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**Ties to Trust: Unveiling Patterns of Collaboration in ‘Ndrangheta
Clans**

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Abstract

Collaboration is a fundamental feature of crime that is defined as organized. Despite considerable research focusing on collaboration within organized crime groups in recent years, only a few studies have examined cooperation between members of different groups or clans of large criminal organizations. Collaboration facilitates coordination and resource acquisition, yet it is challenged by the inherent lack of trust characterizing the criminal environment. This study contributes to the literature by investigating the extent and dynamics of collaboration among members of different ‘Ndrangheta clans, known as *locali*. Specifically, it investigates the degree of collaboration among *locali*, identifies key brokers who facilitate connections among these groups, and analyzes the factors influencing collaboration both within and among *locali*, emphasizing the role of kinship compared to the one of leadership and shared membership, proxies for the formal organizational structure. Data were collected from three major Italian law enforcement investigations targeting multiple ‘Ndrangheta *locali* and analyzed using network analysis methods. The findings suggest a strong collaboration among different *locali*, primarily facilitated by leaders who serve as intermediaries. While the formal hierarchy primarily drives collaboration among *locali*, kinship fosters cooperation among members of the same *locale*, also showing some indirect influences in inter-*locali* interactions.

Introduction

Since the first conceptualizations of organized crime, researchers have investigated how individuals come to collaborate to commit crimes and pursue illicit objectives (Kleemans 2014). In illegal environments, criminals operate and cooperate under significant constraints, including the constant threat of being detected by law enforcement and the inability to seek state assistance for disputes or issues that arise during their activities (Paoli 2002; Reuter 1983). This situation affects cooperation, requiring a balance between maintaining high levels of secrecy and trust, and efficiently carrying out activities and achieving goals (Morselli, Giguère, and Petit 2007; von Lampe and Ole Johansen 2004). Empirical research has explored how organized criminal groups try to manage these constraints through the adoption of a variety of strategies, including controlling resources and information flows, relying on trusted relationships, and adopting specific organizational formulas (e.g., Calderoni and Superchi 2019; Campana and Varese 2013; Catino 2019; Catino, Rocchi, and Vittucci Marzetti 2022; Morselli, Giguère, and Petit 2007; Morselli 2009a; 2009b; Reuter 1983).

Despite the proliferation of research over the years, most criminological studies have focused on collaboration within single organized criminal groups, often overlooking how it extends beyond the group's boundaries. However, cross-group cooperation occurs (Coutinho et al. 2020), and it is especially relevant in contexts where multiple distinct groups coexist and must coordinate, such as clan-based criminal organizations. The subdivision into groups is a common feature in large criminal organizations: from mafias, which typically have a formal division into clans, to less structured entities like Latin gangs and Outlaw motorcycle gangs (Catino 2019). Within these organizations, collaboration enables coordination and resource acquisitions, though it is challenged by distrust. Although inter-group relationships are crucial for the existence of the overall organization, only a limited number of studies have explored how such

collaboration occurs, who mediates it, and the factors that foster trust and cooperation among members of different groups (Battisti, Lavezzi, and Musotto 2022; Calderoni, Brunetto, and Piccardi 2017; Coutinho et al. 2020; Della Posta 2017; 2023; Krajewski, DellaPosta, and Felmlee 2022).

The present study aims to contribute to the current knowledge by examining the interactions among *locali*, the formal subgroups of the ‘Ndrangheta, one of the most powerful and relevant mafia-type organizations originating from Italy. Specifically, the study set out three objectives. First, investigating the differences in collaboration intensity within and among *locali*. Second, identifying brokers among *locali* and exploring their association with leadership roles. Third, assessing the influence of kinship in driving collaboration within and across *locali*, comparing it to the role of the formal organization structure. To fulfill these objectives, the study leverages data from three law enforcement operations conducted in Italy against the ‘Ndrangheta and analyzes them by the means of network analysis.

The study is structured as follows. In Chapter I, Section 1.1 provides an overview of the traditional and contemporary theoretical conceptualization of organized crime, presenting contributions and shortcomings. Section 1.2 underlines how the understanding of organized crime has evolved towards a more flexible perspective over time, fostered by increased reliance on empirical research. It details the strategies that organized criminal groups employ to adapt, survive, and succeed in the hostile, criminal environment. Section 1.3 introduces the research on cross-group collaboration within clan-based criminal organizations, setting the stage for the formulation of the research problem detailed in Section 1.4. Chapter II outlines the methodology used for the analysis, detailing the data sources and collection process, and describes the methods employed to achieve the three objectives, while Chapter III presents the results. To conclude, Chapter IV provides a discussion of the main findings, underlining the

main limitations and contributions of the study and outlining potential directions for future research.

Chapter I. Theoretical background

In a general sense, the term *collaboration* refers to “the act of working together with other people or organizations to create or achieve something” (Cambridge University Press 2011). Given the multiple – and different – definitions of organized crime¹ provided by countries, institutions, and academics, it is possible to argue that collaboration is an intrinsic feature of the phenomenon (Coutinho et al. 2020; van Koppen 2013), though not always directly mentioned. As highlighted by Bouchard (2020, 426), “the word “organized” expresses the idea that individuals form social structures of collaboration in order to generate flows of criminal activity”. With this feature being so relevant for the conceptualization of organized crime, to understand how crime is *in fact* organized, it is necessary to look at how and whether criminals collaborate with each other. All of the theoretical perspectives developed on organized crime, from the bureaucratic model to the more contemporary approaches, frame in different ways the issue of organized crime in terms of models of cooperation amongst individuals, how it occurs, and how it shapes – or is shaped by – the structure and the activities conducted (Kleemans 2014; Rostami et al. 2018).

1.1. The study of organized crime: traditional and contemporary perspectives

The concept of organized crime originated in the United States during the XX century (Woodiwiss 2003), and since the 1920s its meaning has evolved repeatedly over time

¹ For a collection of definitions, see von Lampe (2021).

(Finckenauer 2005; Hagan 2006; Maltz 1976), becoming associated with two main notions: “(a) a set of stable organizations illegal per se or whose members systematically engage in crime; and (b) a set of serious criminal activities, particularly the provision of illegal goods and services, mostly carried out for monetary gain” (Paoli 2014b, 2). The conceptualization of organized crime as *what* or *who* has strongly affected how this phenomenon has been interpreted and understood by scholars, politicians, and law enforcement agencies (Paoli and Vander Beken 2014).

For a long time, the study of organized crime has been developed around – and against – the conceptualization of organized crime provided by the U.S. authorities during the 1950s, i.e., the *alien conspiracy theory*. First proposed by the Kefauver Senate Investigating Committee, this perspective suggested the identification of organized crime with the mafia (*who* perspective), thus understood as an external entity polluting the American economy and society (Paoli and Vander Beken 2014; von Lampe 2009). This theorization was strongly criticized and rejected by most social scientists during the 1960s, who provided arguments against the alien conspiracy theory that can be grouped into two main approaches: the social relation and the illegal enterprise theories. Due to their presence for a long time on a regular basis in the public debate on organized crime, these three theorizations can be labeled, in line with Kleemans (2014), as *traditional* perspectives on organized crime. Stemming from these, in more recent years other theorizations and approaches have been developed in the academic field, proposing not only new ways to conceptualize organized crime but also new methods for its empirical study (Kleemans 2014; von Lampe 2016a).

Alien conspiracy and bureaucratic model of organized crime

The study and discussion on organized crime arose for the first time in a structured way during the Prohibition era (1920s-1930s) in the United States. In this period, organized crime was

usually associated with racketeering – activities such as extortion, fraud, counterfeiting, illegal gambling, trafficking of drugs or liquor – in which there was direct involvement of politicians, police, and businessmen (Woodiwiss 2003). The focus thus was on *what* rather than *who* (D. C. Smith 1991). However, after World War II, the idea of organized crime as a set of criminal activities involving society gave way to a conceptualization of organized crime as a foreign well-structured, and powerful criminal organization, starting to shift the attention from *what* to *who* (Paoli and Vander Beken 2014).

From the 1950s, the concept of organized crime was framed by several American institutions and politicians as a nationwide, centralized criminal organization formed by multiple families dominating the most profitable illegal markets, which derived from an analogous parallel Sicilian organization (Paoli 2002). In this way, organized crime, which matched with La Cosa Nostra, was depicted as an *alien conspiracy*: not a part of society and influenced by the society itself but instead an external, foreign threat (Kleemans 2014; Woodiwiss 2003). In 1969, this interpretation of organized crime received a degree of academic and scientific legitimacy with the publication of *Theft of the Nation* by Donald Cressey (1969), which contributed to the development of the so-called bureaucratic model of organized crime (Kleemans 2014). The analysis of Cressey described the organized crime structure as a Weberian ideal type of legal-rational bureaucracy, characterized by a formal and strict hierarchy with a pyramidal shape, with a set of sanctions and rules of conduct, and in which each member has a specific task (von Lampe 2016a; Kleemans 2014; Paoli 2002). In this framework, the collaboration between members was supposed to occur in a vertical way within the group, following the rigid centralized structure and division of labor of the organization (Krajewski, DellaPosta, and Felmlee 2022). On the other hand, the cooperation between different groups – *families* – was believed to be strictly managed thanks to a national governing body, although little evidence supports this view, which rather suggests a collaboration on ventures (Jacobs 2020).

The conceptualization of organized crime as a foreign mafia polluting the American economy and society has been criticized and rejected by several scholars since the 1960s, in particular due to the scarce evidence of the presence of a such structured and hierarchical criminal organization (Paoli and Vander Beken 2014). This has led to numerous and sometimes entirely different theorizations stemming from the revision of multiple features of the bureaucratic model, moving from the relational approach and then to the enterprise model (von Lampe 2016a).

The illicit enterprise theory and its further elaborations

During the 1970s, the criticism of the alien conspiracy and bureaucratic model gave birth to the theorization of the illicit enterprise approach. This theory was rooted in general economic theories of crimes and in the belief that there is a certain degree of overlap between legal and illegal activities – thus, the focus shifts another time on *what* (Aziani, Berlusconi, and Giommoni 2021; Kleemans 2014; Paoli and Vander Beken 2014). From this perspective, criminals are rational and profit-oriented actors involved in activities that follow similar rules of supply and demand that move legal activities. Some goods and services have been banned by governments, but these restrictions did not affect the demand. In this perspective, the illicit enterprise is conceptualized as an extension of legitimate market activities in areas generally forbidden by the law to meet illicit demand and pursue profit (D. C. Smith 1975). However, unlike legal businesses, illegal enterprises face several constraints in illicit markets. As Reuter argues in his work *Disorganized Crime: The Economics of the Invisible Hand* (1983), the hostile and dynamic environment characterizing illegal markets requires criminal groups to manage information flow and minimize visibility to mitigate risks. For this reason, criminal organizations tend to be small, short-lived, and with a simple internal structure, which prevents them from exerting monopolistic control over illegal markets (Reuter 1983).

Since the 1970s, enterprise theory has received a broad consensus, becoming one of the most affirmed interpretations of organized crime and contributing to a conceptualization of organized crime based on criminal activities (Aziani, Berlusconi, and Giommoni 2021; Calderoni 2018; Liddick 1999; Paoli and Vander Beken 2014; von Lampe 2016a). However, some shortcomings were raised over time. Critiques argue that the theory places excessive emphasis on the rationality assumptions of the economic theory, leading to an overrepresentation of criminals as rational actors whose personal traits determine the success or failure of their illicit enterprises (Kleemans 2013; 2014). In addition, the theory's conceptualization of organized crime as a provider of illegal goods and services has been questioned for its inadequacy in explaining the existence of criminal organizations, such as mafia associations, that were active before and independently of illegal markets (Paoli 2002).

A further elaboration of the conceptualization of organized crime as illicit enterprises was proposed in the Italian context by Diego Gambetta (1992) in his study of the Sicilian Mafia, then elaborated by other authors (see, for example, Varese 2013). Gambetta argues that the mafia's core activity, contrary to other organized criminal groups, is not the supply of illegal goods and services, but rather the provision of private protection. According to Gambetta (1992), the demand for protection generates where there is a lack of trust and responsiveness by the State in the protection of property rights and economic transactions. In response, mafia groups fulfill this demand from citizens. In this framework, the socio-cultural aspects of the mafia, such as violence, *omertà*, and secrecy, are functional to the development of a strong reputation reinforcing the provision of protection not guaranteed by the State (Calderoni 2018).

One of the key contributions of the private protection theory is that it overcomes the sole focus on the provision of illicit goods while offering an explanation for the power and longevity of mafia groups' control over time (Kleemans 2014; Paoli 2003). Nonetheless, this interpretation

has been challenged as it is frequently in contrast with empirical evidence, where usually protection takes the form of extortion, violence, and abuse of power (Kleemans 2014). One of the major critiques of the private protection theory was raised by Letizia Paoli (2003), who acknowledged the importance of the work in shifting the attention to the political dimension of mafia associations but criticized the exclusive emphasis on protection. According to Paoli (2003), mafias are polyfunctional organizations founded on fraternization contracts which over time have always engaged in both power- and profit-oriented activities.

From the social relation to the criminal network approach

A few years earlier than the elaboration of the illegal enterprise theory, the critique of the alien conspiracy gave birth to another theoretical perspective, the social relation approach, which posed great attention to the role of criminal organizations, especially mafias, within society (Calderoni 2018). As well as for the enterprise theory, the social relation approach rejected the idea of a well-structured criminal organization composed of individuals external to American society (Kleemans 2014). Joseph Albin (1971) was one of the first researchers to criticize the bureaucratic model in his study on organized crime in Detroit. According to Albin, there was little evidence of the importance of hierarchy and high-level of coordination in explaining the collaboration between individuals. Organized crime is characterized by the furniture of illegal goods that are required by American society. This implies a more flexible and informal structure, that according to the author can be conceptualized as “a system of loosely structured relationships” based on patron-client relations (Albin 1971, 288), frequently embedded in a larger network of friendship, kinship, and business relations (Calderoni 2018). The focus on the importance of social relations in explaining organized crime, and specifically mafias, was further elaborated by other scholars. Francis Ianni and Elizabeth Reuss-Ianni (1972) also rejected the conceptualization proposed by the bureaucratic model. They argued that mafia

behavior is not generated from internal and strict rules but from loyalty and relational commitment internal to each mafia family, which allows collaboration between different mafia groups as well. From this perspective, the mafia is conceptualized as a social system built on “social, cultural, and ethnic relations” (Calderoni 2014b, 4973). The conceptualization of mafias in terms of social relations was further developed in some studies on the Sicilian mafia. Henner Hess (1973) emphasized the relational and cultural aspects more than the organizational ones, describing the mafia group as multiple relations between mafia members and other individuals, in which kinship relations play a central role. A few years later, Anton Blok (1974) also pointed his attention to the Sicilian mafia highlighting the importance of the environmental and social context for the comprehension of mafia. According to Blok (1974), the mafia can be better understood in terms of social networks, in which the connection between mafiosi within the *cosca* is embedded in a broader network of kinship and friendship relations.

Overall, the relational approach underscored the subcultural and relational dynamics in explaining the functioning and collaborative aspects of mafias, contributing to the overcoming of a criminal organization strict and hierarchical, yet keeping the focus on *who* (Calderoni 2018). In 1999, Kleemans and Van de Bunt expanded the position of Albini, Ianni, and Blok, elaborating a new theoretical perspective based on Granovetter’s social embeddedness theory (1985). According to Granovetter (1985), the embeddedness of economic transactions within personal and social relationships can mitigate uncertainty, distrust, and transaction costs. In the criminal environment, organized crime does not operate in a social vacuum, but is embedded in its social environment (Kleemans and Van de Bunt 1999). Operating in hostile environments characterized by high financial interests, absence of rules, and the constant threat of law enforcement (Kleemans 2014; Paoli 2002), cooperation in organized crime is difficult due to problems of distrust (von Lampe and Ole Johansen 2004). In this context, family, friends, and acquaintances relations in which criminals are embedded mitigate the lack of trust and the risk

of betrayal, providing at the same time new opportunities and access to resources such as money, knowledge, and contacts, making collaboration easier (Granovetter 1973; 1985; Kleemans and Van de Bunt 1999; Kleemans 2013; Kleemans and de Poot 2008; Kleemans and van Koppen 2020; Van de Bunt, Siegel, and Zaitch 2014).

Among the theoretical conceptualization of organized crime, the social embeddedness theory is the one that mostly explains the phenomenon of organized crime in terms of cooperation schemes (Aziani, Berlusconi, and Giommoni 2021; Kleemans 2014), focusing on the types of relations connecting criminals beyond co-offending. In recent years, research has increasingly acknowledged the importance of examining a variety of relationships in the study of criminal groups, advocating for expanding the analytical focus beyond just the co-offending dynamics (Bouchard 2020; Bright et al. 2015; Malm, Bichler, and Van De Walle 2010; Ouellet and Hashimi 2019; C. M. Smith and Papachristos 2016).

Drawing on the theoretical frameworks of the social relation approach and social embeddedness theory, the study of organized crime has increasingly adopted a network approach over the years, enhancing the empirical understanding of the complex structures and dynamics within criminal organizations. The network approach looks at the criminal organization as based on human interactions and relations, allowing to study them as a set of actors and the relations between them (Carrington 2011; von Lampe 2016a). From this perspective, the network model enables to capture “the least common denominator” of organized crime, i.e., social and human relations (McIllwain 1999, 304). Indeed, this approach goes over an aprioristic idea of the social organization of a group and identifies the social relations characterizing a group of individuals using a “bottom-up” approach (Carrington 2011; Calderoni 2018; von Lampe 2009). In the study of organized crime, this type of approach allowed overcome some problems characterizing the traditional models (Calderoni 2018; McIllwain 1999) – the bureaucratic

model, which emphasizes too much the formal structure (Cressey 1969), and the social relations model, which in some cases denied the secret and structured features of organized crime (Albini 1971; Hess 1973). Relations in criminal networks create various social organizations, ranging from autonomous to centralized and hierarchical groups, that can be spotted by looking at individual interactions and collaboration (Calderoni 2018). Despite not being a fully-fledged theory (Morselli 2009b), the network approach highlights the flexibility and dynamism of the world – both legal and illegal – in which organized crime operates (Morselli 2009a), describing different ways of cooperation rather than superimposing one specific model (Kleemans 2014).

1.2. Towards a more flexible understanding of organized crime

The multiple and conflicting conceptualizations of how organized criminal groups structure themselves and operate reflect the difficulty of keeping such a varied and mutable phenomenon under a single umbrella concept (Bouchard and Morselli 2014; Paoli and Vander Beken 2014; Paoli, Greenfield, and Reuter 2009). In addition, it also mirrors the fact that traditional conceptualizations have often reflected political agendas and public narratives on crime, shaping how organized crime was defined and studied (Fijnaut and Paoli 2004; Kleemans 2014; Paoli and Vander Beken 2014; Paoli 2002; Woodiwiss 2003).

Over time, the multitude of conceptualizations has led to the rejection of complementary interpretations – *who* vs *what*, formal vs loose – prompting a view of organized criminal groups that acknowledge its flexibility and multifunctionality (Calderoni 2018). The literature has suggested framing organized criminal groups as falling on a continuum from complex, formal hierarchies to simple, small, and flexible entities (Hagan 1983; von Lampe 2009; 2016a). However, as underscored by Catino (2019, 260), “less attention has been paid to the fact that, very often, rather than choices that are dichotomous or positioned along a continuum, [the organizational activity] is often a matter of polar opposites that have to be managed, with the

solution at neither one pole nor the other”.

In illegal environments, actors face several obstacles that prevent them from opting for the theoretically best way of organization (Catino 2019). Criminals operate “against the state”, meaning they are under continuous threat of surveillance and capture by law enforcement agencies aiming to stop their activities. This situation requires a certain level of secrecy and security in conducting their activities. On the other hand, they also operate “without the state”, to which they cannot turn, unlike legal organizations, in case of disputes or problems in the course of their criminal activities (Paoli 2002; Reuter 1983). This condition implies that collaboration in a criminal environment will require high levels of trust. In this context, however, criminals cannot emphasize only the need for security but also need to act and interact with others in order to efficiently carry out their criminal activities (Morselli, Giguère, and Petit 2007).

The management of these constraints thus shapes the formal structure of organized criminal groups, as well as how individuals within these groups operate and cooperate. The strategies adopted to cope with this trade-off enable criminal organizations to adapt to persist and succeed despite operating in illegal and hostile environments. The approaches employed are multiple and intertwined and pertain to various dimensions: operational, involving the management of information flow and interactions; bonding, focusing on the reinforcement of trust; and organizational, related to the structural models adopted. They are subject to a variety of factors, such as the intensity of law enforcement scrutiny, the nature of the activities undertaken, and the social context in which the criminals operate (Bouchard and Ouellet 2011; Bouchard 2020; Calderoni 2018; Morselli 2005; von Lampe 2016a; 2016b). The examination of these strategies facilitates the integration of flexibility, dynamism, and multifunctionality into the conceptualization of organized crime. This approach enables moving beyond stereotypical

definitions and allows for a simultaneous consideration of the *who* and *what*, of the formal organization and the social environment in which these groups are embedded.

1.2.1. Operational strategies: between group benefits and individual advantages

Organized criminal groups strategically manage the flow of information and the interaction among members considering the trade-off between security and efficiency (Morselli 2009b). Criminal groups need to maintain operational efficiency to achieve profits and take part in criminal activities. Efficiency within criminal organizations requires a smooth flow of communication, supported by direct and frequent interactions among members. However, this direct connectivity also increases visibility and vulnerability, exposing individuals to several risks: frequent meetings or phone calls make individuals more easily detectable by law enforcement (Morselli 2009b). Additionally, widespread information sharing increases the number of people aware of illegal activities and the identities of those involved, increasing risks for the overall organization if caught by law enforcement (Catino 2019). Operating in a hostile environment, criminal groups need to operate in a secure manner to protect their members from law enforcement and competitive threats and keep hidden their illicit activities. This requires strict control over the circulation of information, and the reduction of direct and frequent interactions with other individuals, which in turn, however, reduces the ability to efficiently coordinate the activities (Bouchard 2020; Morselli, Giguère, and Petit 2007; Morselli 2009b).

These opposing needs create a natural tension: increasing security often means sacrificing efficiency and vice versa. Between the two, security tends to be favored over efficiency, especially in those organizations with higher resilience and reputation (Calderoni 2018; Erickson 1981; Morselli 2009b). According to Morselli and colleagues (2007), the need to act to fulfill the ultimate goal of the group determines the preference towards security or efficiency.

The authors adopted a network approach and analyzed the operational dynamics of networks by comparing a 9/11 terrorist network with a drug trafficking network. Their study highlighted that the timing required for criminal groups to carry out their activities – the *time to task* – significantly shapes their operational strategies. For instance, profit-driven drug trafficking groups, which rely on quick returns, operate under a compressed timeframe from decision to action – a short *time to task* – to ensure participants receive their expected rewards swiftly. This requires efficient interaction to facilitate rapid operations and minimize the risk of detection. In contrast, ideologically driven groups, such as those planning terrorist acts, focus on a singular, long-term goal which allows them more time to organize the activities prioritizing the secrecy and favoring sparse and indirect connections (Morselli, Giguère, and Petit 2007). Consequently, while their collaboration may be less efficient, they benefit from operating within more secure settings, where indirect and sparse interactions reduce detection risks.

Therefore, decentralized structures of interactions, characterized by the absence of a clear operational core, promote a controlled circulation of information and enhanced security for the individual involved in the activities. However, this lack of centralization can impede operational efficiency by limiting the availability of information and slowing decision-making and internal coordination, which are guaranteed by some degree of centralization (Bouchard 2020; Calderoni 2018; Catino 2019; Morselli, Giguère, and Petit 2007; Morselli 2009b).

At the individual level, members of criminal organizations face the daily challenge of balancing the security-efficiency trade-off through a variety of strategic decisions. The first one is how they decide to communicate and interact with others. Previous studies have underscored how the most important actors of organized criminal groups tend to prefer face-to-face meetings over phone calls, often choosing public venues, such as bars and restaurants, to enhance secrecy and minimize the risk of law enforcement interceptions (Calderoni and Superchi 2019). This

practice is widespread among criminal groups, which often employ cryptic language, code messages, and nicknames to further enhance their security level and guarantee a certain degree of efficient communication (Catino 2014b; Gambetta 2009). The controlled and limited circulation of information through face-to-face interactions is also the reason why criminal groups tend to limit the geographical dimension of their activities (Reuter 1983).

