / 36.833)
LFM (0.147 / 5.000)	**Sinaloa Cartel** (0.590 / 0.417)	**LFM** (0.041 / 0.001)	**LFM** (0.025 / 13.833)
Sinaloa Cartel (0.147 / 5.000)	**LFM** (0.538 / 0.380)	**Sinaloa Cartel** (0.041 / 0.001)	**CJNG** (0.018 / 10.000)
BLO **Gulf Cartel** (0.088 / 3.000)	**BLO** **Gulf Cartel** (0.476 / 0.337)	**BLO** (0.041 / 0.001)	**Sinaloa Cartel** (0.010 / 5.833)
CJNG **Juarez Cartel** **Tijuana Cartel** (0.059 / 2.000)	**Tijuana Cartel** (0.340 / 0.241)	**Gulf Cartel** (0.041 / 0.001)	**BLO** **Gulf Cartel** **Juarez Cartel** (0.001 / 0.500)

Table 8. 2011 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Los Zetas Cartel (0.119 / 106.000)	**Sinaloa Cartel** (0.906 / 0.640)	**Los Zetas Cartel** (0.003 / 0.000)	**Los Zetas Cartel** (0.309 / 17.000)
Sinaloa Cartel (0.111 / 99.000)	**Juarez Cartel** (0.852 / 0.603)	**Sinaloa Cartel** (0.003 / 0.000)	**Sinaloa Cartel** (0.200 / 11.000)
Juarez Cartel (0.091 / 81.000)	**Los Zetas Cartel** (0.523 / 0.370)	**BLO** (0.003 / 0.000)	**CJNG** (0.109 / 6.000)
Gulf Cartel (0.076 / 68.000)	**Gulf Cartel** (0.413 / 0.292)	**Civilians** (0.003 / 0.000)	**N/A**
Cartel Independiente de Acapulco **La Barredora Gang** (0.052 / 46.000)	**CJNG** (0.086 / 0.061)	**CJNG** **La Resistencia Gang** (0.003 / 0.000)	**N/A**

Table 9. 2012 Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector (Ranks 4–15 have the same scores)	Closeness (Ranks 4–15 have the same scores)	Betweenness
BLO (0.260 / 19.000)	**BLO** (0.990 / 0.700)	**BLO** (0.023 / 0.000)	**BLO** (0.147 / 387.000)
Tijuana Cartel (0.192 / 14.000)	**El Tigre Gang** (0.258 / 0.182)	**El Tigre Gang** (0.023 / 0.000)	**Sinaloa Cartel** (0.105 / 275.000)
Sinaloa Cartel (0.164 / 12.000)	**Los Pineda Gang** (0.226 / 0.160)	**Sinaloa Cartel** (0.023 / 0.000)	**El Tigre Gang** (0.087 / 228.000)
LFM (0.068 / 5.000)	**Nuevo Cartel de la Sierra Gang** (0.226 / 0.160)	**Cartel del Pacifico Sur** (0.023 / 0.000)	**Tijuana Cartel** (0.035 / 91.000)
Los Zetas Cartel (0.041 / 3.000)	**El H2 Gang** (0.226 / 0.160)	**El 2 mil Gang** (0.023 / 0.000)	**LFM** (0.004 / 10.000)

Table 10. 2012 Enemy Network Top 5 Ranked Actors

Degree (Ranks 5–15 same)	Eigenvector	Closeness (Ranks 1–8 same)	Betweenness
Sinaloa Cartel (0.055 / 4.000)	**Sinaloa Cartel** (0.851 / 0.602)	**Sinaloa Cartel** (0.015 / 0.000)	**Sinaloa Cartel** (0.006 / 15.000)
CJNG (0.041 / 3.000)	**CJNG** (0.720 / 0.509)	**CJNG** (0.015 / 0.000)	**CJNG** (0.005 / 14.000)
Los Rojos (0.027 / 2.000)	**Los Zetas Cartel** (0.411 / 0.291)	**Los Zetas Cartel** (0.015 / 0.000)	**Los Zetas Cartel** (0.002 / 6.000)
Los Zetas Cartel (0.027 / 2.000)	**Tijuana Cartel**	**BLO** (0.015 / 0.000)	**Los Rojos Gang** (0.000 / 1.000)
	BLO		
	Juarez Cartel (0.386 / 0.273)		
BLO (0.014 / 1.000)	**Knights Templar Cartel** (0.326 / 0.231)	**Juarez Cartel** (0.015 / 0.000)	**N/A**