Beyond the communication channels employed, criminals, particularly leaders, cope with the security-efficiency trade-off by avoiding direct involvement in criminal activities while still maintaining control over the flow of information and resources within the group through indirect connectivity. This strategic positioning as a broker (Burt 1992; Morselli 2009a; 2009b) is particularly beneficial, as it minimizes direct and frequent interactions, thereby visibility and risk of detection. At the same time, it allows them to compensate by keeping control over crucial information and resources, maintaining a lower profile and enhancing their operational security. For example, Morselli (2009a) research on the Hells Angels in Quebec demonstrated that interactions within the group were not directly managed by the leaders, the bikers, but rather by individuals with lower status. Conversely, leaders favored indirect mediation, which allowed them to effectively balance security and efficiency and minimize the risk of arrest (Morselli 2010). Similarly, Scaglione (2011) conducted a comparative analysis of the structure and organization of a Cosa Nostra family and a Camorra clan. Here too, those most involved in interactions and collaborations, and thus most visible, were not the highest formally ranked individuals, suggesting a preference of leaders for security.

The individual's ability to control information underscores the intersection of operational advantages and personal ambitions connected to the role of the broker: those who control the information in the criminal group ensure security while broadening their access to new opportunities, resources, and information (Morselli 2005). The type of connections an

individual has may reveal how a person can mobilize resources, share information, and exert influence by exploiting his/her relations (van der Hulst 2009). The sociological literature has underscored how people, groups, organizations, and communities with better access to resources are more successful in their performance (Bourdieu 1986; Coleman 1990; Lin 2001; Putnam 2000; van der Hulst 2009). The success, however, does not only depend on the quantity but also – and especially – on the quality (strength) of relations between individuals (Granovetter 1973; van der Hulst 2009). Redundant and frequent interactions – strong ties – likely ensure access to redundant information and resources. On the other hand, indirect interactions with individuals outside their own group – weak ties – allow access to different resources that may be strategic to achieve goals (Granovetter 1973). Those who can reach these resources are individuals who bridge structural holes, i.e., “relationship of non-redundancy between two contacts” (Burt 1992, 65). These individuals are brokers that connect individuals and social groups otherwise disconnected and can strategically manage the flow of information and resources leveraging the information asymmetry. According to Burt (2007), individual and group success is determined by the ability to balance brokerage and closure, i.e. the relations characterized by strong interconnection and high redundancy of information that reinforce cohesion and trust between individuals.

In criminal contexts, strategic positioning is even more relevant than in legal ones (Calderoni 2018). Indeed, “criminal networks are not simply social networks operating in criminal contexts. The covert settings that surround them call for specific interactions and relational features within and beyond the network” (Morselli 2009b, 8). However, strategic positioning is not always easily achievable in criminal environments, and the individuals controlling the flow of information and resources are often the ones frequently interacting with other actors (Morselli 2009b; Morselli, Giguère, and Petit 2007). For example, Calderoni and Superchi (2019) found that leaders in the ‘Ndrangheta, when involved in internal management activities,

act as intermediaries, but are also the ones strongly interacting within the organization. The symbolic role the leaders hold within the organization significantly constrains their ability to withdraw from direct engagement, making them unable to exclusively privilege indirect and strategic interactions. To balance their need to act efficiently and reduce the risk of being detected, leaders strategically select more secure methods of interactions, avoiding phone calls and favoring meetings in public spaces (Calderoni and Superchi 2019). Therefore, an integration of strategies.

For individuals, just as for the group, strategic positioning varies in nature according to the activities conducted. When the activities involve high risk and demand greater efficiency, key members of the group may choose to distance themselves from direct operational roles. This detachment allows them to manage risks more effectively while maintaining oversight. Calderoni (2012) observed that, when involved in drug trafficking, ‘Ndrangheta leaders maintain low direct and indirect connections, not being directly involved in illicit activities. Achieving almost complete detachment, however, is challenging and depends heavily on having strong trust in the individuals who carry out these operational activities. According to the author, the ‘Ndrangheta offers a peculiar social structure, where criminal cooperation is embedded in multiple social relations of kinship, rituals, and secrecy that increase trust among members (Albini 1971; Blok 1974; Hess 1973; Ianni and Reuss-Ianni 1972; Kleemans and Van de Bunt 1999). Such structure allows leaders to delegate control of illicit activities and privilege their security, making the organization more efficient and flexible when participating in illegal market activities (Calderoni 2012; 2018; Paoli 2002).

In general terms, criminal organizations tend to rely on the social environment, rituals, symbols, and other associational criminal structures (von Lampe 2016b) to reinforce trust, facilitate cooperation, and effectively manage the trade-off between security and efficiency. In the

context of organized crime, where activities are inherently risky and illegal, trust becomes crucial for ensuring security. Members must rely on one another to keep operations secret, protect against external threats, and prevent internal betrayals. Trust, in this sense, mitigates the need for excessive oversight that can slow down operations, impacting operational efficiency by enabling faster decision-making processes. Multiple bonding strategies are therefore adopted by organized criminal groups to reinforce trust.

1.2.2. Bonding strategies: how to build trust

Operational strategies are often interrelated with bonding strategies to reinforce connections. As in any organization, criminals do not collaborate with one another either by chance or by the only need to retrieve resources, and co-association in an organized criminal group does not necessarily imply collaboration (van Koppen 2013; von Lampe 2016b; Wood 2016). Unlike in normal organizations, criminals operate in risky environments that make cooperation more difficult (Campana and Varese 2013; van Koppen 2013; von Lampe and Ole Johansen 2004; Paoli 2002). For this reason, trust and reciprocity become key factors for the development of criminal relationships (Erickson 1981; van der Hulst 2009; van Koppen 2013; von Lampe and Ole Johansen 2004; Robins 2009). In the study of organized crime “it has become a truism to say that what holds “organized criminals” together are bonds of trust” (von Lampe and Ole Johansen 2004, 160). However, the crucial dilemma for criminals is to balance their need to access new resources and information, through weak ties, and the need for trusted collaborations to ensure secrecy, which usually are generated through strong ties (van der Hulst 2009; Granovetter 1973).

Social environment

A first bonding strategy in the criminal environment involves embedding criminal relationships within a broader social context (Granovetter 1985; Kleemans and Van de Bunt 1999; Van de

Bunt, Siegel, and Zaitch 2014). Crime and social environments may be more interrelated than other relations due to the need for trust (Bouchard 2020; C. M. Smith and Papachristos 2016; Della Posta 2017; von Lampe and Ole Johansen 2004). According to Hobbs, “[s]erious crime should be understood in terms of interlocking networks which are [...] expressed as amalgams of family, neighborhood, region, nationality, and which merge with purely instrumental commercial coalitions” (2013, 103). Indeed, individuals belonging to organized criminal groups are embedded within multiple social relations (Diviák, Dijkstra, and Snijders 2019; Kleemans and Van de Bunt 1999; Papachristos and Smith 2013). In illegal settings, the multiplexity² of these relations compensates for the lack of formal institutions, since multiple ties tend to be strong ties, fostering trust, reciprocity, and responsibility (Kadushin 2012; Papachristos and Smith 2013; von Lampe and Ole Johansen 2004). Von Lampe (2016b) defines these relations as associational criminal structures, affectionate ties that indirectly contribute to crime by facilitating collaboration. The building blocks of these structures are mainly pre-existing ties, namely kinship, friendship, and community relationships (Diviák, Dijkstra, and Snijders 2019; von Lampe 2016b).

In the study of organized crime, especially mafia associations and other large criminal organizations, particular attention has been given to the role of kinship (Blok 1974; Hess 1973; Ianni and Reuss-Ianni 1972). Anthony Giddens (1990, 10) argues that “kinspeople can usually be relied upon to meet a range of obligations more or less regardless of whether they feel personally sympathetic towards specific individuals involved”. As highlighted by von Lampe

² The concept of multiplexity refers to the number of existing relations between two individuals (Kadushin 2012). For example, two individuals may be friends and co-worker at the same time.

and Ole Johansen (2004), trust among family members generates from individualized trust³, emerging from continuous interaction, and generalized trust⁴, based on the sharing of norms and values. Campana and Varese (2013) argue that kinship in organized crime groups also acts as a form of hostage-taking: “if a member feels disgruntled with the organization and wishes to defect, he will put his entire family at risk” (Campana and Varese 2013, 270). There are several examples of partial or complete overlapping of criminal and kinship structures in organized crime (von Lampe 2016a). Among them, the most relevant are fraternal associations whose members are mainly of the same blood family, such as the Calabrian mafia ‘Ndrangheta (Paoli 2003). These structures are particularly able to ensure secrecy, being resilient to law enforcement infiltration. This is highlighted for example by the low number of *pentiti* among members of ‘Ndrangheta: “the greater the number of blood ties, the less willingness there is to collaborate [with law enforcement]” (Catino 2019, 306).

Considering the importance of kinship in ensuring trust, several scholars have investigated the impact of these relationships on collaboration within criminal organizations, with a focus on mafias. Campana and Varese (2013) studied the role of kinship and shared information on acts of violence in explaining the cooperation among individuals of two criminal groups, a Russian mafia group based in Rome, and the La Torre Camorra clan. The authors found that the

³ Individualized trust occurs when “the expectation of agreeable behavior relates specifically to the trustee as an individual” (von Lampe and Ole Johansen 2004, 169). This type of trust may lie on characteristics of the trustee, on his/her previous behavior, and on the expectations of how he or she will behave in the future.

⁴ Generalized trust arises when “trust is linked to social groups rather than to a particular individual. The trustor places trust in the trustee based on the presumption that the trustee conforms to some more general norms or patterns of behavior” (von Lampe and Ole Johansen 2004, 170).

likelihood of cooperation is higher among members who have shared information about violent acts and also among those who share kinship ties, even if the latter has a weaker effect. Campana and Varese suggest that when non-kinship-based mechanisms fostering cooperation exist, criminal groups will prefer them. Analyzing the impact of the arrests of key players on the structure of a drug trafficking network, Berlusconi (2021) found that sharing kinship ties was associated with criminal collaboration in all the investigative phases, and also after the arrests, suggesting that these relations play a crucial role in reducing uncertainty and increasing trust and security. Mastrobuoni and Patacchini (2012) analyzed the structure and composition of criminal relations between members of American Cosa Nostra, finding that family ties lower the risk of defection, increasing the number of connections. In addition, the authors found support for the use of strategic endogamy, highlighting the role of women in bridging families already closely connected. Catino and colleagues (2022) also investigated interfamily marriage through an exploratory analysis of the strategic use of interfamily marriages within 'Ndrangheta. The analysis found that some families are tied by multiple marriages, highlighting the existence of cohesive subgroups of families in the network of interfamily marriages. These findings on the strategic use of marriages are particularly relevant to understanding how criminal organizations cope with an original absence of trust (von Lampe and Ole Johansen 2004).

Along with these studies, contrasting perspectives on the role of kinship ties coexist in the literature (von Lampe and Ole Johansen 2004). Analyzing Cosa Nostra groups, Pino Arlacchi (1986) highlighted that family and brotherhood relations are more frequently characterized by mutual conflict than cooperation and solidarity. As stressed by Catino (2019), blood ties can favor the creation of factions, especially in case of critical decisions. Similarly, von Lampe (2016a) and Paoli (2002; 2003) highlighted the little relevance of actual blood ties among associates, stressing on the other hand the importance of kin-like bonds generated through

rituals and initial ceremonies.

Rituals, membership, and rules

A ritual is “a predictable and regular observance of some act or procedure, which as a symbolic element resulting in the inculcation or reinforcement of shared values and beliefs” (Coyne and Mathers 2011, 74). Mafias and other criminal organizations, such as outlaw motorcycle gangs, rely on rituals of affiliations, codes, and rules as bonding strategies to strengthen their internal cohesion and cope with a lack of trust (Skarbek and Wang 2015).

Rituals in criminal organizations play a crucial role in establishing common knowledge about a group’s governance rules (Chwe 1998; 2013; Skarbek and Wang 2015). This common knowledge ensures that members are aware of the rules, understand that everyone else is aware, and recognize that this awareness is mutual, facilitating coordination and cooperation within the group (Skarbek and Wang 2015). Additionally, rituals contribute to shaping a member’s identity, aligning individual actions with the group’s norms, and enhancing cooperation (Paoli 2003; Skarbek and Wang 2015).

Among these rituals, the affiliation ritual is likely the most relevant and symbolic one and frequently characterizes mafia associations. According to Paoli (2003), it is not the actual kinship ties, but rather fictitious kinship relationships formed through fraternization rituals that create cohesive and secure clans within mafias. Membership rituals represent a new beginning for the individual, constructing identities through interdependencies within the group and setting the boundaries between members and outsiders (Skarbek and Wang 2015). These rituals create common knowledge and “generalized reciprocity”, generating unconditional trust and solidarity among members of the same group (Paoli 2003). Beyond the initiation rituals, other events also represent symbolic value. In criminal organizations, parties, meetings, and

promotions of new members represent aggregation rituals that reinforce the common sentiments of the organization and strengthen the ties among members (Catino 2019; Hill 2014). Hells Angels' local units, called chapters, hold their club meetings in locations that are clubhouses, which have a strong symbolic value for the biker life and represent the vitality and persistence of the club. In addition, full members have obligatory weekly “church meetings” to attend (von Lampe and Blokland 2020).

More structured organized criminal groups frequently employ a code of conduct based on shared behavioral rules to enhance trust and cooperation among members (Catino 2014b; 2015; 2019; von Lampe 2016b). Rules mainly aim to facilitate cooperation, reduce conflicts, and maintain secrecy. According to Von Lampe (2016b), the enforcement of these norms has two-fold purposes: protecting the organizational structure and, when present, the interests of its leadership, and making interactions among members more predictable, thus simplifying the complexities they face in their illicit activities. Rules may relate to how decisions are taken within the organization or how individuals should behave (Catino 2019; Skarbek and Wang 2015). In this respect, mafias and other structured criminal organizations frequently set rules on how members should behave honorably, thus maintaining and enhancing the reputation of the group (Catino 2014b; Gambetta 1992; Paoli 2003). Moreover, criminals often enforce a code of silence and prohibit cooperation with law enforcement, a principle that in the mafia culture is known as *omertà*. This code extends beyond mere non-cooperation, emphasizing a broader set of behaviors that requires honor, discretion, and loyalty among members (Catino 2015; Ciconte 2014; Paoli 2003; von Lampe 2016b).

Rituals, membership, and rules build associational criminal structures (von Lampe 2016b) that generate what von Lampe and Ole Johansen (2004) describe as trust based on generalizations. Individuals within the group, and more broadly, the criminal organization, are expected to

adhere to established codes and rules. This adherence makes their behavior predictable and ensures alignment with a consistent set of shared values and rules (von Lampe and Ole Johansen 2004), which, in turn, reduces uncertainty among members (Catino 2019).

Shared attributes

Shared characteristics and experiences also contribute to building common bonds that may reinforce trust between two individuals, facilitating cooperation in the criminal environment (Berlusconi 2021; Grund and Densley 2015; von Lampe 2016b). The tendency to form relationships with others who are similar is known as homophily (Mcpherson, Smith-Lovin, and Cook 2001). In criminology, especially but not exclusively, the literature on co-offending widely investigated the role and extent of homophily within criminal groups considering different attributes: among them, ethnicity, nationality, age, gender, operational task (Reiss 1988; Reiss and Farrington 1991; Mastrigt and Carrington 2014; Carrington 2015; Grund and Densley 2015; Bright, Koskinen, and Malm 2019; Campana and Varese 2022). Several authors have found that sharing some features makes collaboration easier reinforcing trust among individuals (Campana and Varese 2022).

The likelihood of forming connections increases when individuals live nearby and share daily activities. This tendency leads to the clustering of people based on factors including geographical proximity, educational background, age, ethnicity, and other characteristics (Kleemans 2013; 2014). Habitual connections generate trust through the creation of affectionate relations and a growing sense of forecasting of the other's conduct (von Lampe 2016b; von Lampe and Ole Johansen 2004). Shared ethnicity is a mechanism that favors cooperation, making it easier to monitor and thus sanction those who engage in opportunistic behaviors (Campana and Varese, 2013). Also shared nationality, gender and age might increase the likelihood of collaboration. As explained by Campana and Varese (2022, 8): "By having shared

similar experiences in the past as a function of having the same age and/or gender, two actors might be more inclined to work together than two actors who come from extremely different personal backgrounds”.

What was presented in these pages is a non-exhaustive overview of the most relevant factors that foster trust among individuals within organized criminal groups, with particular attention given to well-established criminal organizations. Alongside operational and trust-building strategies organized criminal groups also employ organizational strategies to balance the trade-off between security and efficiency.

1.2.3. Organizational strategies: small – or compartmentalized – is beautiful

The constraints characterizing the environment where organized criminal groups operate influence the organizational formulas adopted. Empirical research has confirmed that small and transient criminal groups are the most frequent configuration of organized crime (Bouchard and Morselli 2014). Their flexible structure is more suitable to the dynamism characterizing the illegal markets, making them more efficient. In addition, the small, often clustered nature of these groups makes it easier to maintain the secrecy required, with easier control of the flow of information within the group, and a low and trusted number of members, while ensuring a high level of efficiency (Bouchard and Morselli 2014; Catino 2019; Reuter 1983).

Despite being the exceptions (Paoli 2002), large criminal organizations also exist and persist in the criminal environment, with mafias being the clearest example. These organizations, far from being the bureaucratic organizations described by the bureaucratic approach, adhere to the necessity of remaining small to medium-size with decentralized operations by adopting a clan organizational formula usually built on personal bases (Catino 2019; Paoli 2002). Indeed, the clan form “[...] makes it possible to minimize goal incongruence and tolerate the high level of

ambiguity in performance evaluation” typical of mafias and organized crime (Catino 2019, 131).

The need for security and control over the flow of information favors compartmentation (Duijn, Kashirin, and Slood 2014). As explained by Catino (2019, 268): “This is an organizational strategy to manage secrecy and is based on the breaking down of information by allocating knowledge, and the activities related to it, to various units, individuals, and/or organizations, making it difficult for one subject, whether internal or external, to form an idea of the picture as a whole”. This separation of information and activities makes clan-based organizations more secure against investigative activity. Individuals beyond those who coordinate between the cells – acting as brokers – rarely have information and a clear idea of who is involved, and in what activities. This situation makes the organization potentially highly resilient, as the damage produced by possible collaborators is minimal, with local effects (Williams 2001).

A clan-based structure is particularly adaptable to different environments. Despite the presence of high-level bodies of coordination, especially in mafia-type organizations, clans are largely autonomous in carrying out illegal activities (Catino 2019; von Lampe and Blokland 2020). This structure, while allowing great control over the information flow, makes these criminal organizations flexible when engaging in illegal markets (Paoli 2020). Clans, indeed, are usually embedded in multiple and strong social relations based on kinship, rituals, and shared affiliation that “favor the pooling of material and human resources for the achievement of common aims” (Paoli 2002, 80). This is the case mentioned before on the involvement of ‘Ndrangheta in drug trafficking: the clannish formula, based on trusted, strong relationships, allows leaders to stay detached and ensure a high level of security for the organization (Calderoni 2012).

Although large criminal organizations often adopt a clan-based structure comprising a formal subdivision into subgroups to balance their needs for secrecy and efficiency, there is limited

information on how collaboration occurs beyond the boundaries of the single subgroup. More broadly, the study of organized crime groups has rarely addressed the dynamics of collaboration with external groups (Coutinho et al. 2020). However, these entities operate within a context involving multiple actors and groups, and the challenges they face and how they address them also depend on this broader environment. This is particularly relevant for understanding large criminal organizations, where the collaboration and coexistence of multiple groups determine the functioning of the criminal organization as a whole (Calderoni, Brunetto, and Piccardi 2017).

1.3. Collaboration *beyond* the group's boundaries

In the criminal environment, the heavy reliance on trust, and therefore on strong and pre-existing ties, may suggest that criminals tend to collaborate primarily within their own group rather than with individuals from other criminal factions (Della Posta 2017; Erickson 1981). This is due to the riskiness and difficulties in identifying trusted people outside the group and collaborating with them. For this reason, one may expect that in a context characterized by the presence of multiple groups, individuals will prefer intra-group connections, highlighting a strong social closure (Burt 2007; Della Posta 2017). However, collaboration between groups does occur, both among groups part of the same large criminal organization and among different organized criminal groups (Coutinho et al. 2020).

The scant research on organized criminal groups at the *meso*-level, i.e., considering the interaction beyond the group boundaries, is mainly due to the unavailability of data on the interactions among more than one criminal group (Paquet-Clouston and Bouchard 2022; Calderoni, Brunetto, and Piccardi 2017). However, a few studies investigated how collaboration occurs in clan-based criminal organizations and the factors facilitating it despite the inherent constraints.

Part of the available studies have focused on co-offending in Outlaw Motorcycle Gangs (OMCGs) as their primary unit of analysis. Adopting a descriptive approach, Rostami and Mondani (2019) analyzed the co-offending and offence-type patterns of three Swedish OMCGs. They found that co-offending within the same club was rare, with most collaborations involving non-members. However, when co-offending did occur within the club, individuals tended to collaborate with members of the same chapter⁵ reflecting the territorial-based organizational structure.

Using inferential methods, Coutinho and colleagues (2020) examined the impact of co-location, group type and market overlap on cross-group collaboration among various types of criminal groups in Canada engaged in different criminal activities. Their study compared groups within a large criminal organization – specifically, OMCGs – with independent criminal groups. The findings underscore that less structured groups are less likely to collaborate when operating in the same location. On the contrary, OMCG clubs demonstrated a greater propensity to establish interpersonal collaborative ties across groups. According to the authors, these groups benefit from clear hierarchical structures and established communication channels, which enhance coordination and operational efficiency. A strong shared identity and culture foster loyalty and mutual support among members, while formal conflict resolution mechanisms ensure that disputes are managed effectively within the group (Coutinho et al. 2020). Bright and colleagues (2024) further studied co-offending in Australian OMCGs, finding that criminal collaboration was more likely to occur between members within the same club or chapter. This initial result might appear in contrast with previous findings. However, when analyzing crime types, they

⁵ In OMCGs, chapters are regional groups of up to 30 members, largely independent but operating under the guidance of the national club (Bright and Deegan 2021).

observed that OMCG affiliates were more likely to co-offend with members of the same club for violence/intimidation and public offences, while no significant effect was detected for crimes in illicit markets, those committed for short-term material gain, or other offences against individuals. In line with Coutinho et al. (2020), the authors suggest that, in cases of financial profit, affiliates may be more inclined and able to organize collaborations with members from different clubs.

The extent of inter-group collaboration was also explored by Della Posta in a series of studies on the American Cosa Nostra. Using data from a detailed dossier of the Bureau of Narcotics, Della Posta (2017) reconstructed and analyzed the criminal collaboration of members belonging to twenty-four American Cosa Nostra families. He found that the social structure of the American mafia was characterized by a strong internal cohesion within the families, in which there was a strong connection among mafiosi, with few strategic connections across families, reflecting *small-world*⁶ properties. A follow-up study by Della Posta (2023) identified two distinct types of brokers within these mafia families: marginal members with insecure positions within the group hierarchy and high-status members with well-established roles. Marginal members exploited brokerage roles as a strategic way to enhance their influence and strengthen their status within the organization. Conversely, high-status members leveraged their secure positions and the trust of their group to access and bridge resources, information, and strategic alliances across groups.

⁶ In small-world networks, most actors are not directly connected to one another, but most of them can be reached from every other individual by a small number of steps (Watts and Strogatz 1998).

Similarly, Battisti and colleagues (2022) employed spatial network analysis to explore collaboration in Cosa Nostra, considering its internal subdivision in *Mandamenti*, key territorial units where Mafia families operate. In line with DellaPosta (2017), the study uncovers a high density of intra-*Mandamento* interactions, while also revealing important inter-*Mandamento* connections that facilitate the overall functioning of the organization. These inter-group relationships are critical, showing that despite strong local ties, the need for broader coordination among different *Mandamenti* underpins the mafia's operational success (Battisti, Lavezzi, and Musotto 2022). Yet, the study does not identify the specific individuals responsible for facilitating these crucial connections across *Mandamenti*. Specific attention to the role of brokers among groups was previously paid by Calderoni and colleagues (2017), who employed community detection techniques to examine the interactions within and between subgroups of the 'Ndrangheta. Their findings revealed a strong collaboration among subgroups, mediated primarily by individuals in leadership roles. These leaders acted as brokers at both the individual and community levels, maintaining strong connectivity within their own subgroups while managing resources and the flow of information from the other subgroups.

Additional studies paid greater attention to the factors driving collaboration in groups within Cosa Nostra and American Cosa Nostra. Krajewski and colleagues (2022) analyzed the collaboration patterns among 24 families of American Cosa Nostra, using the same data as Della Posta (2017; 2023), but with a focus on how formal hierarchical structures influence these patterns. Their findings challenged the traditional view of hierarchical organization, showing that mafia members typically established collaborative ties with peers who have similar levels of interactions rather than with those across different hierarchical levels. This suggests that despite the presence of formal ranks, criminal interactions within the Mafia tend toward a more "flat," egalitarian structure, where criminals partner with others who share similar degrees of influence and connectivity, essentially bypassing the formal structure. Moreover, the study

highlighted the significant role of kinship, shared family membership, and geographical proximity in fostering criminal collaborations. These factors considerably increased the likelihood of associations between members, underscoring the importance of personal and familial bonds in the mafia's social structure (Krajewski, DellaPosta, and Felmlee 2022). The role of kinship was further investigated by Tumminello and colleagues (2021) in a study on Cosa Nostra. Specifically, the authors explored how syndicates, defined by distinct geographical territories, collaborate. They found that while blood and marriage relationships weakly characterize the connections within mafia syndicates, they become prevalent in connecting different syndicates together. Notably, the research highlighted that, despite the predominance of males in the analyzed groups, females often served as crucial connectors between syndicates, underscoring the role of interfamily marriages in sealing alliances and ensuring cohesion in the broader organization.

This brief review of the available studies highlights that the analysis of formal groups of criminal organizations can provide new insights into the collaborative dynamics and the strategies adopted beyond the group's boundaries. However, some limitations are identified in the current status of the research. Most of the reviewed studies analyzed Cosa Nostra and American Cosa Nostra (Battisti, Lavezzi, and Musotto 2022; Krajewski, DellaPosta, and Felmlee 2022; Tumminello et al. 2021; Della Posta 2017) or Outlaw Motorcycle Gangs (Bright et al. 2024; Coutinho et al. 2020; Rostami and Mondani 2019), overlooking other types of criminal organizations. On the other hand, the studies analyzing different organizations, such as Calderoni et al (2017) with 'Ndrangheta subgroups, did not examine the real boundaries of subgroups but reconstructed them using community detection techniques. Although the valuable insights of studying communities in criminal networks (Paquet-Clouston and Bouchard 2022), we should look at the real boundaries of membership for a better understanding of the internal structure and dynamics of criminal organizations. Indeed, as

stressed by Bouchard (2020, 445), “A boundary may exist in the data, but not in the mind of the individuals involved”.

1.4. Problem formulation and research questions

Collaboration among individuals is a fundamental feature of crime that is defined as organized (Bouchard 2020; Coutinho et al. 2020; van Koppen 2013). Since the first conceptualizations of organized crime, researchers have investigated how individuals come to interact with each other to commit crimes, and how it affects – or is affected – by the structure and activity conducted by the organization itself (Kleemans 2014). The application of new methods and conceptualization in the study of organized crime has significantly advanced our understanding of criminal organizations by providing new tools to examine the relationships among criminals and the strategies adopted to survive and succeed in the criminal, hostile environment. Despite the proliferation of research in recent years, most studies have predominantly focused on collaborations within the same criminal group. This limitation, primarily due to challenges in gathering reliable data, has led to a neglect of inter-group dynamics and collaborations from a *meso* perspective (Calderoni, Brunetto, and Piccardi 2017; Duijn 2016). Nonetheless, organizational, bonding, and operational strategies strongly depend on the environment in which organized criminal groups operate, which is also composed of other entities. This is particularly relevant for those criminal organizations that adopt a clan-based structure.

As discussed in Section 1.2.3, subgroups are a natural and frequent occurrence in criminal organizations, especially in the case of large criminal entities (Calderoni, Brunetto, and Piccardi 2017). According to the literature (see Bouchard and Morselli 2014), the best organizational structure for criminal organizations is the small- or medium-size one, characterized by a decentralization based on mutual understanding and agreements on relatively few operating procedures (Catino 2019). In order to reduce problems of coordination, control, and trust, and

to maximize the share of objectives, criminal organizations tend to adopt a structure based on clans usually built on personal bases (Catino 2019; Paoli 2002).

The major large criminal organizations, like mafias, are all characterized by a structure divided into formal groups: Cosa Nostra has *families* and *mandamenti*, 'Ndrangheta has *'ndrine* and *locali*, Yakuza has *ikka*, the Triads has *Triad societies*, the Russian Mafia has *brigades* (Catino, 2019). Despite the presence of high-level bodies of coordination in some of these organizations, aiming at the coordination among parties, the ultimate power of mafias stems from the single clans, and segmentation is the prevalent form of organization since it guarantees maximization of secrecy (Catino 2019; Paoli 2003).

The presence of formal subgroups is not a trait of mafia-type organizations only, and less structured criminal organizations similarly exhibit formal internal subdivisions. For instance: Camorra, divided in *clans*, which traditionally has been considered a mafia-type organization, but that nowadays several scholars no longer categorize as a unified organization comparable to other mafias (Paoli 2020; Reuter and Paoli 2020; Catino 2019); Outlaw Motorcycle gangs, whose basic units are *chapters*, which are local units with a formal internal organization that cooperate and coordinate with each other, also at the regional, national, and international level (von Lampe and Blokland 2020); Latin gangs, such as the Mara Salvatrucha-13, which is internally divided into *clicas*, autonomous units that control territory and that cooperate with each other, forming supra-level organizational structures called *programas* (Fuentes 2019).

As discussed, clan-based structures are frequently employed by mafias and other criminal organizations to balance the need for security with the need for efficiency, by compartmentalizing information and activities and making the organization more adaptable and less constrained by formal structures in illegal market operations (Catino 2014b; 2019; Paoli 2002; 2003). From a formal organizational perspective, this clan-based structure meets specific

needs and has strong internal significance for certain criminal organizations, which replicate these structures identically in different locations. For instance, the ‘Ndrangheta *locali*, formal subgroups defined by territorial boundaries and formed by multiple *‘ndrine*, are reproduced with the same structure not only in Calabria, the ‘Ndrangheta region of origin, but also in other areas of settlement, including Northern Italy and abroad (Calderoni et al. 2016; Ciconte 2014; Sciarrone and Storti 2014; Sciarrone 2014; Sergi and Lavorgna 2016b). However, the alignment of operational and bonding strategies, i.e., how individuals come to interact and cooperate, with the formal structure and subdivision remains unclear and understudied. Key questions remain: whether and how these groups collaborate, who the individuals mediating these exchanges are, and what factors strengthen trust in this environment.

Secrecy concerns in criminal organizations extend beyond merely evading law enforcement. Within large organizations, extensive communication between subgroups also poses a risk to operations (Catino 2014b). In addition, operating in hostile environments (Paoli 2002), criminals tend to rely on strong, pre-existing ties that guarantee trust (Kleemans and Van de Bunt 1999; von Lampe 2016b). For these reasons, individuals are expected to collaborate primarily within their own group, rather than across groups (Della Posta 2017; Erickson 1981). Nonetheless, there are several reasons why individuals need to interact externally, both for their security and the efficiency of their activities. First, while criminal groups may have decision-making autonomy in large criminal organizations, they often lack operational independence. These groups need to gain resources not available within their own boundaries to sustain their operations. Consequently, they have to interact with other actors and organizations to gain and secure personnel, information, and other strategic resources (Catino 2019). In addition, being part of a large criminal organization requires a certain degree of coordination among units and their operations. The need for external interactions also pertains to reputational concerns. Excessive secrecy of activities within the organization and restricted information flow can

negatively impact credibility and reputation maintenance. This could diminish the symbolic value of the criminal activities carried out, which is crucial for the group's power, and potentially undermine territorial control (Catino 2014b; Kleemans 2013; Sciarrone 1998b).

Therefore, subgroups in criminal organizations must balance secrecy (internal and external) with the need for cooperation and external visibility, functional to reputation, territorial control, and operations of the overall criminal organization. As discussed, the control over the information flow and resources, as well as the connection with other social groups, is closely linked to the figure of the broker (Burt 1992). Although the role of brokers in organized crime groups has been intensively studied, only a few studies have taken into account the inter-group dimension, considering brokers as people through which otherwise unconnected groups can collaborate (Della Posta 2023; Paquet-Clouston and Bouchard 2022). However, the inter-group dimension is a crucial aspect of the conceptualization of brokers and the meaning of weak ties, as non-redundant ties that connect individuals from different social groups (Burt, 1992; Granovetter 1973). According to Burt (2007), individuals who can effectively balance brokerage among various groups with closure, defined as strong internal connections within their own groups, are typically more successful and provide more advantages. Understanding who mediates external interactions is crucial in clan-based criminal organizations. These individuals exercise control over resources and hold the power to coordinate and mediate with other groups, thereby facilitating integration among groups within a context of extensive autonomy. They are strategic individuals through which the formal compartmentalization of the organization works.

Another open question related to the study of clan-based criminal organizations concerns the factors that enable effective collaboration, i.e., the bonding strategies. Indeed, subgroups within large criminal organizations need to cooperate and interact, and these dynamics are decisive for the activities and existence of the whole criminal organization (Calderoni, Brunetto, and Piccardi 2017; Catino 2019). However, belonging to the same criminal organization does not entirely explain how members from distinct subgroups come to collaborate (von Lampe 2016b; Wood 2016). Shared membership within the same criminal entity may facilitate and foster trust compared to cooperation with external actors; however, it is not the sole factor. Indeed, evidence indicates that interactions among subgroups often manifest not as collaborations but as conflicts (Calderoni, Brunetto, and Piccardi 2017; Catino 2019; 2014a).

1.4.1. Current study

This study contributes to the current knowledge of collaboration in clan-based criminal organizations by examining inter-group dynamics within the 'Ndrangheta, a mafia-type criminal organization originating from Italy. As previously mentioned, the 'Ndrangheta is organized into formal subdivisions including *'ndrine*, the basic organizational units, and *locali*, which are composed of multiple *'ndrine* operating in the same territory. The research takes as the unit of analysis the *locali* and their interactions, aiming at answering the following two main research questions and fulfilling the related objectives:

RQ1. To what extent do different *locali* collaborate? Do high-rank individuals mediate this cooperation?

Objective 1: Examine *locali* cohesion and the interconnections among them.

- **Objective 1.1:** Investigating internal cohesion at the *locale* level to assess internal and external collaboration intensity differences.

- **Objective 1.2:** Identifying brokers among *locali* and their association with leadership roles.

RQ2. What factors influence collaboration in the ‘Ndrangheta? Are there differences between intra- and inter-*locali* collaboration?

Objective 2: Assessing the role of kinship in driving collaboration within and across *locali* and comparing it to the role of the formal organizational structure.

Based on the review of the literature and the considerations previously discussed, it is possible to formulate some hypotheses for each of the three objectives.

Regarding **Objective 1.1** (cohesion within *locale* and internal vs external collaboration), the literature points to two contrasting hypotheses. The first hypothesis relies on the fact that cross-group collaboration is expected to be difficult due to a lack of trust (Coutinho et al. 2020). In the criminal environment, which is inherently risky, individuals tend to cooperate on the basis of strong ties, which include those based on pre-existing relations, such as kinship but also shared affiliation to a group (von Lampe 2016b). Due to the preference for relying on strong and trusted ties, and considering the operational role associated with formal subgroups, which are largely autonomous in carrying out most of their illicit activities, the hypothesis posits that members build collaborative relationships mostly within their *locali*, in line with previous studies on mafias (Battisti, Lavezzi, and Musotto 2022; Della Posta 2017).

Conversely, the second hypothesis is based on the evidence that, despite the tendency towards closure and operational cohesion within groups, inter-group collaboration does occur (Coutinho et al. 2020), and needs to be frequent for several reasons. As previously discussed, subgroups must coordinate their activities within the broader criminal organization and rely on external members to acquire strategic information and resources crucial for the successful execution of

their activities (Catino 2019; Sciarrone 1998a). Furthermore, being part of the same large criminal organization may enhance the capacity for interaction through a robust framework of rules and practices, making cooperation easier (Catino 2015; Coutinho et al. 2020; von Lampe 2016b). Therefore, two alternative hypotheses can be posited:

H1a. ‘Ndrangheta *locali* exhibit strong internal cohesion, engaging primarily in intra-*locale* interactions with limited collaboration with other *locali*.

H1b. ‘Ndrangheta *locali* frequently establish collaborative ties with members from other *locali*, indicating strong inter-*locali* interactions.

Concerning **Objective 1.2** (brokerage and leadership), the hypothesis is that individuals holding formal leadership positions within the ‘Ndrangheta act as brokers among groups, controlling the flow of information and resources, in line with previous research (Calderoni, Brunetto, and Piccardi 2017; Della Posta 2023). Being a broker allows individuals to leverage social relations and exploit information asymmetries for strategic advantages (Burt 1992; 2007). Research has found that brokers in criminal groups achieve faster career advancement (Morselli and Tremblay 2004) and have a greater ability to avoid arrests (Baker and Faulkner 1993; Morselli 2010). Further research also indicates that leaders within criminal organizations take on brokerage roles not only at the individual level (Calderoni 2014a; Calderoni and Superchi 2019; Morselli 2009a; 2005), but also across different groups (Calderoni, Brunetto, and Piccardi 2017; Della Posta 2023). In these roles, they manage the flow of information within and between groups, positioning themselves as crucial actors in the communication and coordination structures of their organizations. Therefore, it can be hypothesized that:

H2. There is a positive association between holding formal leadership positions in the ‘Ndrangheta and being a broker among *locali*.

Lastly, **Objective 2** (kinship and formal organizational structure in driving collaboration within and across *locali*) examines the role of kinship in driving collaboration within and across *locali*, comparing it to the role of the formal organizational structure. While the objective is primarily exploratory, some hypotheses can still be formulated.

Research has underscored the role of blood relations in facilitating cooperation by fostering trust (Berlusconi 2021; Blok 1974; Campana and Varese 2013; Catino, Rocchi, and Vittucci Marzetti 2022; Hess 1973; Ianni and Reuss-Ianni 1972; Tumminello et al. 2021). The literature and investigative evidence have highlighted that the structure of the 'Ndrangheta is strongly based on familial ties (Catino, Rocchi, and Vittucci Marzetti 2022; Catino 2019; Paoli 2003; Sergi 2021; Sciarrone 2014). Specifically, the '*ndrine*, which are the basic organizational units of the 'Ndrangheta, primarily recruit on the basis of blood ties and typically bear the surname of the biological family, despite some scholars underscoring clear differences from the biological families of the members (Paoli 2002; 2014a; Sciarrone 2014). Recent studies have also shown that families resort to strategic inter-'*ndrine* marriages to strengthen alliances and foster trust (Catino, Rocchi, and Vittucci Marzetti 2022), suggesting a role of kinship in favoring cooperation beyond the single families and the *locale* boundaries. In this respect, Catino and colleagues (2002) found that the median number of interfamily marriages per 'Ndrangheta family is one, indicating that kinship ties between '*ndrine* are present but remain limited. These ties appear to be primarily symbolic in nature, emphasizing the importance of quality over quantity. In this context, the existence of even a single familial relationship can act as a symbolic foundation for trust and collaboration among members from different groups, even if they do not directly share a familial tie.

Despite existing knowledge, the actual influence of kinship on cooperation remains poorly understood, especially in terms of whether its influence varies within and across *locali*. Based

on these premises, it can be hypothesized that:

H3. Kinship directly strengthens collaboration between members within the same *locale*, while it indirectly fosters cooperation between members of different *locali* if the respective *locali* are connected by at least one kinship relationship.

At the same time, some scholars assert that the bonds of solidarity originating from group membership and affiliation can be stronger than those originating from kinship (von Lampe 2016a; Paoli 2003; 2002). Along with family ties, a strong relevance is indeed posed on the role of the formal structure and internal hierarchy of the ‘Ndrangheta (Catino 2019; Paoli 2003; Sciarrone 2014).

As previously mentioned, a group of *ndrine* active in the same territory forms a *locale*, which has authority over a specific geographical area. The *locali* are formal organizational structures that, upon authorization from other *locali*, can be created by replicating the internal hierarchies and rituals of the ‘Ndrangheta, even beyond its traditional territories (Calderoni et al. 2016; Ciconte 2014; Sciarrone and Storti 2014; Sciarrone 2014; Sergi and Lavorgna 2016b). As formal organizational units, *locali* are characterized by defined roles, hierarchies, and obligations – with related sanctions – underpinned by codified rules of engagement and responsibilities (Catino 2019; Paoli 2003; Sciarrone 2014). These rules make the members’ behavior predictable, reducing uncertainty among members (Catino 2019; von Lampe and Ole Johansen 2004). In addition, rules typically lose their applicability if an individual leaves the *locale*, at which point the former member ceases daily collaboration and no longer participates in internal meetings or activities (Tribunale di Milano 2010).

Shared *locale* membership may influence collaboration not only through formal organizational obligations but also through the affinity stemming from familiarity and shared identity. On the

one hand, repeated social interaction within the group fosters emotional bonds and a sense of predictability that, in turn, reinforces the so-called “individualized trust” (von Lampe and Ole Johansen 2004). On the other hand, the shared membership formalized through rituals creates “generalized reciprocity” with other members, which may facilitate cooperation generating trust and solidarity (Paoli 2003).

Given the importance of these structures for the ‘Ndrangheta and their autonomy in conducting illicit activities, coupled with the solidarity generated through affiliation (Paoli 2003), membership in the same *locale* can be identified as a potential bonding factor facilitating cooperation (von Lampe 2016b). This is consistent with hypothesis *H1a* and previous research (Bright et al. 2024; Krajewski, DellaPosta, and Felmlee 2022). Therefore, it can be hypothesized that:

H4. Shared *locale* membership strengthens collaboration among ‘Ndrangheta members.

Along with the *locale* membership, the formal hierarchical order, replicated identically across *locali*, underscores a strong reliance on formalization and rules, which may shape the way in which individuals cooperate. In the ‘Ndrangheta, coordination among groups is known to be facilitated by high-level bodies of coordination composed of high-status individuals (Catino 2019). However, the operational role of these bodies and the extent to which collaboration across *locali* adheres to this rigid formal structure remain underexplored. The hypothesis that leadership drives collaboration across groups aligns with *H2*, which posits that leaders control the flow of information among *locali*.

Regarding the role of hierarchy in driving collaboration within the same *locale*, existing literature does not provide a clear consensus. On the one hand, there may be a tendency towards rank homophily, given that coordination and decision-making within the *locali* are concentrated

at the top levels of the hierarchy (Catino 2019). On the other hand, this centralization and vertical differentiation (von Lampe 2016a) may require cross-rank cooperation and coordination (Krajewski, DellaPosta, and Felmlee 2022), made evident during internal meetings where members of different ranks meet to align their activities (Catino 2019). In addition, given that most criminal activities are conducted within the *locale*, and are not necessarily centralized around leaders due to security reasons (Calderoni 2012), it can be hypothesized that reliance on the formal hierarchy becomes less rigid in a context where adaptability and flexibility are critical (Paoli 2020). Consequently, it may be posited that holding a formal leadership position is not a decisive factor in fostering cooperation within the same *locale*, as informal dynamics, e.g., based on kinship, and the need for vertical coordination could outweigh formal hierarchical roles in such settings. Building on this, it can be hypothesized that:

H5. Collaboration between members from different *locali* is strengthened when both individuals hold leadership positions. By contrast, formal leadership has no discernible effect on collaboration between members of the same *locale*.

Chapter II. Methodology

This chapter presents the methodological steps employed to address the two research questions and fulfill the objectives of the study. The research design is summarized in Section 2.1, outlining the overall approach adopted in the project. Section 2.2 describes the data, including the case studies used as data sources (Section 2.2.1) and the process of data collection and cleaning (Section 2.2.2). The methods used to carry out the analysis are presented in Section 2.3.

2.1. Research design

The current study adopts an empirical approach to analyze the patterns of collaboration within and across different ‘Ndrangheta *locali*. Specifically, the network perspective is adopted to shed light on these interactions, conceptualizing individuals as nodes embedded in a multitude of relationships – collaborative, kinship, and *locali* ties – often interconnected.

The sources of data consist of judicial documents stemming from three law enforcement operations targeting ‘Ndrangheta *locali* conducted over the past decade: *Crimine*, *Infinito*, and *Minotauro*. Information extracted from these documents was collected and systematized to yield standardized data. These datasets encompass multiple details, including conversations – both in-person and telephonic – charges faced by the defendants, kinship bonds, and a multitude of attributes characterizing the individuals involved, such as demographics, *locali* affiliation, and ranks.

The analytical approach leverages metrics and techniques from network analysis to address the research questions. To answer RQ1, the research begins with a descriptive evaluation of the extent of collaboration within and between *locali*. Brokerage measures that account for group

subdivisions are then applied to identify brokers among *locali*, and their association with leadership positions is analyzed using a series of regression models. To address RQ2, the research adopts a multiplex approach to examine the factors driving collaboration within and across *locali*. By distinguishing and analyzing multiple interdependent network dimensions, the study first conducts a descriptive assessment of the overlap between collaboration and other relations dimensions. Multiple regression models are then employed to test their association and provide insights into the mechanisms underlying collaboration within and among *locali*.

Qualitative analysis is integrated to interpret and contextualize the findings, particularly those related to RQ1 and brokerage. This involved an in-depth, though not systematically structured, reading of pre-trial judicial documents, including wiretaps and law enforcement commentary on events and individuals. Specifically, the review focused on identifying and interpreting information about the most central individuals in the network (i.e., the brokers), examining their roles and social relationships. This enriched the understanding of organizational dynamics and provided insights that complement the quantitative results and inform their discussion.

The following sections will detail the data collection and analysis methods used to meet the research objectives.

2.2. Data

2.2.1. Data sources

The analysis of collaboration between ‘Ndrangheta *locali* relied on secondary data, specifically unique pre-trial court orders of three operations concerning the criminal organization: *Crimine*, *Infinito*, and *Minotauro* operations.

In recent years, data from judicial cases and electronic surveillance have been increasingly employed by scholars to explore the internal structure and dynamics of criminal and terrorist groups (among others, Baradel and Breuer 2024; Berlusconi 2021; Bright, Brewer, and Morselli 2021; Campana and Varese 2012; 2013; Calderoni 2012; 2014a; Calderoni and Superchi 2019; Morselli, Giguère, and Petit 2007; Morselli 2009a; Natarajan 2000; Screen, Bright, and Aziani 2024; Tenti and Morselli 2014). Despite being subject to several limitations (see Discussion chapter), this type of data allows the observation of informal connections among the members of the organization, while avoiding preconceptions about the structure of the group (Berlusconi 2013). In addition, the information retrieved from electronic surveillance can be extremely valuable for research purposes, allowing for the capture of spontaneous conversations, which are usually difficult to gather using other, more standard data collection methods (Campana and Varese 2012).

Pre-trial court orders employed in the analysis provided details regarding the defendants – e.g., name, surname, date and place of birth, residence –, the criminal activities they carried out, and additional information, including details on kinship, useful for judicial purposes and for the general description of the criminal environment. During the investigations, ‘Ndrangheta groups were subjected to many electronic surveillance and telephone wiretaps, providing information on communication among defendants and other people. As highlighted by Judge Giuseppe Minutoli in the first-instance judgment pertaining to the *Crimine* investigation, the information gathered through wiretaps was of such quantity and quality that prosecutors and law enforcement could reconstruct fundamental aspects of the functioning and internal structure of the ‘Ndrangheta. This understanding primarily relied on these sources, with the involvement of collaborators of justice limited to complementing and validating this evidence (Tribunale di Reggio Calabria 2012).

The three case studies were chosen from a broader set of investigations,⁷ looking for judicial cases concerning the involvement of multiple criminal groups belonging to the same criminal organization. The choice to focus on the ‘Ndrangheta and its subgroups to conduct the current study is justified by several reasons.

The ‘Ndrangheta, also known as Honored Society (*Onorata società*), shows a peculiar internal subdivision that makes it suitable for the study of inter-group dynamics (Figure 1). The basic organizational structure is the *‘ndrina*, which consists of a dozen of people mainly members of the same family nucleus that have control over a specific territory or neighborhood (Catino 2014a).⁸ A group of *‘ndrine* operating in the same area can form a *locale* or *società*,⁹ which takes the name of the territory that controls and autonomously exercises power over the area of competence. As highlighted by Operation *Crimine* first and Operation *Rinascita-Scott*¹⁰ then, all *locali* are connected to the *Crimine di Pisci* (also known as *Crimine* or *Provincia*), a higher-

⁷ The database of investigations involving organized crime groups operating in Italy was made available to Transcrime by Public Prosecutors or law enforcement agencies for previous studies or projects awarded by the research center.

⁸ The research is not conducted on the *‘ndrine* due to insufficient information on their structure in the judicial documents, which, in contrast, provide detailed information on the composition at the *locale* level.

⁹ *Locali* are organized based on a double compartmentalization: there is the *società minore* (minor society) and the *società maggiore* (major society), in which importance and seniority are measured in *doti*. Not all *locali* are able to form the *società maggiore*; when it occurs, the *locale* is called *società* (Tribunale di Reggio Calabria 2012).