Table 11. 2012 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (Ranks 1–10 same)	Betweenness
Los Zetas Cartel (0.117 / 131.00)	**Los Zetas Cartel** (0.993 / 0.702)	**Los Zetas Cartel** (0.003 / 0.000)	**Los Zetas Cartel** (0.418 / 38.000)
Gulf Cartel (0.071 / 80.000)	**Gulf Cartel** (0.897 / 0.634)	**CJNG** (0.003 / 0.000)	**Sinaloa Cartel** (0.187 / 17.000)
Sinaloa Cartel (0.062 / 69.000)	**Sinaloa Cartel** (0.427 / 0.302)	**Civilians** (0.003 / 0.000)	**CJNG** (0.176 / 16.000)
Knights Templar Cartel (0.025 / 28.000)	**Juarez Cartel** (0.106 / 0.075)	**Government of Mexico** (0.003 / 0.000)	**Knights Templar Cartel** (0.099 / 9.000)
Juarez Cartel (0.020 / 22.000)	**Velazquez Caballero Faction** (0.101 / 0.071)	**Velazquez Caballero Faction** (0.003 / 0.000)	**Civilians** (0.099 / 9.000)

Table 12. 2013 Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.080/16.000)	**Los Zetas Cartel** (0.626 / 0.442)	**Sinaloa Cartel** (0.014/ 0.000)	**N/A**
Los Zetas Cartel (0.070 / 14.000)	**Latin Kings Gang** (0.522/ 0.369)	**Los Zetas Cartel** (0.013 / 0.000)	**N/A**
Gulf Cartel (0.055 / 11.000)	**Sinaloa Cartel** (0.475 / 0.336)	**Gulf Cartel** (0.013 / 0.000)	**N/A**
LFM (0.008 / 1.000)	**Gulf Cartel** (0.387 / 0.274)	**LFM** (0.012 / 0.000)	**N/A**
Tijuana Cartel (0.379 / 8.000)	**LFM** (0.379/ 0.268)	**Tijuana Cartel** (0.012 / 0.000)	**N/A**

Table 13. 2013 Enemy Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.040 / 4.000)	**Sinaloa Cartel** (0.888 / 0.628)	**Gulf Cartel** (0.021 / 0.000)	**Los Zetas Cartel** (0.001 / 2.000)
Knights Templar Cartel (0.030 / 3.000)	**Los Zetas Cartel** (0.707 / 0.500)	**Los Zetas Cartel** (0.020 / 0.000)	**Autodefenses Unidas de Michoacana** (0.001 / 2.000)
Los Zetas Cartel (0.030 / 3.000)	**Juarez Cartel** (0.408 / 0.289)	**Autodefensas Unidas de Michoacana** (0.020 / 0.000)	**Knights Templar** (0.001 / 2.000)
Autodefensas Unidas de Michoacana (0.010 / 1.000)	**La Mochomera Gang** (0.408 / 0.289)	**BLO** (0.020 / 0.000)	**BLO** (0.001 / 2.000)
BLO (0.010 / 1.000)	**BLO** (0.408 / 0.289)	**CJNG** (0.020 / 0.000)	**Sinaloa Cartel (0.001/2.000)**