¹⁰ Operation *Rinascita-Scott* was a large law enforcement operation against the ‘Ndrangheta conducted between 2016 and 2019. It led to the arrest of more than 300 individuals connected to the *locali* settled in the province of Vibo Valentia (Calabria, Italy) and linked to the *Crimine di Pisci* (Tribunale di Catanzaro 2018).

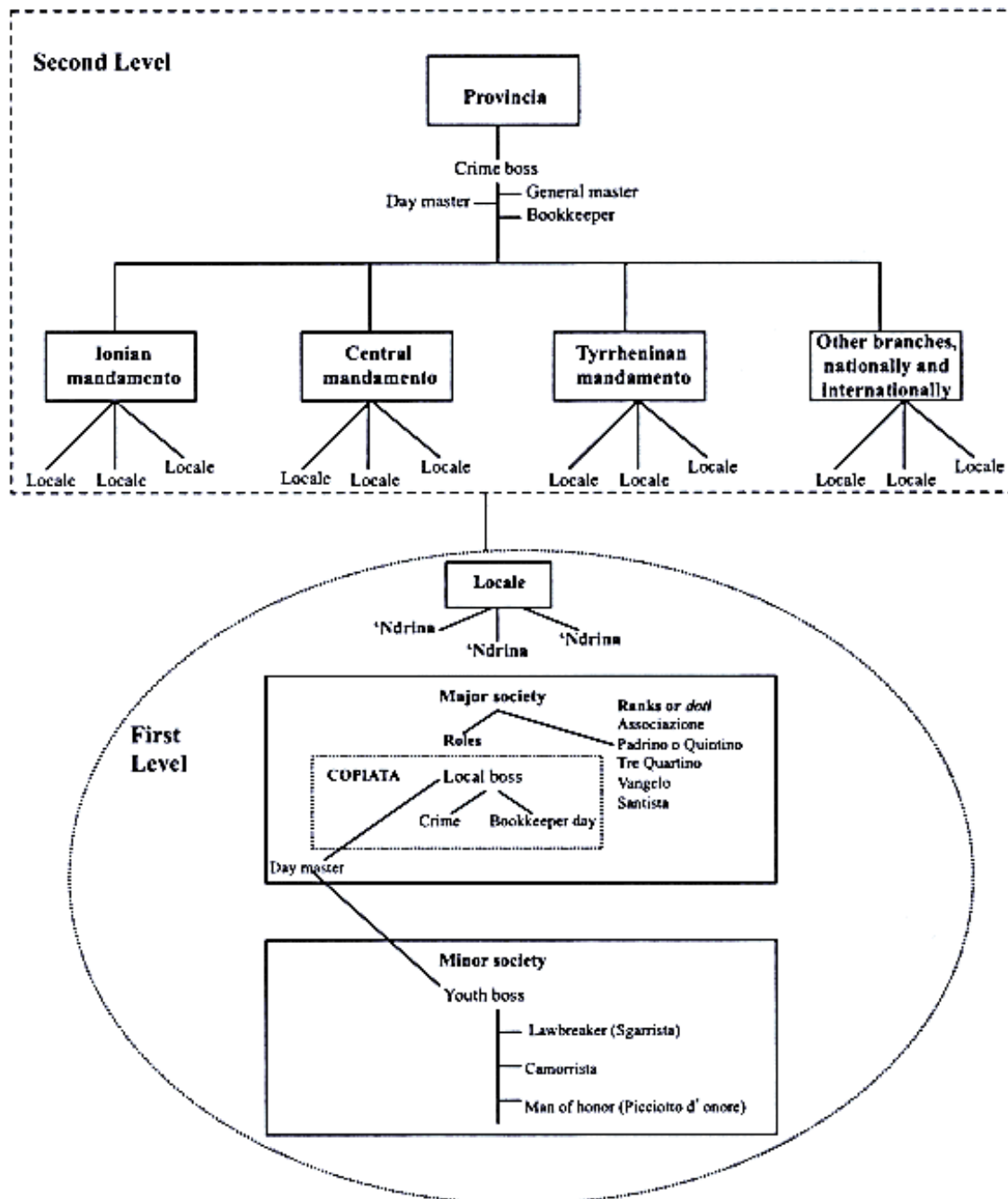
level body of coordination that formally recognizes their formation. Interposed between these two bodies, there are different middle-level structures, such as the *Crimine locale*, the *Camera di Controllo*, and the *Mandamento*, that allow vertical coordination yet avoiding a strict operational and hierarchical dependence of *locali* on the *Crimine* (Tribunale di Catanzaro 2018; Tribunale di Reggio Calabria 2012). Despite a high degree of autonomy, the ‘Ndrangheta is, therefore, a clan-based federation with higher-level bodies of coordination, in which the relations among different *locali* are crucial for the existence of the ‘Ndrangheta as a unitary criminal organization (Sergi 2023b; Catino 2019).

Another peculiarity of this criminal organization lies in the importance often attributed to familial and marital relationships in the description of its formal structure (Catino 2019; Paoli 2003; Sciarrone 1998a; Ciconte 1992). As aforementioned, *‘ndrine* are frequently based on kinship ties and usually take the surname of the family, while connections between different families are fostered by intermarriage (Catino, Rocchi, and Vittucci Marzetti 2022; Sergi 2021; Catino 2019; Paoli 2003). Nonetheless, as Letizia Paoli (2003) highlighted, the *locali* show an internal structure that clearly differs them from the biological families of the members. Despite the emphasis put on the role of family ties within the ‘Ndrangheta, which is often labeled as a fraternal organization (Catino 2019; von Lampe 2016a; Paoli 2003), scarce information, mainly based on single case studies and anecdotal knowledge, is available on the role of kinship as strategic means to foster trust and seal alliances within and beyond the *locale* boundaries (Catino, Rocchi, and Vittucci Marzetti 2022).

The study of the ‘Ndrangheta and its inter-group dynamics is relevant not only for the Italian context but also from a worldwide perspective. This is emphasized by previous investigations involving foreign countries and by the development of international actions for the prevention and counteraction of the ‘Ndrangheta at the global level, such as the project I-CAN of Interpol

(2023). Significant law enforcement operations have brought the ‘Ndrangheta into the global limelight in the past decade, marking a shift from years when media and law enforcement attention was primarily directed towards Sicilian Cosa Nostra (Paoli 1994). Nowadays, the ‘Ndrangheta is acknowledged as the most powerful Italian mafia: the *Direzione Investigativa Antimafia* (DIA) has defined it as the current dominator of the criminal scene, extending its dominion not solely within Calabria, but across Italy overall (DIA 2022a). Beyond Italy, the ‘Ndrangheta is present in five continents, with a strong presence outside Europe especially in Canada, Australia, Latin America, and the United States (Sergi and Lavorgna 2016b; Varese 2011). Outside Calabria, it replicates its organizational structure: groups settled in the North of Italy and foreign countries are indeed organic to the structure of the groups based in Calabria (Calderoni et al. 2016; Catino 2019; Sciarrone and Storti 2014; Sergi and Lavorgna 2016b; Tribunale di Reggio Calabria 2012). The replication of the *locale* structure outside Calabrian territories stresses the value of these organisms for the overall organization while highlighting the relevance of the research on the ‘Ndrangheta and its internal dynamics.

Figure 1: The Internal Structure of the 'Ndrangheta



Source: Catino (2014a, 193)

No other criminal organizations were included in the study for comparisons due to two primary reasons. Certainly, the potential inclusion of multiple case studies encompassing various criminal groups would have implied some considerations about the recurrent presence of certain dynamics across different criminal organizations. However, this would not, in any case, have contributed to guaranteeing external validity to the study – only slightly increasing it – concurrently diminishing the number of cases addressed per each criminal group due to time constraints, thereby weakening the results obtained for the single criminal organization. In addition, no judicial cases concerning other criminal organizations involving multiple groups were easily accessible using the Transcrime database or other potential sources of data.

2.1.2.1 Case studies: *Crimine*, *Infinito*, and *Minotauro* operations

The present study analyzes three long-lasting operations against the 'Ndrangheta that occurred in the first decade of the 2000s in Italy, specifically in Calabria, Lombardy, and Piedmont regions. The three investigations occurred during the same period of time and led all to final judgments (Table 1): *Crimine* was the first to start and led to the opening of two other lines of investigation in the North of Italy. Coordinated by the local anti-Mafia prosecutor's offices with the help of other law enforcement agencies, *Crimine*, *Infinito*, and *Minotauro* operations all aimed at unveiling the internal functioning of the 'Ndrangheta, placing great importance on the structure of *locali* and their members.

Several studies have already analyzed these police operations (see, for example, Calderoni (2014a); Calderoni, Brunetto, and Piccardi (2017); Calderoni and Superchi (2019); Ciccarello (2014); Ciconte (2010); Grassi et al. (2019); Sergi and Lavorgna (2016a)), highlighting the utility of these data in providing relevant information on the internal structure and functioning of the 'Ndrangheta and contributing to multiple advancements in the criminological field.

Table 1: Basic information on Crimine, Infinito, and Minotauro operations

Operation	Date	Length	Region	Suspects charged in the pre-trial court order ¹¹	Final judgment
Crimine	07/13/2010	7 years	Calabria	155	Yes
Infinito	07/13/2010	4 years	Lombardy	160	Yes
Minotauro	05/31/2011	5 years	Piedmont	191	Yes

Case Study 1: *Crimine* Operation

Crimine was a large operation against ‘Ndrangheta groups in the province of Reggio Calabria (Calabria, Italy), conducted by law enforcement in 2010. Involving more than 150 defendants and lasting more than 7 years, the investigation provided information on more than 15 *locali* settled in Calabria and confirmed the presence of the ‘Ndrangheta in Lombardy, Piedmont, and Liguria – giving birth to investigations *Infinito* and *Minotauro* – as well as in Germany, Canada, and Australia. The judgments led to 93 convictions in the first-degree trial with the abbreviated procedure and 102 convictions confirmed in the second-degree trial (Binelli 2012; Lametino 2012; Quicosenza 2014). The investigation of a multitude of *locali* makes *Crimine* a suitable case study for the analysis of cross-group collaboration. The data employed in the analysis has been retrieved from the pre-trial court order (Tribunale di Reggio Calabria 2010) and the first-instance judgment (Tribunale di Reggio Calabria 2012).

Case Study 2: *Infinito* Operation

Infinito was a maxi-operation against ‘Ndrangheta groups operating in the Lombardy region (Italy) conducted by law enforcement in 2010, within the larger operation named *Crimine*. The investigation, which lasted more than 4 years, shed light on the existence of 16 *locali* operating

¹¹ This figure refers to the total number of people with at least a charge in the pre-trial court order.

in Lombardy, all connected to *locali* based in Calabria. The trials led to the final convictions of more than 90 individuals (Rinaldi 2021). Operation *Infinito* highlighted that the ‘Ndrangheta in the North of Italy did not simply involve individuals who started committing crimes in another region, but also replicated rituals, languages, ranks, *doti*, and offences typical of the Calabrian ‘Ndrangheta, which had been transplanted in a different territory by reproducing the original internal organization. The focus on the presence of multiple ‘Ndrangheta *locali* in Lombardy makes the *Infinito* Operation a suitable case study for the understanding of inter-group relations within the criminal organization. The information used for the analysis comes from the pre-trial court order (Tribunale di Milano 2010) and the *informativa*¹² of Carabinieri di Monza (Carabinieri di Monza 2008).

Case Study 3: Minotauro Operation

Minotauro was an operation addressing multiple ‘Ndrangheta groups settled in Piedmont conducted by law enforcement in 2011. The investigation, which led to the arrest of 191 people, has revealed the presence of 8 *locali* in Turin and surrounding towns, linked to six prominent *locali* settled in Calabria; one separated ‘*ndrina* called “*bastarda*”, whose existence has not been authorized by the *Crimine di Polsi*, i.e., the ‘Ndrangheta high-level body of coordination; and the so-called *crimine*, an organism based in Piedmont responsible for carrying out violent actions on behalf of all the *locali* established in Turin and surrounding areas. The trials led to a final sentence for more than 70 individuals (AMDuemila 2020; Giambartolomei 2016). The involvement of multiple *locali* makes therefore *Minotauro* a suitable case study for fulfilling the objectives of the present study. Data employed for the analysis were extracted from the pre-

¹² The *informativa* is a document involving the preliminary and immediate reporting of criminal activity by law enforcement to the public prosecutor.

trial court order (Tribunale di Torino 2011).

2.2.1.2. Other sources of data

All information concerning meetings, phone calls, charges, and kinship of the three cases was extracted from the previously mentioned judicial documents. However, supplementary data related to individual attributes – in particular, date and place of birth, *locale* affiliation, and occupation – were integrated relying on open sources whenever not available from the judicial records. These additional sources primarily encompassed Italian press news outlets, such as LaCNews, along with online judicial documents pertinent to other ‘Ndrangheta-related cases. The acquisition of this information involved online searches using the person’s name, surname, and, when available, date of birth, conducted through search engines like Google.

Data were integrated with online sources only when there was absolute certainty that the open-source information pertained accurately to the person taken into consideration. This is relevant since, especially in Southern Italy, it is very common to have multiple homonymous, especially within the same family, due to the tradition of naming newborns after grandparents.

2.2.2. Data collection

For each case study, the same type of information was collected and coded in a standardized way, including individual attributes, data on participation in meetings and phone calls, data on charges, and kinship data. Part of this data was previously extracted and collected by other researchers (Calderoni 2014a; Superchi 2018; Calderoni and Superchi 2019) and then validated through cross-verification to ensure data consistency. Data on co-charges and family ties were entirely collected and coded for this research for the first time.

2.2.2.1. Meetings and phone calls

Meetings and phone calls were employed as proxies of collaboration in the analysis. The meetings analyzed in this study included the commission of some criminal activities but, especially, various social events, such as dinners, bar gatherings, meetings in private houses, weddings, and funerals. Interestingly, even in events apparently unrelated to ‘Ndrangheta activities – such as weddings and funerals – members were found to discuss critical organizational matters, including the resolution of internal conflicts, rank assignments, criminal activity management, and other strategic issues. Similarly, phone calls often involved individuals using cryptic language to arrange meetings, discuss managerial issues, and relay details of previous meetings to those who had not been present.

The use of this information for the study of the internal structure and interactions within criminal organizations has become a well-established approach in the last decades (Baker and Faulkner 1993; Bright et al. 2015; Calderoni 2012; 2014a; Calderoni and Superchi 2019; Campana 2011; Campana and Varese 2013; Ficara et al. 2020; Natarajan 2000). Wiretaps and the surveillance of meetings allow for the collection of extensive information regarding the relationships between individuals, the roles they play within the organization, and the activities they carry out. Additionally, the nature of the documents in which this information is reported, i.e., pre-trial court orders, ensures that the events and calls reported within these judicial documents are always relevant for evidentiary purposes and thus highly pertinent to the criminal activities conducted by the individuals involved. Given the type and relevance of activities monitored through surveillance and wiretaps during the investigations, meetings and phone calls can serve as a suitable proxy for collaboration. In the present study, collaboration is understood, in line with Bouchard (2020), as an umbrella concept encompassing actions including conspiracy, collusion, crime commission, and non-criminal cooperation instrumental

to the existence and functioning of the ‘Ndrangheta and its groups.

In the project, each event included in the judicial documents was assigned a unique identifier (E001/T001). The information related to the event was systematically coded as detailed in Table 2 by previous researchers, with a small portion of events newly coded for the project. Only events that occurred during the investigations were considered in the analysis, while other recorded events that were cited in judicial documents and occurred before the investigation, for instance, relevant meetings from previous operations and cited in the pre-trial court order to provide context information, were not included in the dataset. Specifically, the events included in the analysis occurred within the timespan 2007-2010 for *Infinito* and *Crimine*, and 2007-2011 for *Minotauro*. The two datasets included not only meetings and phone calls detected through electronic surveillance but also those mentioned by individuals under scrutiny, even if not directly tapped. The total number of meetings and phone calls codified is reported in Table 6.

Table 2: Data collected on meetings and phone calls

Variable	Description
ID	Unique Identifier of the event (meeting or phone call)
Year	Year of occurrence
Date	Date of occurrence
Time	Time of occurrence
Place	Place of occurrence
Indirect	Whether the meeting or phone call is indirectly reported by other individuals (1) or not (0)
Participants	IDs of each participant who took part in the meeting or phone call

2.2.2.2. Attributes and leadership

Attributes data, detailed in Table 3, were collected and coded for all people named in the pre-trial court order, including both the defendants and any other individuals mentioned in connection with the investigation, not necessarily affiliated to the ‘Ndrangheta. To ensure anonymity, an alphanumeric ID (N0001, N0002, ...) was assigned to each individual, and for this reason, no real names will be used in the discussion of results.

Considering the relevance of the information on *locali* for the objective of the current study, all data previously coded by other researchers on *locale* affiliation were checked and integrated using additional data sources, specifically open-source articles and other judicial documents, to reduce missing values. The same was done for the variables of date and place of birth.

For individuals identified as having been affiliated with the ‘Ndrangheta, their rank within the organization was coded based on information reported in the judicial documents from previous researchers and double-checked a second time for the present project. Except for mid-high-ranking positions, limited information was available on the rank of other affiliated individuals, who were usually mentioned as *partecipi* or *esponenti*, i.e., individuals actively participating in the ‘Ndrangheta and within a specific *locale*. The identification of these ranks, and especially the ones related to middle-high-ranking individuals, was based on direct evidence gathered from wiretaps and integrated with other evidence from previous investigations. Specifically, the intercepted individuals themselves described in detail the internal structure of the ‘Ndrangheta and hierarchies of the *locali*, thereby identifying individuals as holding specific positions within them. This makes the categorization robust and independent of police judgments and deductions.

The categorization of leaders, relevant to answering the first research question, was conducted based on this rank categorization. Specifically, individuals holding the highest ranks were categorized as leaders: the boss within the locale (*capo locale* and *capo società*), the individual handling the finances of the *locale* (*contabile*), and the spokesperson of the boss (*mastro di giornata*). In line with previous research (Superchi 2018), a few leaders were classified as non-leaders based on two criteria:

1. Imprisonment or death: leaders unable to participate in meetings or calls due to imprisonment or murder at the early stages of the investigations were excluded.
2. Geographical distance: leaders affiliated to *locali* outside the scope of the investigation or residents in foreign countries with rare participation in events. Geographical distance does not automatically prevent the classification as a leader; when actively involved in meetings and phone calls, the individuals were still classified as leaders.

Only a few members in the three case studies met these criteria, leading to little impact on the overall classification. Nonetheless, this procedure allowed for the reduction in the risk of bias in the subsequent analysis. The classification of leadership was included in the dataset as a dichotomous variable *Leader* (Table 3). In the final analysis, 48 leaders were identified in *Infinito* (20%), 47 in *Crimine* (17%), and 29 in *Minotauro* (14%).¹³

¹³ The final number of leaders identified in the analysis differs from the one reported in previous analysis on the same operations (Calderoni and Superchi 2019) due to two factors: the different threshold for meeting participation used for the exclusion based on geographical distance criteria, as well as the different timespan considered for the analysis.

Table 3: Attribute variables

Variable	Description
ID	Unique Identifier
Name and Surname	-
Gender	-
Date of birth	-
Place of birth	-
Residence	-
Locale	In case of affiliation, the <i>locale</i> the individual belongs to; in case of non-affiliation, “not affiliated”; in case of no information, “not specified”
Rank	In case of affiliation, the rank within the <i>locale</i> or other ‘Ndrangheta’s structure of coordination (e.g., <i>capo locale</i> , <i>contabile</i> , <i>mastro di giornata</i>)
Leader	In case of affiliation, whether the individual has a leadership position (1) or not (0)
Defendant	Whether the individual is a defendant (1) or not (0)
Defendant for Mafia-type association	Whether the individual is charged for mafia-type association according to article 416bis (1) or not (0)
Defendant for crimes aggravated by mafia methods	Whether the individual is charged for crimes aggravated by mafia methods according to art. 7 D.L. 152/1991 (1) or not (0)
Dead	Whether the individual is dead (1) or not (0)
Total meetings	Total number of meetings in which the individual is involved
Total phone calls	Total number of phone calls in which the individual is involved
Total charges	Total number of charges in which the individual is involved
Total kinship	Total number of kinship ties in which the individual is involved

2.2.2.3. Charges

Data on charges were collected from pre-trial court orders. At the beginning of these documents and after the list of defendants, public prosecutors report all the crimes for which the suspects are accused, specifying the type of crime and the individuals involved. All available details were coded and systematized in a dataset (Table 4). The information on co-charges was used

as a proxy for co-offending, excluding solo charges from the analysis and the charge for Mafia-type associations, which includes almost all defendants in all three case studies.

The use of charges data as a proxy for co-offending faces several limitations. Pre-trial court orders and other types of judicial documents are written by law enforcement and public prosecutors for very precise purposes. This implies that the activities under scrutiny are specific and aligned with the ultimate goal of the investigation, rather than encompassing the entirety of criminal events occurring within the investigative timeframe. Hence, only a small part of the offences taking place during the investigations are later brought forward when requiring pretrial detention. In the three cases analyzed, the most common crime, excluding the Mafia-type association, was unlawful possession of firearms, followed by usury and extortion.

Despite the limitations of these data, information on co-charges provides valuable and additional details on criminal collaboration that are rarely retrievable by looking at meetings and phone call events. For this reason, data on co-charges were included in the analysis. The total number of coded co-charges per case study is reported in Table 6.

Table 4: Charges variables

Variable	Description
ID	Unique Identifier of the charge
Year	Year of occurrence
Date	Date of occurrence
Place	Place of occurrence
Legislative reference	Penal code articles
Category	Type of crime (mafia association, firearms, extortion, etc.)
N. defendant	Total number of defendants involved in the crime
Participants (P1, P2, ..., P _N)	IDs of each participant who took part in the crime

2.2.2.4. Kinship

Data on kinship were extracted and coded manually starting from the three pre-trial court orders (plus the *informativa* for the *Infinito* operation). Italian judicial documents report a valuable amount of extra-judiciary information about the people involved in the case. When introducing a person, law enforcement frequently includes details on the parents, eventual wife or husband, and children of the individual. If relevant from a criminal perspective, and thus for investigative purposes, law enforcement often provides details not only about close relatives but also about third and fourth-degree connections. For instance, relationships formed through marriages, which are known to be particularly significant within the ‘Ndrangheta environment as a means for sealing alliances (Catino, Rocchi, and Vittucci Marzetti 2022), are frequently reported in detail in judicial documents.

To detect kinship-related information within the judicial documents, Italian terms that pertain to the most significant familiar connections were identified. This process subsequently guided the selection of the following set of 20 keywords used in the search bar of the judicial files: “*fratell*”, “*sorell*”, “*padre*”, “*madre*”, “*cognat*”, “*nuor*”, “*figli*”, “*gener*”, “*nipot*”, “*cugin*”, “*nonn*”, “*suocer*”, “*genitor*”, “*sposat*”, “*parent*”, “*zio*”, “*zia*”, “*marito*”, “*moglie*”, “*coniuge*”.¹⁴

¹⁴ The translation in English of the terms is the following one: brother, sister, father, mother, brother-in-law, daughter-in-law, son, son-in-law, nephew, cousin, grandfather/grandmother, father/mother-in-law, parent, uncle, aunt, husband, wife, spouse.

Table 5: Kinship variables

Variable	Description
ID	Unique Identifier of the kinship tie
Type	Type of kinship relation – e.g., siblings, cousins, father-son, etc.
Participants (P1, P2, ..., P _N)	IDs of the two relatives

This procedure enabled the extraction of a substantial amount of data concerning familiar relationships from the judicial files, with details on the type of kinship relation (variable *Type* in Table 5). Starting from these data, the amount of information was enlarged by deriving indirect family relations, i.e., kinship ties deduced by looking at the information available from the document. The rationale behind this process is explained in the following example: if the pre-trial court order reveals that N001 is the brother of N002 and that N002 is the cousin of N003, it is possible to deduce that N001 and N003 are cousins. This deductive process was applied to all information directly extracted by the judicial files for *Infinito*, *Crimine*, and *Minotauro*, leading to a notable increase in information on family relations.

The total number of kinship relations coded is reported in Table 6. The direct and indirect codification enabled the extraction of many details on kinship relations, especially for the *Crimine* case study, also about individuals who were not directly involved in meetings or phone calls. As will be outlined in the method section, information regarding these individuals was eventually removed from the analysis, allowing instead for a focus exclusively on individuals involved in collaborative relations.

Table 6: Summary of the total number of meetings, phone calls, co-charges, and kinship relations coded, per case study

	Infinito	Crimine	Minotauro
Meetings	629	561	441
Phone calls	440	702	1391
Co-charges	98	22	78
Kinship	402	1466	436

2.2.3. Data reliability and validity

The validity of the sample of conversation was examined by assessing the three validity requirements identified by Campana and Varese for wiretap data (2012): no self-censorship, reasonably wide group coverage, and a large sample of conversations covering a long period of time.

No self-censorship

People involved in the three investigations discussed freely on the phone or in presence, and widely talked about the activities of the *locali*. This is highlighted also by the remark made by Judge Giuseppe Minutoli, who stressed the importance of wiretaps' content for unveiling fundamental aspects of the internal dynamics of the 'Ndrangheta (Tribunale di Reggio Calabria 2012). In the wiretaps included in the three operations, actors usually talked freely but not always openly, i.e., using an encrypted language. To provide an example of non-self-censorship, three conversations extracted from each operation are reported below.

Operation *Infinito* (wiretap 29th February 2008, N0079 to N105):

*“...as a friend I respect you, yes, but as a member of the 'Ndrangheta, I am accountable solely and exclusively to compare N161 (note: leader of la Lombardia). I collaborate with others when they collaborate with me, but to be clear, as a boss, I recognize only and exclusively N161, ...the others are all bosses just like me!”*¹⁵ (Tribunale di Milano 2010, 68).

In this conversation, the boss of the Bollate *locale* explains to the boss of the Cormano *locale* his relationship with the head of the ‘Ndrangheta in Lombardy, N161, who was murdered during the investigation due to his autonomic aspirations from the Calabrian ‘Ndrangheta.

Operation *Crimine* (wiretap 16th March 2010, N157 to N158):

*“I know what you're saying, but we are all part of the 'Ndrangheta, so show yourself! ... There are friends ... who need to be cultivated ... [otherwise] ... our organization is finished...”*¹⁶ (Tribunale di Reggio Calabria 2010, 32).

As contextualized in the pre-trial court order, in this conversation, the boss of the southern area of Reggio Calabria explains to another leader of the Jonic *mandamento* (see the internal structure of the ‘Ndrangheta in Figure 1) the importance of being a point of contact, always

¹⁵ Translation from the Italian: *“...come amico ti rispetto sì, ma come 'ndrangheta io do conto solo ed esclusivamente a compare N161. Collaboro con gli altri quando gli altri collaborano con me, ma per essere chiari come capo riconosco solo ed esclusivamente a N161, ...gli altri sono tutti capi quanto a me!”*.

¹⁶ Translation from the Italian: *“Lo so cosa dici tu, ma tutti siamo nella 'ndrangheta, ma fatti vedere insomma! ... Ci sono amici ... che si devono coltivare ... [altrimenti] ... l'organizzazione nostra è finita...”*.

present, to deal with issues related to the internal organization, in which all they belong.

Operation *Minotauro* (wiretap 22nd April 2008, N110 and N005):

"N005: Which thumb do they cut... the one on the right hand...? or the left hand?"

N110: Here... I think the left one... (he probably shows the exact point on the hand)

N005: incomprehensible... thumb...

N110: But if someone is a capizzuni... (a Boss ndr) ... they do it on the shoulder... to the bosses...

N005: incomprehensible...

N110: They make a cross on the shoulder...

N005: Like they did to Pietro?

N110: No... like... instead of cutting them here on the neck, they make a cross with the knife on the shoulder... but small, you know... like this...

N005: incomprehensible...

N110: Ah... but if someone is a boss... like... incomprehensible... they do it on the neck, you understand? ... incomprehensible... I mean... not the regular ones... the underlings...

Brief pause, then N005: "You have it in your blood!"¹⁷ (Tribunale di Torino 2011, 86).

¹⁷ "N005: Quale pollice incidono...quello della mano destra...? o della mano sinistra? N110: qua..mi pare alla sinistra.. (probabilmente gli mostra il punto esatto sulla mano, ndr).. N005: incomp..pollice.. N110: invece chi è un CAPIZZUNI... (un Capo ndr)...te lo fanno nella spalla..ai capi.. N005: incomp.. N110: ti fanno una croce nella spalla.. N005: quella come a PIETRO? N110: no..come..invece di tagliarli qua nel collo gli fanno una croce con il coltello nella spalla..ma piccola eh....così.. N005: incomp.. N110: ah...però chi è capo..tipo..incomp..gli fanno il collo, hai capito?... i..incomp..nel senso di..no.. dei normali..degli sciacquini.. Breve pausa poi N005: "li avete nel sangue!".

In the conversation, N110, a young member of the Volpiano *locale* explains the blood rituals that characterize the transitions to ranks higher than that of *picciotto* in the ‘Ndrangheta to N005, another young member of the Volpiano *locale* who had never participated in a ritual directly.

As suggested by Campana and Varese (2012), considering that the individuals talked freely about the structure of the *locali*, the functioning of high-level bodies of coordination, the attribution of ranks, and other incriminating matters, it is reasonable to be confident about the validity of the conversations.

Reasonably wide group coverage

Wiretapped conversations did not encompass all members of the *locali*. However, given that the three operations were aimed at unveiling the internal structure and operations of specific groups of the ‘Ndrangheta, we can assume that key individuals within the organization were involved in the investigation. As highlighted in Section 2.2.2.1, in order to avoid biases and include individuals with marginal roles throughout the investigation, the analysis of wiretaps and meetings was restricted to the period of constant surveillance by law enforcement, thereby avoiding the inclusion of peripheral individuals not truly relevant to the activities described in the judicial documents. In addition, to take into account the criteria used by the police for conducting the investigation (Campana and Varese 2012), the codification of leaders also considered the geographical dimension, as described in Section 2.2.2.2.

Large sample of conversations covering a long period of time

As reported in Table 6, hundreds of conversations that occurred over 3 or more years of investigation were coded and included in the analysis. All meetings and wiretaps from the selected time period reported in the judicial documents were coded and included in the analysis. In addition, as the next section will illustrate, these meetings and phone calls involved a large

number of people; specifically, between 100 and more than 200 individuals across the three operations.

The reliability and consistency of the data collected from the judicial documents were then assessed by randomly checking the information coded. Specifically, about 20% of the data already coded by previous researchers on meetings and phone calls were checked by my supervisor, Francesco Calderoni, and myself; the control was carried out on the same sample of data to assess the consistency across the two validations. A double-check was also carried out on the already extracted attribute data.

2.3. Methods

The general objective of this dissertation is to examine relationships – both social and criminal ones. Over the past three decades, the analysis of such relationships has been inherently associated with the methodological framework of social network analysis (Calderoni 2018), an application of graph theory aiming to investigate social structure. From a network perspective, individuals and other social entities, such as groups or organizations, are represented as a set of nodes (or vertices, actors), while the relations or interactions among them as a set of edges (or links, ties) (Scott and Carrington 2011; Wasserman and Faust 1994).

All forms of organizations, including criminal ones, are based on human interactions and relations, and for this reason, they can be studied as networks, thus a set of actors and the relations between them (Carrington 2011; von Lampe 2016a). From this perspective, the network approach enables one to capture “the least common denominator” of organized crime, i.e., social and human relations (McIllwain 1999, 304). In the study of organized crime, the network approach allows for the description and testing of the extent to which a group is *in fact* organized – whether it is hierarchical and stable or fluid and decentralized (Diviák 2018; von

Lampe 2009). Indeed, this approach goes over an aprioristic idea on the social organization of a group and identifies the social relations characterizing a group of individuals using a “bottom-up” approach (Carrington 2011; Calderoni 2018; von Lampe 2009). Furthermore, the network approach facilitates the investigation of interrelation and coexistence of different types of relations in criminal environments, such as collaborative, kinship, or friendship relations (Bright and Whelan 2020). By exploiting these varied layers, researchers can achieve a more comprehensive understanding of how different relational dimensions interact and influence each other within the network (Diviák 2020).

The network approach, which emphasizes social relations, is one of the more effective empirical methods to examine collaborative dynamics. Therefore, this dissertation used social network analysis as the main methodological approach. Before presenting the methods employed for the data analysis, it is useful to briefly present some network analysis foundational concepts that will be employed in the following subsections.

Introduction to key concepts in network analysis

In network analysis, networks can be categorized by the nature of the nodes and the ties among them. Ties can be either directed or undirected. Directed ties, also known as arcs, represent asymmetric relationships that go from one node (the sender) to another (the receiver), like a phone call. On the other hand, undirected ties denote symmetric relations that exist between two nodes with no particular direction (e.g., co-attendance at a meeting). Both directed and undirected ties can take different values: dichotomous (or binary) ties indicate the presence (1) or absence (0) of a connection between nodes, while valued ties assign a numerical value to the relation to specify the strength, frequency, or intensity of the tie (Scott and Carrington 2011; Wasserman and Faust 1994). The types of ties between two nodes can be of different kinds – transaction, communication, sentiment, kinship (Wasserman and Faust 1994). When multiple

types of ties coexist, the network is defined as multiplex.

Nodes can also show multiple attribute variables, such as gender, ethnicity, age in the case of individuals, and be of different types. The term “mode” indicates how many types of nodes are involved in the network: for instance, two-mode or n -mode networks involve two or n sets of nodes. Typically, networks consist of a single set of nodes, such as individuals, groups, or organizations, and are referred to as one-mode (Scott and Carrington 2011; Wasserman and Faust 1994).

The type of networks that can be computed therefore depends on the type of available data, and on the type of methods that one wants to apply. Indeed, the methods used for analyzing networks are contingent upon the specific properties of the network itself (Wasserman and Faust 1994).

To answer RQ1 (*To what extent do different locali collaborate? Do high-rank individuals mediate this cooperation?*), the thesis used social network analysis to analyze the entire networks of collaboration for the three case studies and explore first, the cohesion of *locali* to assess internal and external collaboration intensity differences (objective 1.1), and second, to identify the individuals strategically positioned as intermediaries across *locali* and their association with leadership positions (Objective 1.2).

To answer RQ2 (*What factors influence collaboration in the ‘Ndrangheta? Are there differences between intra- and inter-locali collaboration?*), the thesis used social network analysis to assess the extent of overlap between collaboration and multiple types of relationships and test for statistical significance among them. These analyses were performed on the entire networks of collaboration, the same used to achieve objectives 1.1 and 1.2. Additionally, two separate networks were analyzed. The first was a network isolating ties

between members within the same *locali* and the second included ties among members from different *locali*. This approach enabled a disentanglement of the factors influencing cooperation within and across groups.

Therefore, multiple networks were defined and constructed to achieve the three objectives, applying the same process across all three case studies to ensure consistency in the methodology.

2.3.1. Networks construction and boundaries' definition

Collaboration network

The data on meetings and phone calls described in Section 2.2.2.1 enabled the generation of separate networks of meetings and phone calls as one-mode, valued, and undirected matrices based on the list of participants (nodelist). The two networks were then merged to create a unique network serving as a proxy of collaboration, used as the main network for the analyses. The nodes within the meetings and phone calls networks can overlap, meaning that an individual participating in meetings may also be involved in phone calls, and vice versa. Specifically, in *Infinito* there were ($N_i=149$; $E_i=158$) overlapping vertexes and edges between the two networks, while in the *Crimine* and *Minotauro* cases, there were ($N_c=115$; $E_c=110$) and ($N_m=137$; $E_m=155$), respectively. This overlap accounts for the discrepancy between the total number of nodes in the overall collaboration network and the combined sum of nodes from the meetings and phone calls networks. Table 7 reports the information on the number of nodes and edges for the three networks.

Table 7: Meetings and phone calls network employed to generate the initial collaboration network – number of nodes and edges

	Meetings		Phone calls		Collaboration	
	<i>N</i>	<i>E</i>	<i>N</i>	<i>E</i>	<i>N</i>	<i>E</i>
Infinito	294	2350	193	286	338	2436
Crimine	469	4283	210	314	564	4423
Minotauro	380	8228	271	474	514	8426

After the merging, the attributes of age (computed based on the date of birth and taking as reference the year in which the investigation ended), residence, *locale* affiliation, and role of leadership (as coded in *Leader* in Table 3) were assigned to the nodes of the network. As highlighted in Section 2.2.2.2, the individuals involved in meetings and phone calls coded from the judicial documents were not all members of the ‘Ndrangheta, and for some, there was no available information regarding their membership in specific *locali*. Since the focus of the analysis is on *locali* dynamics, nodes not affiliated or with no specified *locale* affiliation were removed from the collaboration network. Specifically, this includes 102 nodes removed from the *Infinito* network, 270 from *Crimine*, and 305 from *Minotauro*. Following the removal of these nodes, isolates were also excluded from the network to focus the analysis on active collaboration (1 isolate in *Infinito*, 11 in *Crimine*, and 1 in *Minotauro*). Table 8 reports some descriptive statistics of the final *collaboration networks* for the three case studies used for the analyses.

The *collaboration network* was employed for the analyses related to the first objective, i.e., assessing the cohesion and integration of *locali* in the ‘Ndrangheta. To fulfill the second objective, i.e., assessing the factors influencing collaboration within and across *locali*, other network dimensions were elaborated to be employed in the analyses.

Other network dimensions

For the nodes included in the *collaboration network*, additional networks were elaborated to represent other dimensions (or layers) of interaction among the same nodes. These additional dimensions represent different types of relationships among collaborating individuals, allowing for a multidimensional analysis of how various types of connections influence the *collaboration network*:

- *Co-charge network*: it was computed based on the nodelist cited in Table 4 as a one-mode, valued, and undirected matrix, excluding solo charges and the 416 bis charge on mafia association.
- *Kinship network*: it was constructed as one-mode, dichotomous, and undirected matrix, starting from the list of edges (edgelist) including each family dyad (Table 5). To disentangle the role of different types of kinship relations, two additional networks were computed:
 - *Family network*: it includes only immediate family ties as spouses, parent-son, and siblings;
 - *Third-degree kinship network*: it includes all kinship ties excluding the ones included in the *family network*.
- *Same locale affiliation network*: it was computed as dichotomous and undirected by creating an edge among individuals involved in the *collaboration network* and with the same *locale* attribute.

Information on the number of nodes and edges included in the dimensions can be found in Table Appendix B in the Annex.

Intra-collaboration and inter-collaboration networks and related dimensions

Considering that the second objective of the study aimed to compare the factors influencing collaboration within and among *locali*, two additional collaboration networks were generated (Table 8), isolating the two distinct edges as follows:

- *Intra-collaboration network*: starting from the entire network (*collaboration network*), the collaboration network that includes only collaborative edges between members of the same locale was constructed by removing all edges that connect individuals from different *locali*. After these edges were removed, any isolated nodes were also removed, ensuring the network contained only connected nodes.
- *Inter-collaboration network*: the network of collaboration ties among members of different *locali* was then created by subtracting the edges of the *intra-collaboration network* from the entire *collaboration network* and removing any remaining isolated nodes.

To isolate *intra-locale* and *inter-locale* ties in the kinship, family, third-degree kinship, and co-charges networks, two versions of each network were created following the same approach described for the *intra-collaboration* and *inter-collaboration networks*:

- *Intra-kinship network, intra-family network, intra-third-degree kinship network, and intra-co-charges network*: they were computed by removing edges among individuals from different *locali* from the whole networks described in the subsection “Other network dimensions”.
- *Inter-kinship network, inter-family network, inter-third-degree kinship network, and inter-co-charges network*: they were computed by subtracting the edges of the *intra-*networks described in the previous bullet point from the entire networks described in the subsection “Other network dimensions”. In addition to the already mentioned

networks, another network of kinship ties was created for the analysis of *inter-collaboration* only to test hypothesis *H3*:

- *Kinship locale network*: this network was constructed by establishing a tie between two individuals from different *locali* if at least two people from each of their respective *locali* were bound by a kinship tie. The rationale for the construction of this network is that kinship ties and marriages within the ‘Ndrangheta are used strategically to enforce trust and seal alliances (Catino, Rocchi, and Vittucci Marzetti 2022). From this perspective, the focus is not on the quantity but on the presence of a symbolic kinship tie between the two groups: for example, the study of Catino and colleagues (2022) highlights that the median number of interfamily marriages per ‘Ndrangheta family is 1. Considering the symbolic role of these kinship ties, one may hypothesize that individuals belonging to *locali* that are tied by a kinship relation will be more prone to collaborate even if not directly linked by kinship relations (*H3*).

Details on the number of nodes and ties included in the intra- and inter-dimensions are provided in Table Appendix C and Table Appendix D in Annex. A graphical exemplification of the process used to construct all networks is available in Figure 2.

An alternative approach was contemplated to distinguish between intra-collaboration and inter-collaboration. This involved separating meetings and phone calls occurring solely between members of the same locale from those involving people from both the same and different *locali*, without isolating the individual dyads through intersection. Nonetheless, the results from this approach did not isolate the effect of kinship on collaboration effectively. Specifically, the kinship relations between members of the same *locale* who participated in meetings with members of different *locali* amplified the influence of kinship on *inter-collaboration*, thereby

confounding the true impact of kinship at the dyadic level between *locali*. For this reason, the intersection approach was preferred over this method.

Figure 2: Exemplification of the networks' construction process

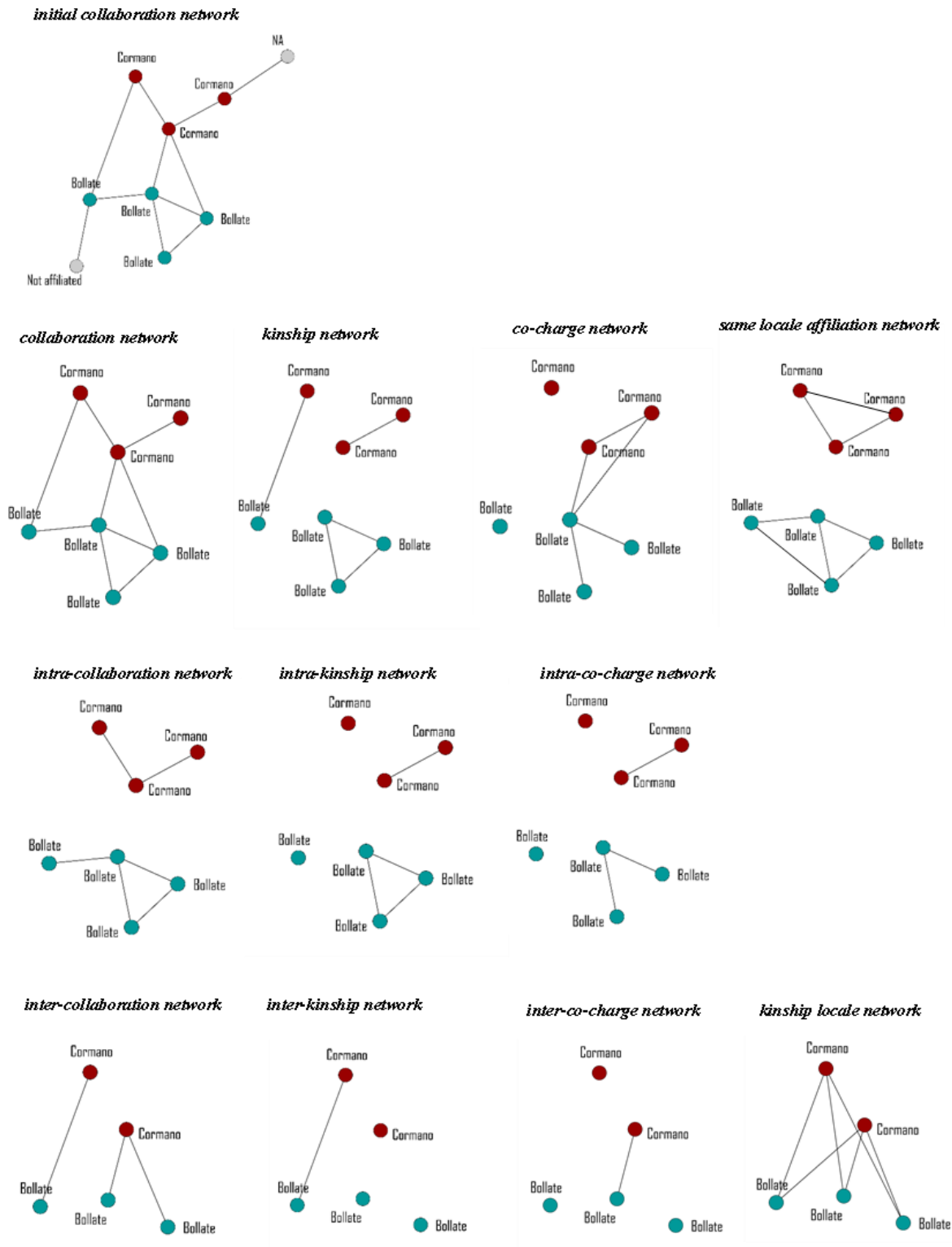


Table 8: Summary of the descriptive statistics for the collaboration network, intra-collaboration network, and inter-collaboration network, per case study

	Infinito	Crimine	Minotauro
<i>Collaboration – whole network</i>			
Nodes	235	283	208
Edges	2036	1769	4226
Density	0.07	0.04	0.20
Max degree	83	108	135
Min degree	1	1	1
Mean	17.3	12.5	40.6
Median	11	8	38.5
St. dv.	16.7	14.4	35.9
<i>Intra-collaboration</i>			
Nodes	210	228	172
Edges	696	406	1084
Density	0.03	0.02	0.07
Max degree	22	35	38
Min degree	1	1	1
Mean	6.6	3.6	12.3
Median	5.5	2	9
St. dv.	5.1	3.6	9.7
<i>Inter-collaboration</i>			
Nodes	184	241	189
Edges	1340	1363	3142
Density	0.08	0.05	0.18
Max degree	80	73	124
Min degree	1	1	1
Mean	14.6	11.3	33.2
Median	8	6	24
St. dv.	15.2	12.7	30.4

2.3.2. Objective 1. Examine the internal cohesion of *locali* and the interconnections among them

To answer RQ1, the study aimed at conducting a descriptive assessment of the extent of collaboration both within and among *locali*, by first investigating the internal cohesion of each *locale* (objective 1.1). Upon confirming the relevance of inter-*locali* connections, the analysis then aimed to identify the brokers who intermediate among *locali*, allowing the integration of the entire network, and to explore the association between having leadership roles and this strategic positioning (objective 1.2). The following paragraphs present the methods applied to fulfill these objectives.

Objective 1.1 *Locali* cohesion

As highlighted in Section 1.2.2, individuals operating in high-risk environments are expected to build collaborative relations towards trust and closure, thus mainly within their group, rather than with other groups' members (Erickson 1981; Della Posta 2017). Due to this preference for relying on strong ties, and considering the operational role of *locali*, one may hypothesize that 'Ndrangheta *locali* exhibit strong internal cohesion, engaging primarily in intra-*locale* interactions (*H1a*). On the other hand, in large criminal organizations, there is a strong need for coordination among groups, which requires continuative and frequent relations with members of other groups, that may be facilitated by defined rules and practices (Catino 2015; 2019; Coutinho et al. 2020; von Lampe 2016b). Therefore, it may be hypothesized that contrary to *H1a*, 'Ndrangheta *locali* frequently establish collaborative ties with members from different *locali* (*H1b*).

To test these alternative hypotheses, the first analysis aimed to assess whether the intensity of intra-*locale* collaboration was significantly larger compared to inter-*locali* collaboration.

Leveraging the methodology usually employed for the study of communities, the cohesion ratio of each *locale* was assessed by computing the ratio between the internal strength of the *locale* and the total strength of the *collaboration network* as follows (Calderoni, Brunetto, and Piccardi 2017; Hric, Darst, and Fortunato 2014; Piccardi 2011):

$$\alpha_k = \frac{\sum_{i \in C_k} \sum_{j \in C_k} w_{ij}}{\sum_{i \in C_k} \sum_{j \in \{1,2,\dots,N\}} w_{ij}}$$

Where C_k is the induced subgraph including only the nodes belonging to *locale k* and w_{ij} is the weight of the tie between i and j .

The higher α_k the higher the intra-group intensity of connections. As the value of α_k increases with the size of C_k , the results were tested for their statistical significance through permutation, which allowed to generate the distribution of α_k under the null hypothesis. Specifically, a group membership permutation was conducted 10,000 times, allowing for randomization by reassigning each individual to a different *locale*, while conditioning on the network's structure (Shizuka 2019). The cohesion ratio was then calculated on these 10,000 permuted networks, and the mean and standard deviation of the permuted cohesion ratios were used to compute the z-score of α_k . This approach ensured that the observed cohesion ratio was compared against the distribution of cohesion ratios expected under random group assignments, providing a robust test of statistical significance.

Objective 1.2 *Locali*' interconnection: leadership and meso-level brokerage

The analysis subsequently aimed to identify the brokers among *locali* and test the hypothesis that there is a positive association between holding leadership positions and being brokers among groups ($H2$).