Table 14. 2013 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Los Zetas Cartel (0.057 / 93.00)	**Los Zetas Cartel** (0.917 / 0.648)	**Los Zetas Cartel** (0.003 / 0.000)	**Los Zetas Cartel** (0.015 / 2.000)
Sinaloa Cartel (0.050 / 82.000)	**Gulf Cartel** (0.835 / 0.590)	**CJNG** (0.003 / 0.000)	**Autodefensas Unidas de Michoacana** (0.015 / 2.000)
Gulf Cartel (0.042 / 68.000)	**Sinaloa Cartel** (0.548 / 0.388)	**Civilians** (0.003 / 0.000)	**Knights Templar Cartel** (0.015 / 2.000)
Juarez Cartel (0.033 / 54.000)	**Juarez Cartel** (0.396 / 0.280)	**Government of Mexico** (0.003 / 0.000)	**Beltran-Layva Cartel** (0.015 / 2.000)
Knights Templar (0.017 / 27.000)	**Civilians** (0.049 / 0.035)	**Velazquez Caballero Faction** (0.003 / 0.000)	**Sinaloa Cartel** (0.015 / 2.000)

Table 15. 2014 Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (Ranks 4–15 same)	Betweenness
Gulf Cartel (0.194 / 13.000)	**Gulf Cartel** (0.827/ 0.585)	**Gulf Cartel** (0.030 / 0.000)	**Gulf Cartel** (0.202 / 447.000)
Los Zetas Cartel (0.179 / 12.000)	**Los Zetas Cartel** (0.542 / 0.383)	**'Ndrangheta Mafia** (0.030 / 0.000)	**Los Zetas Cartel** (0.171 / 379.000)
Sinaloa Cartel (0.149 / 10.000)	**'Ndrangheta Mafia** (0.369 / 0.261)	**Los Zetas Cartel** (0.030 / 0.000)	**'Ndrangheta Mafia** (0.136 / 300.000)
BLO (0.104 / 7.000)	**Los Rojos Gang** (0.255 / 0.181)	**Los Rojos Gang** (0.029 / 0.000)	**Los Rojos Gang** (0.089 / 196.000)
Juarez Cartel (0.060 / 4.000)	**Grupo Lacoste Gang** (0.223 / 0.157)	**Grupo Bravo Gang** (0.029 / 0.000)	**BLO** (0.085 / 189.000)

Table 16. 2014 Enemy Network Top 5 Ranked Actors

Degree (Ranks 7–15 same)	Eigenvector	Closeness (Ranks 1–13 same)	Betweenness
Sinaloa Cartel (0.075 / 5.000)	**Sinaloa Cartel** (0.800 / 0.566)	**Los Zetas Cartel** (0.018 / 0.000)	**Los Zetas Cartel** (0.022 / 49.000)
Los Zetas Cartel (0.060 / 4.000)	**Los Zetas Cartel** (0.723 / 0.512)	**Sinaloa Cartel** (0.018 /0.000)	**Sinaloa Cartel** (0.017 / 38.000)
Knights Templar Cartel (0.045 / 3.000)	**CJNG** (0.378 / 0.267)	**CJNG** (0.018 /0.000)	**CJNG** (0.012 / 27.000)
Los Rojos Gang (0.030 / 2.000)	**Civilians** (0.344 / 0.243)	**Civilians** (0.018 /0.000)	**Knights Templar Cartel** (0.009 / 21.000)
CJNG **Civilians** (0.030 / 2.000)	**BLO** **Forces of Damaso Faction** **Juarez Cartel** **La Mochomera Gang** (0.320 / 0.226)	**Gulf Cartel** (0.018 /0.000)	**Civilians** (0.005 /11.000)