The connections within a network suggest to what extent an actor is able to reach, mobilize, and transfer information, and exercise influence (van der Hulst 2009). The concept of an ego's positioning *between* different individuals is the central point of investigation in the study of strategic positioning in ego networks (Scott and Carrington 2011). As highlighted by Kleinbaum (2012, 407), "If the social networks literature has taught us anything, it is that brokers do better". Previous research has conclusively demonstrated the strategic advantages linked to playing the role of broker between actors; this phenomenon has been extensively explored not only in the context of social networks at large but also within the realm of criminal networks (Morselli 2009b).

An extension of the concept of brokerage involves examining the individual's benefits deriving by connecting people in a modular network, i.e., a network where nodes are grouped into different modules, i.e., subgroups. Classical centrality measures, such as degree, betweenness, and closeness centrality, do not consider the potential modular structure of the network, and the groups to which the individuals may belong, in the identification of influential actors (Paquet-Clouston and Bouchard 2022). On the contrary, a meso-level approach distinguishes two types of links: intra-group ties, which occur among nodes belonging to the same group and have a local influence in the dissemination of information or other resources; and inter-group ties, which bridge among groups and exert a global influence (Ghalmane et al. 2019). Through meso-level centrality measures it is, therefore, possible to take into consideration individuals' *bonding* and *bridging* social capital simultaneously (Lo 2010; Putnam 2000).

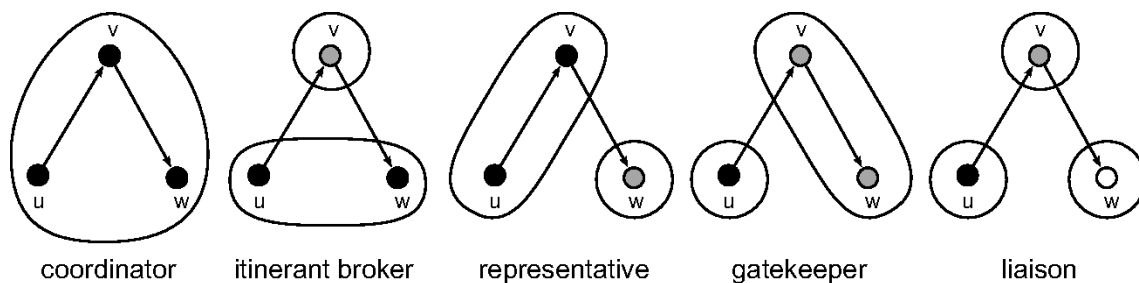
To explore brokerage among *locali*, three centrality measures that consider the clan-based structure of the 'Ndrangheta were calculated on the *collaboration network* described in Section 2.3.1. Although the literature offers additional metrics suitable for modular networks, many of these metrics strongly rely on the size of the groups to compute or weight the brokerage power.

However, the data used in this project are notably incomplete, as not all *locali* members were involved in the law enforcement operations, and, consequently, were not included in the network. To prevent distortions, these metrics were omitted from the analysis.

The first two meso-level metrics were developed by Gould and Fernandez (1989), who greatly emphasized group dynamics in the study of brokerage in transaction network dynamics (Zádor et al. 2022). Considering nodes belonging to non-overlapping groups, the authors identified five distinct types of brokers (Gould and Fernandez 1989):

- i. Coordinator: the broker and the two connected nodes belong all to the same group.
- ii. Itinerant: two nodes belong to the same group, while the broker belongs to a different group.
- iii. Gatekeeper: the broker intermediates an incoming contact from a node outside the group and a node within the group it belongs to.
- iv. Representative: the broker intermediates an outgoing contact from a node inside the group and a node outside the group it belongs to.
- v. Liaison: the broker mediates between two nodes belonging to two distinct groups, without a preexisting allegiance to either.

Figure 3: Brokerage roles according to Gould and Fernandez (1989)



Source: De Nooy et al. (2005, 151)

Gatekeeper, representative, and liaison involve nodes belonging to different groups and, for this reason, were included in the analysis. The first two can be considered alternatively, as no

direction is considered in the analysis, and the computation for undirected networks is the same. In the following sections, the term representative will be employed to refer to this positioning.

The third bridging measure was derived from Guimerà and Amaral (2005), and aimed at providing a more direct measure of an actor's connection with members of different *locali*. Analyzing metabolic networks, the authors developed a method in which the role of a node is determined by its degree within the group (z) and its participation coefficient (P), i.e. its positioning with respect to its own group and to other groups. Focusing on inter-group connections, the analysis considered only the participation coefficient (1) which assesses the degree to which a node establishes uniform connections across all groups, rather than solely within its own group:

If $s_i \in \{1, 2, \dots, G\}$ the group node i belongs to, then:

$$P_i = 1 - \sum_{s=1}^G \left(\frac{k_{is}}{k_i} \right)^2$$

Where k_{is} is the number of links of node i to nodes in group s , and k_i is the total degree of node i .

In the present analysis, high values of P_i indicate actors with connections homogeneously distributed among all *locali*.

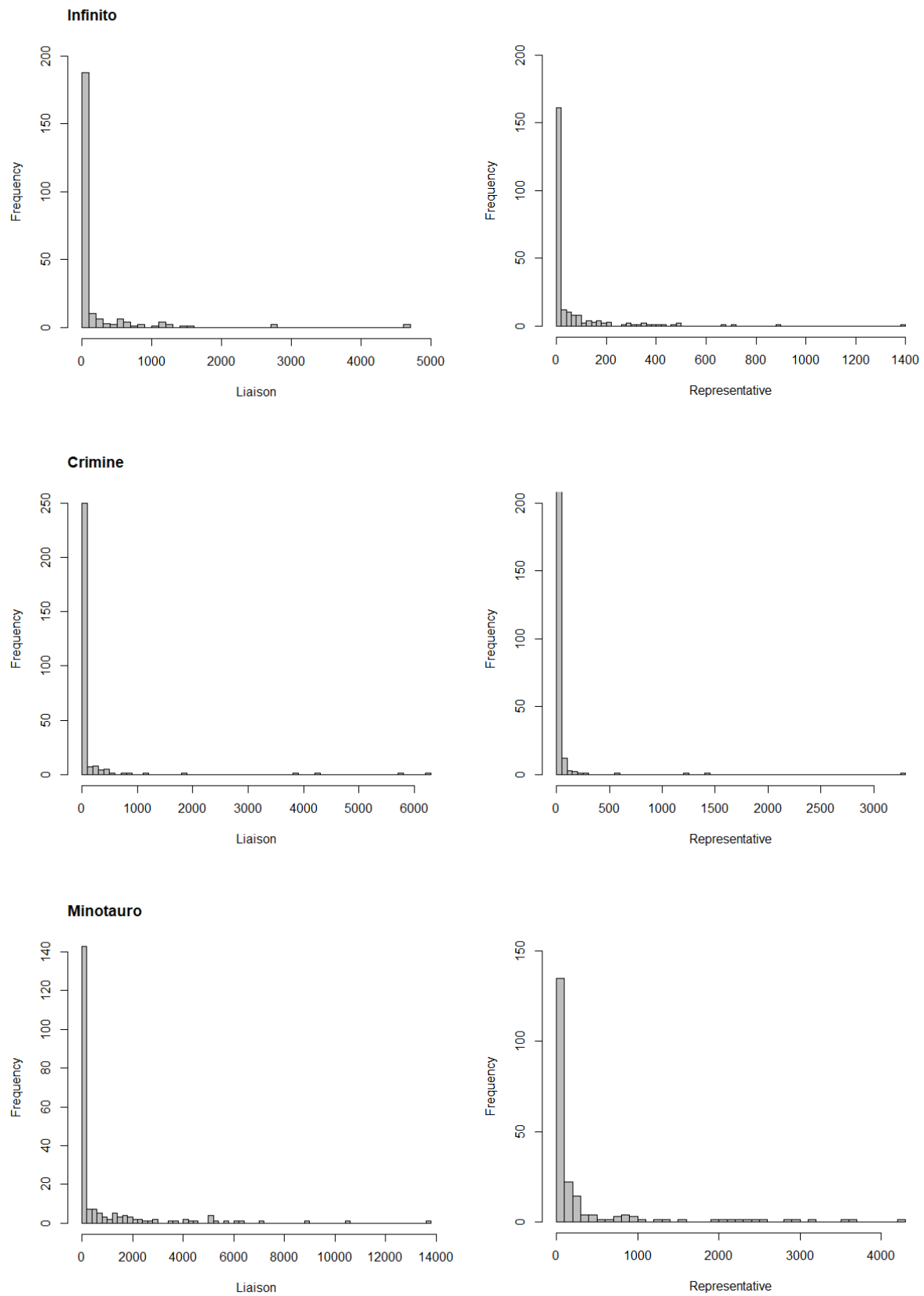
After the computation of the three metrics, a set of statistical methods was employed to test the relationship between the role of broker at the meso-level and the role of leader within the 'Ndrangheta. As a preliminary analysis, the Mann-Whiney U test¹⁸ was used to compare the

¹⁸ The non-parametric Mann-Whiney U test was chosen after checking for non-normality using the Shapiro-Wilk test.

median of the three metrics between leaders and non-leaders, to determine if there was a significant difference between the two distributions. Additional metrics were computed and compared between leaders and non-leaders: number of collaborative events, degree centrality, strength, and betweenness centrality.

Subsequently, different statistical models were adopted to assess the association between the three brokerage measures and leadership positions. First, two zero-inflated negative binomial models (ZINB) were estimated with liaison and representative as the response variable. These models belong to the family of generalized linear models and are employed for modeling count variables with excessive zeros and characterized by overdispersion (Long and Freese 2001), both of which are characteristics present in all three datasets for the liaison and representative variables (Figure 4).

Figure 4: Frequency of liaison and representative variables, per case study



Zero-inflated models assume that there are two separate data generation processes: a process that generates extra zeros beyond what would be expected from the standard count distribution (zero-inflation process), and a process that generates counts, including some zeros, according to a standard count distribution (in this case, negative binomial) (Zeileis, Kleiber, and Jackman 2008). These models approximate the distribution of the outcome variables combining two models: one for the count data and another for the excess zeros. For the excess zeros, a logistic regression is used to predict the number of zeros that exceed those predicted by the count model. On the other hand, the count model, which in this study is a negative binomial regression, assesses covariates' effects on the count outcome for the observations that are not excess zeros (Long and Freese 2001).

Zero-inflated models require a distinction between covariates associated with the exceeding zeros, and covariates associated with the counts. In the present analysis, prosecution biases may affect the correct identification of liaison individuals, and we may expect that a low number of meetings attended and phone calls may be correlated with the extra zeros. For this reason, a dummy variable (*high_meet*), indicating whether the individual had attended more meetings than the median number of meetings attended, and the number of phone calls done (*n. call*) was employed as a covariate in the logistic regression (Table 9). The row number of meetings attended was avoided due to complete or quasi-complete separation problems.

In the negative binomial model, the dummy variable *leader*, which identifies whether the individual holds a leadership position as defined in Section 2.2.2.2, was included as an explanatory variable to test the hypothesis that individuals in leadership positions are associated with brokerage across *locali*. Various specifications of the model were computed by incorporating multiple control variables. These include *age*, computed as mean-centered to avoid multicollinearity in the model (Cohen and Cohen 2003); the number of an individual's

kinship ties within the network (*n. kinship*); and the categorical variable *locale_size*, designated to mitigate potential biases resulting from the varying levels of information available about each *locale* size. This control is particularly relevant for the computation of the representative measure. Indeed, individuals in larger groups have more opportunities to score higher in these measures, due to the higher number of potential intra-*locale* interactions that need brokering. The *locale size* variable categorized individuals into three categories based on the size of the *locale*: 1 – *locali* with 1 to 10 members, 2 – *locali* with 11 to 20 members, 3 – *locali* with more than 20 members (Table 9). The number of meetings was not included as a control due to the high correlation with the *leader* variable to avoid multicollinearity.

An Ordinary Least Squares (OLS) regression model was employed to analyze the association between leadership position and high participation coefficient scores, given the continuous nature of the dependent variable (McNulty 2021). In this analysis, the predictor variable was *leader*, and various specifications were tested, including the same control variables used in the ZINB model, excluding the covariates related to the zero-inflated model. The correlation matrix of the continuous variables employed in both analyses is available in the Annex (Table Appendix E, Table Appendix F, Table Appendix G).

Considering that the dependent variables of both ZINB and OLS models are centrality measures, the assumption of independence of the observations is violated (Borgatti et al. 2022). To overcome this limitation and have reliable significant tests not based on standard errors, the p-values of the coefficients were calculated by adopting a Y-permutation approach (Borgatti et al. 2022). Specifically, the dependent variable was permuted 10,000 times without replacement, and each regression model was replicated using each permuted dependent variable. The coefficients from the permuted regressions were then used to estimate the distribution of all possible values we could have seen under the null hypothesis of no association. The two-tailed

p-values were eventually calculated as the proportion of permuted coefficients as extreme as the observed coefficients. This procedure was adopted for all models' specifications in the ZINB and OLS regressions.

The information on the *age* was missing for some individuals included in the network, specifically 22% for *Infinito*, 2% for *Crimine*, and 11% for *Minotauro*. These observations with missing information on *age* were excluded from the models presented in the results chapter.

A sensitivity analysis was conducted for both the ZINB and OLS models to account for potential law enforcement biases. This implied adding to the models the control variable *mafia association*, a binary measure indicating whether an individual was charged under Article 416bis for mafia association – the major charge in the analyzed pre-trial court orders. Given that these judicial documents are primarily intended to present evidence to establish the culpability of the defendants, it is likely that law enforcement prioritized monitoring and reporting on individuals involved in this major charge, making *mafia association* a reasonable proxy for bias. The results of this sensitivity analysis are reported in the Annex (Table Appendix H, Table Appendix I, and Table Appendix J) and briefly discussed in the Result section.

Table 9: Summary of the variables included in the ZINB and OLS models

Variable	Description	Nature	Type
<i>Liaison</i>	The number of instances an individual connects two people belonging to different <i>locali</i> .	Count	Response ZINB
<i>Representative</i>	The number of instances an individual connects one member of his <i>locale</i> and a member of a different <i>locale</i>	Count	Response ZINB
<i>Participation coefficient</i>	The extent to which an individual is connected across different <i>locali</i> – a higher participation coefficient indicates that the individual is more evenly connected across multiple <i>locali</i> .	Continuous	Response OLS
<i>Leader</i>	Being a leader (1=yes, 0=no)	Binary	Predictor NB/OLS
<i>High_meet</i>	Having a number of attended meetings higher than the median of the attended meetings of the individuals included in the network (1=yes, 0=no)	Binary	Predictor ZI
<i>N. call</i>	Number of calls done with other individuals included in the network	Continuous	Predictor ZI
<i>Age</i>	Age in years, mean-centered	Continuous	Control
<i>N. kinship</i>	Number of kinship ties with other individuals included in the network	Continuous	Control
<i>Locale_size</i>	Being a member of a <i>locale</i> with 1-10 members (1), 11-20 members (2), 20+ members (3)	Categorical	Control
<i>Mafia association</i>	Being charged under Article 416bis for mafia association (1=yes, 0=no)	Binary	Control - sensitivity

2.3.3. Objective 2. Investigating the factors influencing collaboration within and across *locali*

The second objective of the research focused on the factors driving collaboration within and across *locali*, with a specific focus on how kinship relations contribute to facilitating this cooperation compared to the formal organizational structure. To fulfill the objective and test the related set of hypotheses identified (*H3, H4, H5*), the research adopted a multiplex approach by distinguishing different interdependent network dimensions and analyzing their property and how they are interrelated. The concept of multiplexity refers to the coexistence of more than one type of relationship between a set of actors (Ertug, Brennecke, and Tasselli 2023). In illegal environments, the interrelation of criminal and social ties is crucial as it fosters trust, reciprocity, and accountability, compensating for lack of formal institutions (Kadushin 2012; von Lampe and Ole Johansen 2004; Papachristos and Smith 2013). Therefore, distinguishing these varied types of relations is essential to gain a better understanding of the structure and dynamics of criminal organizations (Diviák, Dijkstra, and Snijders 2019).

Information extracted from the judicial documents allowed for the identification of various types of relationships among individuals included in the *collaboration network*, including multiple dimensions beyond collaboration. As discussed in Section 2.3.1, the following dimensions were identified and included in the analyses:

- *Kinship network*, which encompasses all kinship ties among individuals included in the *collaboration network*.
- *Family network*, which is limited to immediate family ties, specifically parent-son; siblings; and spouses.

- *Third-degree kinship network*, which covers all kinship ties except those included in the family network.
- *Same locale affiliation network*, which consists of ties among members of the same *locale*.
- *Co-charge network*, which includes ties among individuals who are jointly charged for a crime in the pre-trial judicial document, excluding the mafia association charge.

The same dimensions, excluding the *same locale affiliation network*, were computed for the two additional networks of collaboration which isolated respectively the ties among members from the same *locali* (*intra-collaboration network*) and the ties among members from different *locali* (*inter-collaboration network*), as described in Section 2.3.1 (subsection “Intra-collaboration and inter-collaboration networks and related dimensions”). For the *inter-collaboration network*, an additional dimension was included to test hypothesis *H3*, *kinship locale network*, establishing a tie between two individuals from different *locali* if at least two people from each of their respective *locali* were bound by a kinship tie.

The multiplexity of the three networks of collaboration and their dimensions was investigated first to assess the extent of overlap across network layers and second to examine how the different network dimensions influence and drive collaboration. By disentangling the *intra-collaboration* and *inter-collaboration* networks, the analysis explored potential differences in collaboration within and across *locali*.

The overlap across all network layers (i.e., collaboration and its dimensions) was investigated by adopting two similar, yet complementing approaches. First, the Jaccard Index (Jaccard 1901)

was computed to assess the similarity between the different layers of the network.¹⁹ This metric [1,0] measures the proportion of shared ties between two layers relative to the total number of unique ties present in either layer. The higher the coefficient, the more similar the two network layers. Formally:

$$J(A, B) = \frac{|A \cap B|}{|A \cup B|}$$

Where:

$|A \cap B|$ is the intersection between layer A and layer B (i.e., the number of shared ties).

$|A \cup B|$ is the union of layer A and layer B (i.e., the total number of unique ties across the two layers).

The Jaccard Index is one of the most used measures for investigating multiplexity, also in the criminological field (see, for example, Ficara et al. 2022; Diviák, Dijkstra, and Snijders 2019). It is informative as a global measure of similarity and is particularly useful for concurrent comparisons of multiple network layers. However, its primary limitation is that it does not account for the size differences between layers. As a result, when one network is sparse and the other is much denser, the Jaccard Index may yield a low value even if the ties in the sparse network are almost fully embedded within the denser one. This occurs because the Jaccard Index normalizes the overlap by the total number of unique ties in both networks (i.e., the union), which may disproportionately penalize sparse networks.

To address this shortcoming, the direct overlap between pairs of networks was also computed by focusing on their intersection only. This measure considers the shared ties between two

¹⁹ The analysis was conducted using the R package *multinet* (Magnani, Rossi, and Vega 2021).

networks ($|A \cap B|$) relative to the size of one of the networks only ($|A|$ or $|B|$). In this way, it highlights the percentage of edges in one network that are also present in the other.

Assessing the extent of overlap requires selecting one of the two networks as the reference (denominator). In the present study, the collaboration network was used as the reference to assess its overlap with all other dimensions, while the co-charge network was employed as the reference to measure its direct overlap with the kinship and same locale affiliation dimensions.

This preliminary examination offered a first insight into the interplay between collaboration and kinship and the other dimensions in the three ‘Ndrangheta networks. Nonetheless, to quantify their impact and significance, and test hypotheses *H3*, *H4*, and *H5*, the application of statistical methods became necessary. Standard statistical linear models cannot be applied to the data employed in this study due to the violation of the assumption of independence of observations. Networks indeed are dyadic in nature, and this feature makes it impossible to assume independence (Krackhardt 1988). In the last decades, statistical theorists have developed new and sophisticated models that cope with this limitation and consider dependence in the data when investigating the association between network matrices. Among them, there are quadratic assignment procedure regressions (Scott and Carrington 2011).

The quadratic assignment procedure (QAP) was developed starting from the work of Mantel (1967), who developed a nonparametric matrix correlation test that employs permutations to overcome the problem of interdependence. First applied to social networks by Hubert (1987) and Krackhardt (1987), the QAP regression tests the null hypothesis of no correlation between two matrices by randomly permutating the order of rows and columns of the dependent variable matrix while keeping the other matrix unaltered. In a nutshell, the QAP first runs the estimation on the observed matrix. Then, it randomly permutes the dependent variable matrix in a way that rows and columns move together so that in the permuted matrix the tie value between

nodes i and j does not change while i and j are relocated in the matrix (Borgatti et al. 2022). On permuted data, it runs the estimations and repeats this process a large number of times to stabilize the p -values. The original estimation is compared against the distribution of the results arising from the permuted regressions. If it is at an extreme percentile of the distribution under the null hypothesis – the permuted dataset – it is possible to reject the null hypothesis. For example, if less than 5% of the regression coefficients generated from the permuted data are larger than the observed data, then the coefficient is deemed as statistically significant at the 0.05 level (Borgatti, Everett, and Johnson 2018; Scott and Carrington 2011; Simpson 2001).

The multiple regression quadratic assignment procedure (MRQAP) is an extended version of the QAP which includes multiple network matrices for the prediction of the outcome (Krackhardt 1988). Various MRQAP approaches have been developed based on different permutation procedures (see Dekker, Krackhardt, and Snijders 2007). In the analysis, a Poisson MRQAP using the Double-Dekker Semi-Partially procedure was employed, considering the count nature of the dependent variable. All models were performed using networks in the form of adjacency matrices and analyzed with the *xUCINET* package in R (Borgatti et al. 2022).

The choice of MRQAP over alternative methodological approaches was guided by the specific aims of this research and the nature of the available data. Objective 2 examines the influence of kinship and formal organizational structure factors (leadership and same *locale* affiliation) on collaboration in a static context, i.e., without considering the temporal evolution of the networks. Although some information regarding the timing of meetings and phone calls was available, it was not always complete. Therefore, the study adopted a conservative approach by constructing static networks, as detailed in Section 2.3.1. Given the static nature of the data, methodologies designed for analyzing longitudinal networks, such as temporal exponential random graph models (TERGM) (Hanneke, Fu, and Xing 2010), stochastic actor-oriented

models (SAOM) (Snijders, van de Bunt, and Steglich 2010), and the more recent relational hyperevent models (RHEM) (Lerner et al. 2021), were not taken into account.

Exponential random graph models (ERGM) were considered among the options for the analysis, as they apply to the study of static networks. ERGM estimates the probability of the presence or absence of ties between nodes based on node-level attributes (e.g., rank), dyad-level attributes (e.g., homophily by ethnicity), and structural configurations (e.g., reciprocity and transitivity) (Borgatti et al. 2022; Lusher, Koskinen, and Robins 2012; Robins et al. 2007). Although ERGMs are well-suited to modeling these structural mechanisms generating the network, they are computationally intensive and require a precise specification of hypotheses related to structural patterns. Given the higher computational costs and the primary goal of this research – to assess the influence of kinship and formal organizational structure on collaboration ties rather than to investigate the endogenous structural mechanisms – MRQAP was chosen. Quadratic assignment procedure regressions implicitly control for network interdependencies through permutation tests, without the need to explicitly model the structural processes (Borgatti et al. 2022). This approach offers a straightforward and effective method to test the study hypotheses while accounting for the inherent dependencies within the network data, making it the preferred methodology for this study.

A set of multiple MRQAPs with 5,000 permutations and different specifications were computed using as dependent variables *collaboration*, *intra-collaboration*, and *inter-collaboration networks*. The covariates included the dimensions explored in the descriptive analysis, namely kinship, family, third-degree kinship, which served alternatively as explanatory variables, especially in the analysis of *intra-collaboration* to test the hypothesis that kinship directly strengthens collaboration between members of the same *locale* (H3). For the *collaboration network* only, the *same locale affiliation network* was also included as a proxy of the formal

organizational structure to test the hypothesis that having shared *locale* affiliation strengthens collaboration among ‘Ndrangheta members (*H4*). In the analysis of the *inter-collaboration network*, the covariates were distinct, excluding kinship, family, and third-degree kinship variables, but including the *kinship locale network*, to test the hypothesis that kinship indirectly fosters cooperation between members from different *locali* if the respective *locali* are connected by at least one kinship relationship (*H3*).

Three additional factors were also included in the analysis of all dependent variables. First, *both leaders network*, including a tie if two actors held a leadership position, which was used as a proxy of the formal organizational structure to test the hypothesis that being both leaders reinforces collaboration between members from different *locali*, with no effect on collaboration between members of the same *locale* (*H5*). Second, *same age network*, including a tie if two actors have less than 4 years of difference (demographic factor); the aim was to capture the tendency to rely on similar people as cooperation is usually localized in social space (Charette and Papachristos 2017). Third, *same residence network*, including a tie if two actors lived in the same municipality. Social relations are embedded in the physical space as well, and cooperation may be driven by the geographical distance between two people, especially in the case of physical collaboration such as meetings (Charette and Papachristos 2017; Kleemans 2014). These three networks were computed as one-mode, dichotomous, and undirected matrices relying on information stored in the attribute dataset (Table 3 on page 61). The pre-existing nature of the covariates (kinship, *locale* affiliation, leadership, age, residence) strengthens the causal interpretation of their relationship with collaboration. This condition mitigates potential concerns about reverse causality, thereby ensuring that the interpretation of the results remains valid.

Prior to the MRQAPs, the correlation between matrices was examined using a QAP correlation, those results are reported in the Annex (Table Appendix K, Table Appendix L, Table Appendix M, Table Appendix N, Table Appendix O, Table Appendix P).

Table 10: Summary of the variables included in the MRQAP models and used in the descriptive analysis

Variable	Description	Nature
Collaboration	A tie exists if two individuals participated in at least one meeting or had at least a phone call together	Count
Intra-collaboration	A tie exists if two individuals from the same <i>locale</i> participated in at least one meeting or had at least a phone call together	Count
Inter-collaboration	A tie exists if two individuals from two different <i>locali</i> participated in at least one meeting or had at least a phone call together	Count
Kinship	- A tie exists if two individuals are relatives (collaboration network) - A tie exists if two individuals from the same <i>locale</i> are relatives (intra-collaboration network) - A tie exists if two individuals from different <i>locali</i> are relatives (inter-collaboration network) – <u>only descriptive analysis</u>	Binary
Family	- A tie exists if two individuals are parent-son or siblings (collaboration network) - A tie exists if two individuals from the same <i>locale</i> are parent-son or siblings (intra-collaboration network) - A tie exists if two individuals from different <i>locali</i> are parent-son or siblings (inter-collaboration network) – <u>only descriptive analysis</u>	Binary
Third-degree kinship	- A tie exists if two individuals are relatives, excluding parent-son or siblings (collaboration network) - A tie exists if two individuals from the same <i>locale</i> are relatives, excluding parent-son or siblings (intra-collaboration network) - A tie exists if two individuals from different <i>locali</i> are relatives, excluding parent-son or siblings (inter-collaboration network) – <u>only descriptive analysis</u>	Binary

<i>Kinship locale</i>	A tie exists if two individuals belong to two distinct <i>locali</i> which share at least one kinship relation (inter-collaboration network)	Binary
<i>Same locale affiliation</i>	A tie exists if two individuals are members of the same <i>locale</i> (collaboration network)	Binary
<i>Both leaders</i>	• A tie exists if two individuals are both leaders (collaboration network) • A tie exists if two individuals from the same <i>locale</i> are both leaders (intra-collaboration network) • A tie exists if two individuals from different <i>locali</i> are both leaders (inter-collaboration network)	Binary
<i>Same residence</i>	• A tie exists if two individuals reside in the same municipality (collaboration network) • A tie exists if two individuals from the same <i>locale</i> reside in the same municipality (intra-collaboration network) • A tie exists if two individuals from different <i>locali</i> reside in the same municipality (inter-collaboration network)	Binary
<i>Same age</i>	• A tie exists if two individuals have less than four years of age difference (collaboration network) • A tie exists if two individuals from the same <i>locale</i> have less than four years of age difference (intra-collaboration network) • A tie exists if two individuals from different <i>locali</i> have less than four years of age difference (inter-collaboration network)	Binary

Chapter III. Results

This chapter presents the results of the study, which aims to answer the two research questions and their associated objectives:

RQ1: *To what extent do different locali collaborate? Do high-rank individuals mediate this cooperation?*

Objective 1.1: Investigating internal cohesion at the *locale* level to assess internal and external collaboration intensity differences.

Objective 1.2: Identifying brokers among *locali* and their association with leadership.

RQ2: *What factors influence collaboration in the ‘Ndrangheta? Are there differences between intra- and inter-locali collaboration?*

Objective 2: Assessing the role of kinship in driving collaboration within and across *locali* and comparing it to the role of the formal organizational structure.

Section 3.1 presents the findings relevant to RQ1: Subsection 3.1.1 details the results for Objective 1.1, while Subsection 3.1.2 discusses the findings for Objective 1.2. Section 3.2 then presents the results pertaining to Objective 2.

3.1. Cohesion and integration in the ‘Ndrangheta

3.1.1. *Locali* cohesion

To explore the cohesion of each *locale* and the differences in collaboration intensity within and among *locali*, the study employed the *collaboration network* described in Section 2.3.1 and

computed the cohesion ratio for each *locale*. This analysis aimed to assess whether collaboration was more intense within *locali* than among members from different *locali* in the three case studies.

The findings presented in Table 11, Figure 5, and Figure 6 primarily concern those *locali* central to the three operations and having more than five members²⁰ – respectively 15 in *Infinito*, 12 in *Crimine*, and 10 in *Minotauro*. These results are reported at the case study level, while the detailed results for each *locale* are available in the Annex (Table Appendix A).

Table 11: Descriptive statistics on locali size and cohesion ratio at the aggregate level for locali located in the region of interest of the operation and with more than five members, per case study (N=235 Infinito; N=283 Crimine; N=208 Minotauro)

<i>Locali</i>				α_k				
	N locali	Mean size	Median size	Min	Max	Mean	Median	Sd
<i>Infinito</i>	14	14	13.5	0.08	0.82	0.39	0.37	0.22
<i>Crimine</i>	12	13.8	9	0.07	0.58	0.26	0.22	0.16
<i>Minotauro</i>	10	16.8	10.5	0.05	0.62	0.26	0.19	0.20

Within the case studies, the size of *locali* varies significantly: from 5 to 29 members in *Infinito* (average of 14), from 5 to 45 members in *Crimine* (average of 14), and from 5 to 42 members in *Minotauro* (average of 17) (Table Appendix A). Figure 5 highlights that across case studies larger *locali* generally exhibited higher levels of internal cohesion, yet not showing a well-

²⁰ *Infinito locali*: Seregno, Desio, Milano, Erba, Cormano, Pioltello, Bresso, Bollate, Mariano Comense, Pavia, Rho, Legnano, Corsico, Solaro. *Crimine locali*: Cardeto, Società di Rosarno, Marina di Gioiosa Jonica, Società di Siderno, Società di Melito Porto Salvo, Grotteria, Roghudi, Piscopio, San Luca, Croce Valanidi, Oliveto, Gioiosa Jonica. *Minotauro locali*: Natile di Careri a Torino, Bastarda, Cuorigné, Siderno a Torino, Crimine di Torino, Chivasso, Volpiano, San Giusto Canavese, Rivoli, Moncalieri.

defined pattern. This trend is likely influenced by the greater amount of monitoring these *locali* received, which resulted in more comprehensive data being available about their activities. However, regardless of the size of the *locale*, results indicated limited cohesiveness of *locali*, represented by the *ak* ratio, which measures the intensity of intra-*locale* collaboration as the ratio between the internal strength and total strength at the *locale* level. On average, 39% of the collaborative interactions involved members of the same *locale* in *Infinito*, while this figure is 26% for both *Crimine* and *Minotauro*. Despite some *locali* showed stronger cohesion, such as *Seregno* in *Infinito* (0.82), *Cardeto* in *Crimine* (0.62), and *Bastarda* in *Minotauro* (0.58), the median cohesion ratios were generally low, ranging from 0.22 in *Infinito* to 0.16 in *Crimine*. The results were always statistically significant, except for the lowest levels of *ak* registered in *Crimine* and *Minotauro* (see z-score in Table Appendix A). Overall, only four *locali* in *Infinito*, one in *Crimine*, and two in *Minotauro* showed an intra-locale intensity of collaboration that was statistically significant and higher than 0.5 (Table Appendix A, Figure 5).

Figure 5: Locale size vs internal cohesion (*ak*), dot color by case study

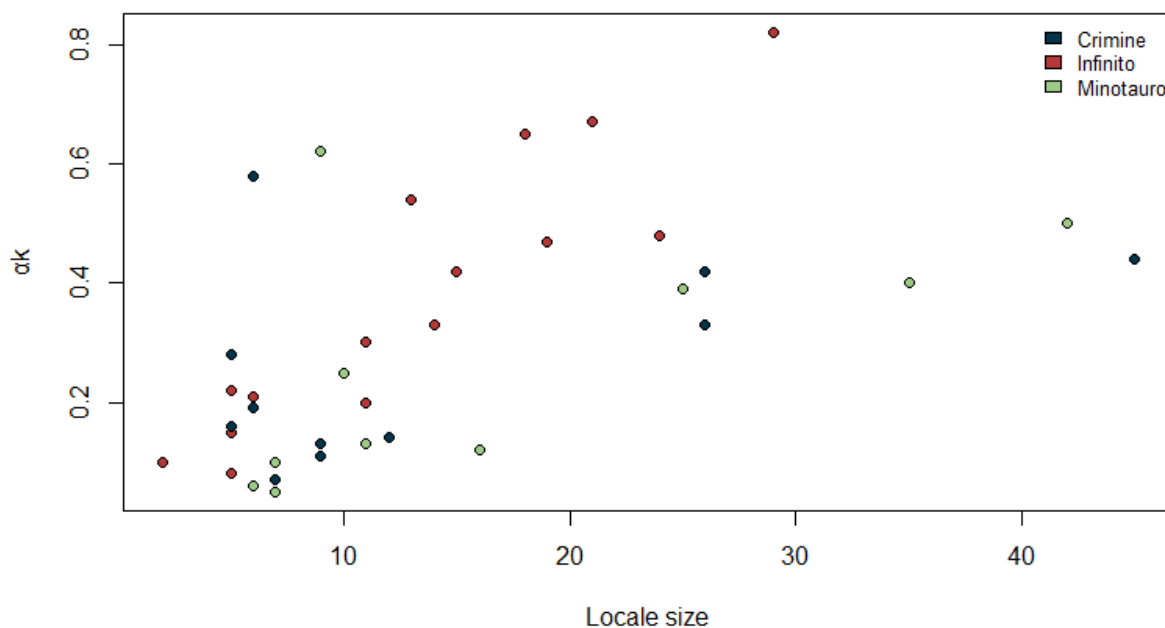
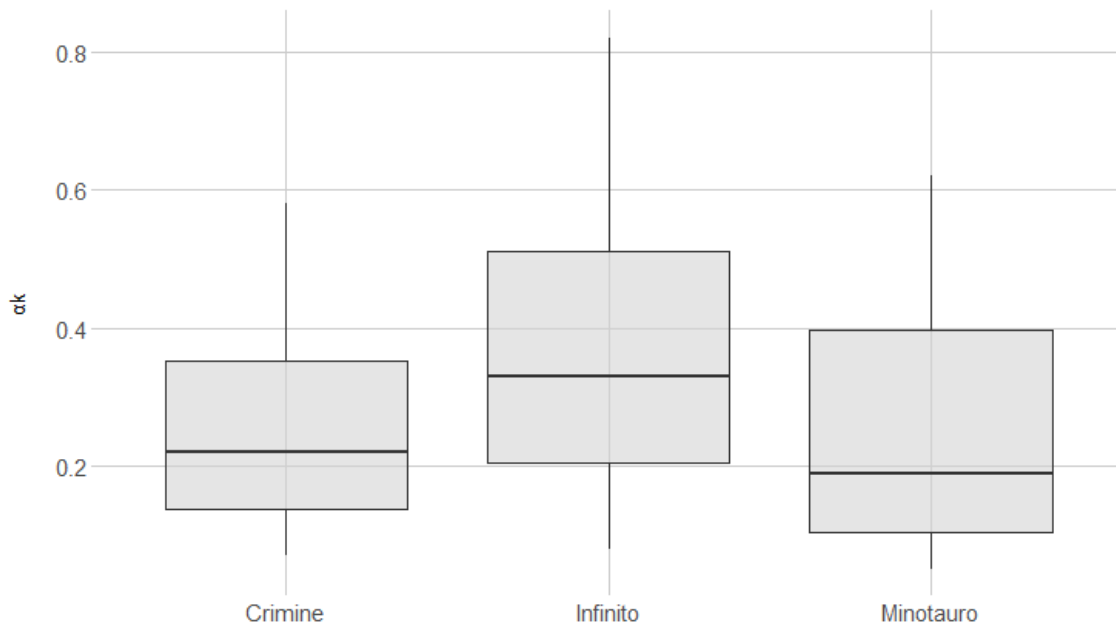


Figure 6: Comparison of the locali internal cohesion (α_k) distribution across case studies

These findings are likely influenced by the quality of the information gathered from law enforcement and the purposes of the three operations. Specifically, the extent of collaboration among members within the same *locale* may have been underestimated due to the operations' focus on depicting and inferring the structure of the 'Ndrangheta groups operating across the three regions, primarily concerning governance-type activities (Campana and Varese 2018). Despite these potential limitations, the results clearly confirmed strong collaboration among *locali* across the three case studies. In *Infinito*, over 60% of the collaboration interactions involved members of different *locali*, a figure that increases to over 75% in *Crimine* and *Minotauro*. These results support the hypothesis that frequent interactions are necessary among *locali* to coordinate their activities effectively (*H1b*).

The *locali* cohesion was calculated at the *locale* level to provide a preliminary overall analysis of the extent of collaboration within and across *locali*, thus setting aside potential variations at the individual levels, especially differences between leaders and non-leaders, which are explored and detailed in the following section.

3.1.2. Brokerage between *locali*

After establishing that members of different *locali* frequently collaborated, the study aimed to identify the individuals acting as intermediaries between *locali* and to assess the association between this strategic positioning and holding leadership positions (Objective 1.2). To identify strategic intermediaries at the meso-level, i.e., among groups, three distinct brokerage centrality measures were computed. First, *liaison*, which captures the number of times an individual intermediates between two members of two distinct *locali*. Second, *representative*, which indicates the number of times an individual mediates a relation between a member of his *locale* and a member of a different *locale*. Third, *participation coefficient*, which represents the extent to which individuals show evenly connections with multiple *locali*. All of the metrics were computed on the *Infinito*, *Crimine*, and *Minotauro collaboration network*, previously described in Section 2.3.1.

A preliminary analysis (Section 3.1.2.1) explored the differences in brokerage roles between leaders and non-leaders. This analysis included the three brokerage metrics of interest – i.e., *liaison*, *representative*, and *participation coefficient*. It also included other relevant measures to provide a comprehensive understanding of the individuals' network positioning. This involved, the number of collaboration events that individuals participated in; the degree centrality; the internal and external strength – i.e., the strength computed within the *locali* and with members of different *locali*, employed for the analysis of cohesion presented in the previous section; and betweenness centrality. To further test the association between the three brokerage measures and leadership and test hypothesis *H2*, multiple statistical models were employed and are presented in Section 3.1.2.2: a set of zero-inflated negative binomial regression models was computed with *liaison* and *representative* as dependent variables, while a set of OLS regression models was used for analyzing *participation coefficient* as the dependent variable.

3.1.2.1. Preliminary descriptive analysis

Results in Table 12 provide a comparison of collaboration events and multiple centrality measures – including liaison, representative, and participation coefficient – between leaders and non-leaders across the case studies. The table includes the median values with standard deviations in brackets for both categories, the ratio of leaders to non-leaders for each metric, and the Mann-Whitney *U* test results indicating the statistical significance of the differences.

This preliminary analysis highlights that leaders had consistently higher values in all metrics across all groups. In all three case studies, they were more active in collaboration events, with their median number of events being 2.5 to 9 times higher than non-leaders. Leaders were also the ones more connected to other people (median degree centrality around 3 to 4 times higher), and with higher intensity, both within their *locali* (internal strength) and especially outside their *locali* (external strength). In this respect, the median internal strength centrality for leaders was around 2.5 higher in *Infinito* and 3.1 higher in *Minotauro* compared to non-leaders, but no significant difference was registered in *Crimine*. On the other hand, the median external strength was much higher for leaders compared to non-leaders across all case studies: 6.7 higher in *Infinito*, 5.7 higher in *Crimine*, and 11.6 higher in *Minotauro*. As will be further discussed, this may suggest that the results of the *locali* cohesion presented in Section 3.1.1 were likely driven by the tendency of leaders to have intense collaboration outside their own *locali*.

Leaders consistently also showed a stronger preference for indirect connectivity, in line with previous research (Calderoni and Superchi 2019), both at the macro-level (betweenness) and at the meso-level (liaison, representative, participation coefficient) (Figure 7, Figure 8, Figure 9). Liaison and representative measures show that leaders had roles of intermediation between *locali* that non-leaders almost did not fill at all, as indicated by non-leaders having a median of 0 across all case studies, except for representative in *Crimine*. The participation coefficient

results show a net difference in *Infinito* and *Crimine*, where leaders exhibited the role of hubs with links homogeneously distributed among all *locali* (participation coefficient >0.75 in line with Guimerà and Nunes Amaral (2005) definition) compared to non-leaders. However, the difference was less marked in *Minotauro*, where the ratio between the medians of the two was around 1.14. The Mann-Whitney *U* test results confirmed the statistical significance of the higher scores of leaders for all metrics compared to non-leaders ($p < 0.001$), except for the internal strength in *Crimine* ($p < 0.7$). The analysis was also conducted by removing the outliers for each metric, showing stable and statistically significant results.

Table 12: Median of the number of collaboration events and centrality measures between leaders and non-leaders (sd), the ratio between the two, and results from the Mann-Whitney U test.

<i>Infinito</i> (N=235)	Leaders	Non-leaders	Ratio	Mann-Whitney U
Collaboration events	17.5 (42.1)	3 (8.3)	5.8	1586.5****
Degree	36 (24.1)	9 (11.5)	4	1578****
Internal strength	20 (28.0)	8 (13.7)	2.5	3269****
External strength	46.5 (73.0)	4 (15.7)	11.6	1073****
Betweenness	350.8 (922.4)	17.7 (327.9)	19.9	1988****
Liaison	245 (1059.3)	0 (136.2)	-	1461****
Representative	81 (279.3)	0 (67.1)	-	2078****
Participation coefficient	0.86 (0.2)	0.40 (0.3)	2.16	1430.5****
N	48	187		
<i>Crimine</i> (N=283)	Leaders	Non-leaders	Ratio	Mann-Whitney U
Collaboration events	5 (33.9)	2 (8.4)	2.5	2820****
Degree	21 (28.1)	7 (10.7)	3	3118****
Internal strength	2 (16.3)	2 (5.6)	1	5729
External strength	23 (49.9)	4 (13.6)	5.7	2511****
Betweenness	322.5 (2399.1)	7.21 (263.8)	44.7	2807.5****
Liaison	66 (1427.8)	0 (90.8)	-	2385****
Representative	8 (539.1)	0 (25.2)	-	3198****
Participation coefficient	0.83 (0.27)	0.57 (0.32)	1.4	2596.5****
N	47	236		
<i>Minotauro</i> (N=208)	Leaders	Non-leaders	Ratio	Mann-Whitney U
Collaboration events	27 (50.1)	3 (16.0)	9	620.5****
Degree	128 (55.3)	34 (38.9)	3.8	834.5****
Internal strength	37 (75.9)	12 (32.1)	3.1	1410.5****
External strength	155 (137.7)	23 (53.5)	6.7	740****
Betweenness	341.2 (562.3)	22.8 (162.7)	14.9	829.5****
Liaison	2404 (3508.1)	0 (937.9)	-	656.5****
Representative	447 (1260.2)	2 (464.4)	223.5	876.5****
Participation coefficient	0.83 (0.07)	0.73 (0.33)	1.14	998.5****
N	29	179		

Figure 7: Differences between leaders and non-leaders for liaison, representative, participation coefficient, betweenness, external and internal strength centrality measures, Infinito (N=235)

Infinito

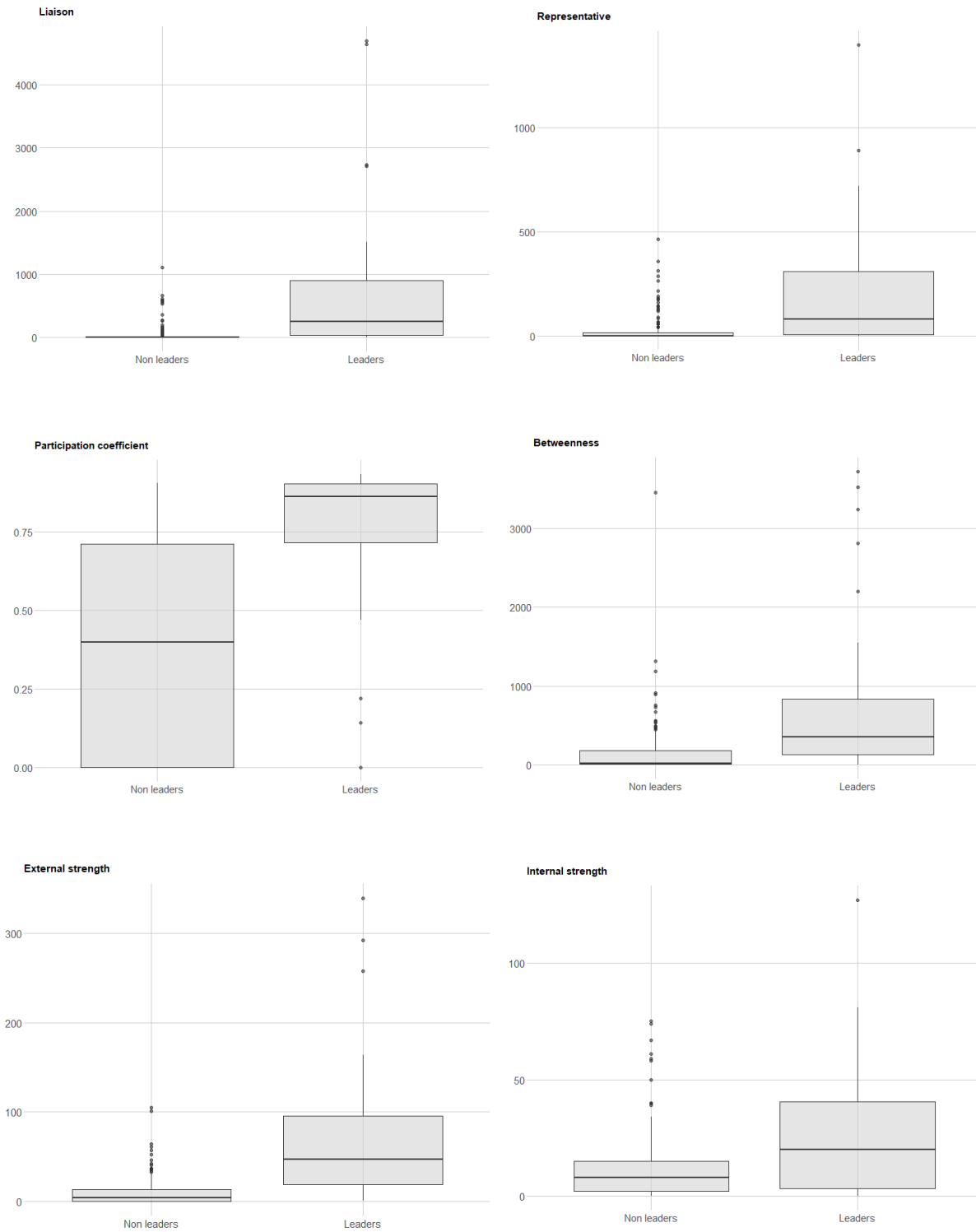


Figure 8: Differences between leaders and non-leaders for liaison, representative, participation coefficient, betweenness, external and internal strength centrality measures, Crimine (N=283)