Table 17. 2014 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness (Ranks 1–10)	Betweenness
Sinaloa Cartel (0.097 / 57.000)	**Los Zetas Cartel** (0.819 / 0.579)	**Los Zetas Cartel** (0.004 / 0.000)	**Los Zetas Cartel** (0.233 / 49.000)
Los Zetas Cartel (0.090 / 53.000)	**Sinaloa Cartel** (0.699 / 0.494)	**Sinaloa Cartel** (0.004 / 0.000)	**Sinaloa Cartel** (0.181 / 38.000)
Gulf Cartel (0.048 / 28.000)	**Gulf Cartel** (0.646 / 0.457)	**Civilians** (0.004 / 0.000)	**CJNG** (0.129 / 27.000)
CJNG (0.044 / 26.000)	**BLO** (0.413 / 0.292)	**La Mochomera Gang** (0.004 / 0.000)	**Knights Templar Cartel** (0.100 / 21.000)
Knights Templar Cartel (0.039 / 23.000)	**Juarez Cartel** (0.354 / 0.251)	**CJNG** (0.004 / 0.000)	**Civilians** (0.052 / 11.000)

Table 18. 2015 Collaboration Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Los Zetas Cartel (0.065 / 26.000)	**Los Zetas Cartel** (0.576 / 0.407)	**Juarez Cartel** (0.008 / 0.000)	**Los Zetas Cartel** (0.005 / 49.500)
Sinaloa Cartel (0.063 / 25.000)	**Sinaloa Cartel** (0.505 / 0.357)	**Barrio Azteca Gang** (0.008 / 0.000)	**Crips Gang** (0.003 / 27.000)
Gulf Cartel (0.058 / 23.000)	**Gulf Cartel** (0.403 / 0.285)	**Sinaloa Cartel** (0.007 / 0.000)	**BLO Cartel** (0.002 / 16.000)
LFM (0.035 / 14.000)	**LFM** (0.345 / 0.244)	**Los Zetas Cartel** (0.007 / 0.000)	**Juarez Cartel** (0.001 / 14.500)
Juarez Cartel (0.030 / 12.000)	**Crips Gang** (0.332 / 0.235)	**Gulf Cartel** (0.007 / 0.000)	**LFM** (0.001 / 10.000)

Table 19. 2015 Enemy Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.020 / 8.000)	**Sinaloa Cartel** (0.946 / 0.669)	**CJNG** (0.005 / 0.000)	**Sinaloa Cartel** (0.001 / 12.000)
Los Zetas Cartel (0.007 / 3.000)	**Juarez Cartel** (0.563 / 0.398)	**Gulf Cartel** (0.005 / 0.000)	**Los Zetas Cartel** (0.000 / 3.000)
CJNG (0.007 / 3.000)	**CJNG** (0.464 / 0.328)	**Los Zetas Cartel** (0.005 / 0.000)	**N/A**
Knights Templar Cartel (0.005 / 2.000)	**Los Zetas Cartel** (0.460 / 0.326)	**BLO Cartel** (0.005 / 0.000)	**N/A**
Juarez Cartel (0.005 / 2.000)	**BLO Cartel** (0.282 / 0.199)	**Los Zetas Cartel** (0.005 / 0.000)	**N/A**

Table 20. 2015 Violence Network Top 5 Ranked Actors

Degree	Eigenvector	Closeness	Betweenness
Sinaloa Cartel (0.052 / 114.00)	**Sinaloa Cartel** (1.000 / 0.707)	**CJNG** (0.001 / 0.000)	**Sinaloa Cartel** (0.026 / 10.000)
Tijuana Cartel (0.025 / 55.000)	**Tijuana Cartel** (0.832 / 0.588)	**Gulf Cartel** (0.001 / 0.000)	**Los Zetas** (0.008 / 3.000)
Los Zetas Cartel (0.020 / 43.000)	**Forces of Damaso Faction** (0.484 / 0.342)	**Los Zetas Cartel** (0.001 / 0.000)	**N/A**
El Pepillo Faction (0.015 / 34.000)	**Juarez Cartel** (0.212 / 0.150)	**BLO Cartel** (0.001 / 0.000)	**N/A**
Los 28 Faction (0.015 / 34.000)	**BLO** (0.166 / 0.118)	**Juarez Cartel** (0.001 / 0.000)	**N/A**

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