Crimine

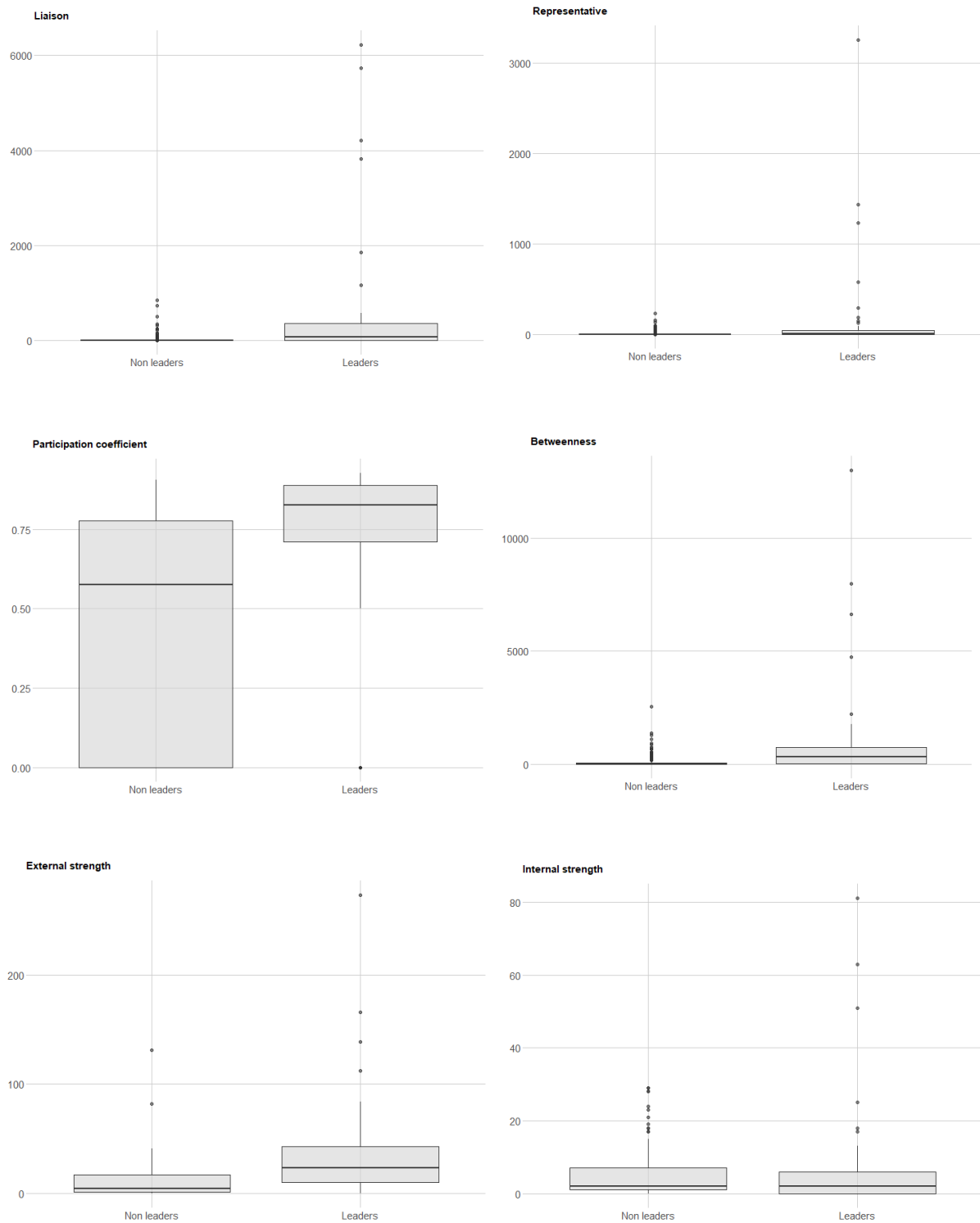
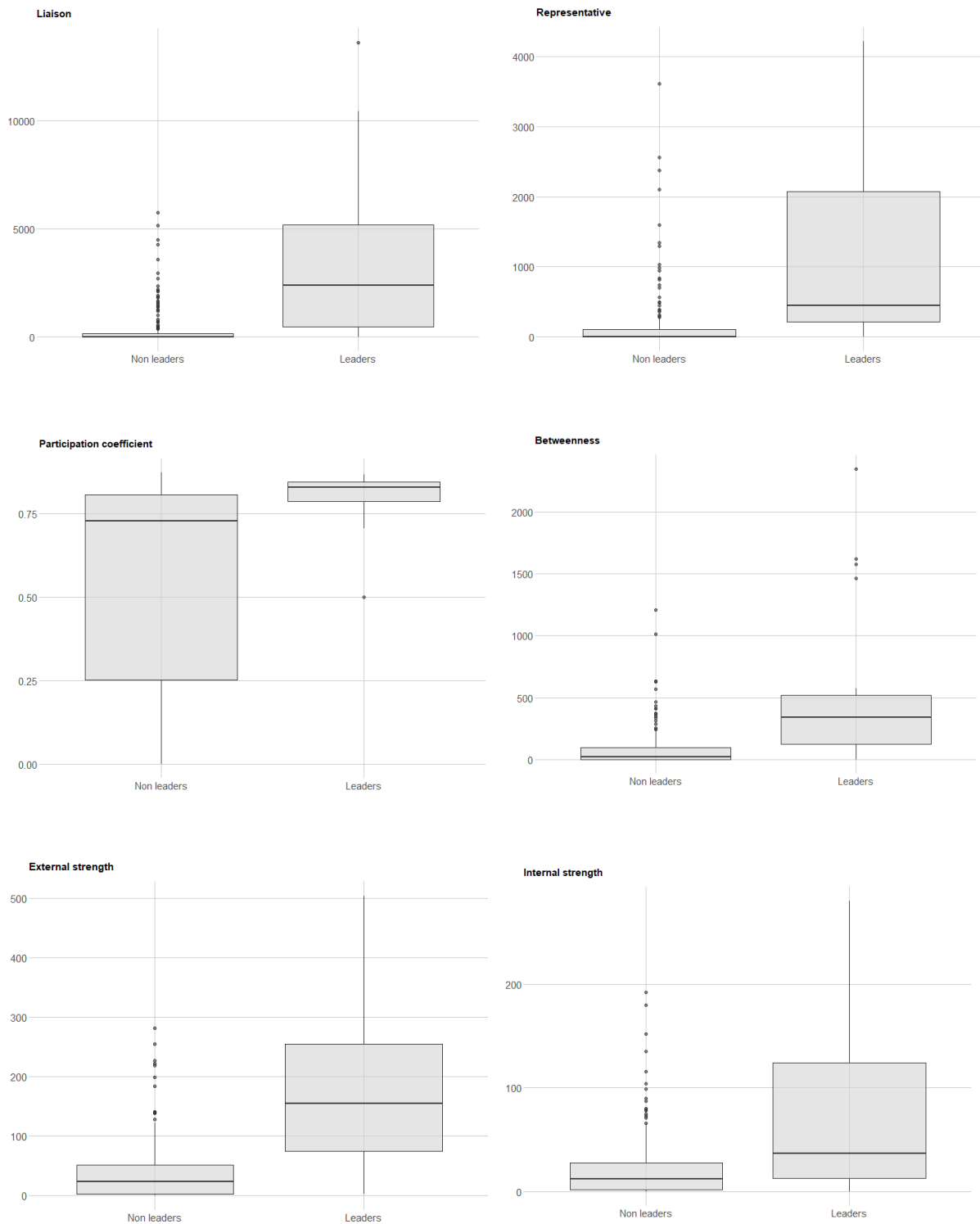


Figure 9: Differences between leaders and non-leaders for liaison, representative, participation coefficient, betweenness, external and internal strength centrality measures, Minotauro (N=208)

Minotauro



3.1.2.2. ZINB and OLS regression analysis

Multiple statistical regression models were employed to identify the features of ‘Ndrangheta members who acted as brokers across *locali* within the organization. The primary focus was to investigate the association between brokerage roles and leadership. Zero-inflated negative binomial regression models were run, with *liaison* and *representative* as the response variables. Additionally, a set of OLS regressions was computed using the participation coefficient as the dependent variable. The main explanatory variable was the variable *leader*, a binary variable of whether an individual held a leadership position. Other covariates included the age (mean-centered), the number of kinship ties, and the size of the *locale* – divided into three categories: 1-10 members; 10-20 members; and >20 members. For the zero-inflated models, a high number of meetings and the number of phone calls were included as predictors of extra-zeros.

To partially control for law enforcement biases, a sensitivity analysis was conducted across all models by adding, alongside all other covariates, the control variable *mafia association*. This dummy variable indicates whether an individual was charged under 416bis for mafia association, which represented the main charge in the three operations. The results are only briefly commented here, and the full models can be found in the Annex (Table Appendix H, Table Appendix I, and Table Appendix J).

Table 13 reports the results of the bivariate (model I) and complete (model II) zero-inflated negative binomial models using the *liaison* centrality measure as the dependent variable, which identifies the number of times an individual mediates between two members of two distinct *locali* different from the one he belongs (see Figure 3 on page 82 for a graphical representation). Coefficients in the table are not exponentiated, while in the presentation and discussion of the results they are reported as incident rate ratios (IRRs).

The results of the negative binomial model highlight that the variable “leader” showed a

positive and significant effect on the score of the liaison metric in all three case studies, suggesting a strong association between leadership status and the role of broker between *locali*, in line with what was hypothesized (*H2*). In the bivariate model, having a leadership position increased the expected count of liaison by approximately 7.5 times in the *Infinito* case study, while the expected increase of count was equal to 12.0 times for *Crimine* and 4.3 times for *Minotauro*. After adjusting for the control variables in model II, the effect of leadership remained significant but showed a decrease in magnitude and significance for *Crimine* and *Minotauro*, whose IRR decreased respectively to 7.7 and 4.2. This reduction may suggest that while leadership was a key factor, other variables also contributed to the liaison role, confounding the sole impact of leadership.

The analysis of the other covariates in model II indicated that age (mean-centered) was positive and significantly associated with higher values of liaison in the *Minotauro* network only. For each year above the mean age, the expected count of the liaison metric increased by a factor of 1.05 in *Minotauro*, possibly reflecting an effect of greater experience or seniority in the role of intermediary across *locali*, yet not consistent across case studies. However, in both the bivariate model (age alone) and the model with controls only reported in Annex (Table Appendix Q), age showed a significant association with the liaison metric across all case studies (in the bivariate model, IRR=1.04 in *Infinito*, IRR=1.05 in *Crimine*, IRR=1.07 in *Minotauro*). This pattern may suggest a potential mediation effect, where age influences the dependent variable indirectly through its effect on leadership position.

The number of kinship ties showed varied effects in terms of direction, though none are statistically significant in the case studies. When considering the bivariate model (“n. kinship ties” alone) in Annex (Table Appendix Q), the number of kinship ties showed a significant association with the liaison metric in the *Crimine* case study only (IRR=1.45). On the contrary, the size of the *locale* did not significantly influence the score of liaisons, neither in the complete model II nor in the bivariate analysis (Table Appendix Q) across all case studies.

For what concerns the zero-inflated model, the variable “high_meet” showed a negative and significant effect in the *Infinito* and *Minotauro* case studies, suggesting that a high number of meetings attended reduced the likelihood of zeros. In contrast, the variable “n_call” was significant only in the *Crimine* case study, for which “high_meet” was not significant, indicating that a high number of phone calls reduced the likelihood of excess zeros in this network. These results may suggest a potential bias introduced by law enforcement activities, which focused their attention on certain individuals. This targeted prioritization can affect the observed frequency of meetings and calls, increasing the probability of non-zero outcomes for these individuals, as their activities are subjected to more intensive monitoring and documentation.

The results from the sensitivity analysis, which included *mafia association* as an additional control variable to control for prosecution biases, remain consistent with the main findings (see Table Appendix H). Despite a limited variation in effect size and some multicollinearity issues in the *Infinito* and *Minotauro* models, the results for *leaders* remain positive and statistically significant, reinforcing the robustness of the findings.

To summarize, leaders consistently registered higher scores in the liaison brokerage compared to other non-leader ‘Ndrangheta members. The regression analysis underscored the significant role that leaders played in intermediating between members of distinct *locali* in the three case studies. These results seem to suggest a central role of leaders in facilitating communication and coordination within the three networks, reinforcing the hypothesis that leadership status is closely associated with the role of broker among *locali* in the three case studies (H2).

Table 13: Bivariate (I) and complete (II) zero-inflated negative binomial models for liaison, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
<i>Negative binomial</i>	I	II	I	II	I	II
Intercept	4.678	4.359	4.208	3.506	6.717	6.555
Leader	2.011***	2.394***	2.510***	2.041*	1.450**	1.432**
Age		0.008		0.023		0.050***
N. kinship		-0.159		0.236		-0.108
Locale_size2		0.691		0.105		0.334
Locale_size3		0.209		0.619		-0.110
Log(theta)	-0.851*** (0.183)	-0.880*** (0.208)	-1.553*** (0.165)	-1.408*** (0.193)	-0.931*** (0.148)	-0.852*** (0.153)
<i>Zero-inflated</i>						
Intercept	1.587*** (0.351)	1.559*** (0.359)	1.601*** (0.257)	1.622 (0.262)	0.880*** (0.234)	0.879*** (0.234)
High_meet	-3.412*** (0.606)	-3.610*** (0.791)	-10.391 (69.280)	-5.004 (4.832)	-3.021*** (0.603)	-3.132*** (0.675)
N. call	-0.039 (0.055)	-0.034 (0.060)	-1.014*** (0.385)	-0.999*** (0.386)	-0.096 (0.068)	-0.092 (0.069)
Log-likelihood	-747.6	-745.1	-607.0	-600.3	-911.7	-903.7
N	183	183	277	277	185	185
Significance: *** = p < 0.01; ** = p < 0.05; * = p < 0.1						

The same model specifications were then adopted to test the relationship between the representative brokerage measure and holding a leadership position, whose results are reported in Table 14. The representative metric captures the number of times an individual acts as an intermediary between a member of his locale and a member of a different locale (see Figure 3 on page 82 for a graphical representation).

The bivariate analysis (model I in Table 14) highlights a positive and significant association between the variable “leader” and the representative metric across all three case studies. Specifically, for *Infinito*, being a leader was associated with an expected count of representative approximately 3.7 times greater than that of non-leaders. In *Crimine*, the effect was more pronounced, with leaders showing a 12.1-fold increase in the expected count of representative, though with a lower statistical significance ($p < 0.1$). For *Minotauro*, the increase was lower, at 2.8 times compared to non-leaders, yet statistically significant.

When the other covariates were included (model II), a positive and statistically significant effect persisted for the *Infinito* and *Minotauro* networks. In *Infinito*, being a leader was associated with the expected count of representative being 4.7 times greater than that of non-leaders. In *Minotauro*, the increase was 3.1 times higher than for non-leaders; however, this result showed a lower significance compared to the bivariate model ($p < 0.1$). On the contrary, the results for *Crimine* were not statistically significant after adjusting for the covariates. This highlights that, unlike the liaison brokerage position, intermediation between group members and members of other *locali* did not consistently associate with leadership status, potentially suggesting context-specific cooperation that may not align with formal leadership hierarchies within the organization.

In line with the previous analysis of liaison, the variable “age” did not exhibit a significant association with representative brokerage, except for the *Minotauro* case. In *Minotauro*, each additional year is associated with a 3.0 times increase in the expected count. The bivariate analysis (age alone) reported in Annex (Table Appendix R) indicates a positive and significant association of age with the representative metric for *Crimine* (IRR = 1.06, $p < 0.05$) and *Minotauro* (IRR = 1.06, $p < 0.001$), whereas no such association was observed in the *Infinito* case study.

In the analysis, the number of kinship ties showed no significant association with the role of representative in any of the case studies. However, contrary to the analysis of the liaison brokerage analysis, “n. kinship” held a positive and weakly significant effect in the bivariate models (“n. kinship” alone) across all case studies (IRR=1.15, $p < 0.1$ in *Infinito*, IRR=1.49, $p < 0.1$ in *Crimine*, and IRR=1.23, $p < 0.1$ in *Minotauro* (Table Appendix R). This difference may indicate that the impact of “n. kinship” may interact with other variables in the full model, potentially affecting the influence. The analysis also showed a relationship between the variable “locale size” and the expected count of representative, particularly for the *Infinito* and *Minotauro* networks. Specifically, “locale_size2” (i.e., being part of a locale of 10-20 members) was positively and significantly associated in both case studies, while “locale_size3” (i.e., being part of a locale of more than 20 members) was statistically significant in *Infinito* only. None of them was significant in *Crimine*. The positive association with the representative metric was expected and aligned with the measure’s computation based on locale size, as discussed in Section 2.3.2.

In the *Crimine* case study, the bivariate analyses (Table Appendix R) showed a significant association between all controls and the representative metric. However, in the full model II (Table 14) none of them show a significant association. Even if the variance inflation factor (VIF) indicated low multicollinearity in model II (Table 14),²¹ these results may signal that there still was shared variance among the covariates that weakened the individual effects in the full model. The zero-inflated model confirmed also in this case that a high number of meetings (“high_meet”) attended consistently reduced the likelihood of an observation being an excess zero across all models, showing a robust association. On the other hand, the number of calls (“n_calls”) reduced the likelihood of excess zeros in *Infinito* and *Minotauro*, but this effect was not consistently significant in *Crimine*, indicating a weaker association compared to variable “high_meet”.

The sensitivity analysis confirmed that the inclusion of *mafia association* as a control variable did not alter the main findings. The variable *leader* maintained the same directional effect and statistical significance as in Model II across case studies (Table Appendix I), further reinforcing the robustness of the findings.

To summarize, the regression analysis identified a positive association between holding a leadership position and acting as an intermediary between affiliates to the same *locale* and those from different *locali*. However, this association was weaker and not consistently significant across all case studies, particularly in *Crimine*. This inconsistency may suggest alternative dynamics influencing this specific type of brokerage role, indicating that such intermediary activities might be less directly connected to leadership in some contexts.

²¹ Vif results for *Crimine* model II: Leader = 1.9; Age = 1.3; N. kinship = 1.7; Size_category = 1.9.

Table 14: Bivariate (I) and complete (II) zero-inflated negative binomial models for representative, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
<i>Negative binomial</i>	I	II	I	II	I	II
Intercept	4.166	2.453	3.066	2.040	5.830	4.399
Leader	1.307***	1.547***	2.492**	1.893	1.270**	1.102*
Age		0.007		0.006		0.036***
N. kinship		-0.054		0.196		-0.030
Locale_size2		1.960***		-0.093		0.904
Locale_size3		1.782***		1.286		1.625**
Log(theta)	-0.664*** (0.167)	-0.574*** (0.169)	-1.312*** (0.176)	-0.996*** (0.183)	-0.756*** (0.147)	-0.445*** (0.145)
<i>Zero-inflated</i>						
Intercept	1.417*** (0.335)	1.412*** (0.341)	1.546*** (0.255)	1.599** (0.249)	0.802*** (0.232)	0.817*** (0.229)
High_meet	-2.648*** (0.477)	-2.747*** (0.510)	-2.405*** (0.706)	-2.367*** (0.659)	-4.124*** (1.189)	-3.903*** (0.915)
N. call	-0.166** (0.078)	-0.173** (0.083)	-1.039*** (0.320)	-1.024*** (0.306)	-0.059 (0.066)	-0.059 (0.063)
Log-likelihood	-689.6	-680.1	-505.2	-490.2	-848.8	-827.7
N	183	183	277	277	185	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$						

The third brokerage measure taken into analysis was the participation coefficient, which represents the extent to which individuals show evenly connections with multiple *locali*. The results of the bivariate and multiple OLS regression models are reported in Table 15.

The bivariate analysis results (model I in Table 15) confirmed a positive, strong, and significant association between holding leadership positions and having well-distributed connections with multiple *locali*. Specifically, leaders in *Infinito* showed an increase of 0.315 in their participation coefficient compared to non-leaders, keeping all other variables constant. For

Crimine and *Minotauro*, the increases were 0.241 and 0.265, respectively, all of which were highly significant, with a p-value lower than 0.001. The inclusion of the other covariates (model II) did not affect the robustness of the results, which kept highlighting a positive and significant association between leadership and participation coefficient. For *Infinito*, the increase was slightly reduced to 0.261 while keeping all other variables fixed, for *Crimine* to 0.193, and for *Minotauro* to 0.267, with all effects maintaining high statistical significance. This consistency across the case studies supports the hypothesis and suggests that leaders were more involved across various *locali*, reflecting their influence and central role in keeping the connections with external members.

Regarding the other covariates, “age” did not exhibit a significant association with the participation coefficient in any of the case studies in the full model. However, the relationship was positive and significant but very weak (ranging from 0.003 in *Minotauro* to 0.007 in *Infinito*) in the bivariate analysis (Table Appendix S), suggesting potential mediations in the full models. The variables “n. kinship” and “locale_size2” (i.e., being members of a locale with 10-20 members) were not significant across all case studies, neither in model II in Table 15 nor in the bivariate analysis (Table Appendix S). “Locale_size3” (i.e., be part of a locale with more than 20 members) showed inconsistent results across case studies, with a negative association in the *Infinito* model II, and a positive and significant association in the *Minotauro* model II. The bivariate analysis (Table Appendix S) highlighted a negative and significant association in *Infinito* ($b = -0.32$, $p < 0.001$) and *Crimine* ($b = -0.12$, $p < 0.001$), while a significant positive association in *Minotauro* ($b = 0.16$, $p < 0.001$). This inconsistent result may be related to the differences in the number of individuals belonging to the three categories across the three case studies. Indeed, almost 50% of individuals in *Minotauro* belonged to a *locale* with more than 20 members, while in *Infinito* and *Crimine* the percentage was around 30%.

The adjusted R-squared indicates that *Infinito* models were the ones with the best fit among the case studies, with an adj. R-squared of 0.28 in model II. *Crimine* and *Minotauro* both showed relatively low adj. R-squared, equal to 0.08 and 0.14 respectively. In all cases, the inclusion of control variables increased the fit of the models compared to the bivariate models, yet with a limited increase in *Crimine*.

In line with the analysis for liaison and representative, the results from the sensitivity analysis confirmed the findings of Model II, with *leader* continuing to show a positive and statistically significant effect after the introduction of the control variable “mafia association” (Table Appendix J).

To summarize, the analysis underscored a strong and positive association between participation coefficient and leadership across all case studies: leaders were always more involved across multiple *locali*, reflecting their influence and central role in maintaining connections with external members from various groups compared to non-leaders.

Table 15: Bivariate (I) and complete (II) OLS models for participation coefficient, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
	I	II	I	II	I	II
Intercept	0.480	0.561*	0.487	0.519	0.540	0.482
Leader	0.315***	0.261***	0.241***	0.193***	0.265***	0.276***
Age		0.003		0.002		0.001
N. kinship		-0.005		-0.006		-0.026
Locale_size2		0.007		0.100		0.119
Locale_size3		-0.218***		-0.067		0.169***
R ²	0.18	0.30	0.07	0.10	0.09	0.16
Adj. R ²	0.17	0.28	0.07	0.08	0.09	0.14
N	183	183	277	277	185	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$						

In conclusion, leadership consistently influenced all three brokerage measures, confirming the hypothesis that leaders play a central role in mediating interactions among *locali* under different perspectives (H2). First, leadership was strongly associated with the role of intermediation among distinct *locali* (liaison), evident across *Infinito*, *Crimine*, and *Minotauro*. Second, leaders reported higher scores of representative brokerage, indicating that leaders mediated between members of their own *locali* and those of other *locali*. However, the effect in this case was weaker and not always statistically significant, suggesting possible alternative dynamics at play. Lastly, leaders showed higher participation coefficients, which demonstrates the role of leaders in intermediating relationships across multiple *locali*, with leaders consistently exhibiting higher connectivity compared to non-leaders. These findings confirmed the significant role of leaders in facilitating inter-*locale* connections, while also suggesting some variations in the type of mediated relationships across case studies.

3.2. Factors influencing collaboration in the ‘Ndrangheta

The second objective of the study explored the factors associated with collaboration in the ‘Ndrangheta, and whether these factors differ when considering collaboration within *locali* and across *locali*. To achieve this, a descriptive analysis was conducted using the Jaccard Index and the direct overlap measure to assess the overlap between various types of relationships (collaboration and its dimensions). The direct overlap analysis specifically focused on the intersection between collaboration and kinship, same *locale* affiliation, and co-charge. Additionally, the direct overlap between co-charge and the dimensions of kinship and same locale affiliation was also examined to provide further insights for discussion. Subsequently, a set of Poisson MRQAP regressions were performed to statistically test the association between collaboration and the aforementioned dimensions, including also leadership roles and demographic and geographical factors, and thus test hypotheses *H3*, *H4*, and *H5*.

These analyses were conducted using the three collaboration networks and related dimensions as identified in Section 2.3.1: the *collaboration network* (including all collaborative relations without *locali* distinctions), the *intra-collaboration network* (including only ties among members of the same *locali*); and the *inter-collaboration network* (including only ties among only members of different *locali*). The following subsections present the results of the descriptive multiplexity and the regression analyses.

3.2.1. Descriptive analysis of multiplexity

The results on multiplexity of the whole networks, without distinguishing between intra- and inter- *locali*, are reported in Figure 10 and Table 16. Figure 10 displays the outcomes based on the Jaccard Index, while Table 16 shows results on the direct overlap using the *collaboration network* and the *co-charge network* as reference networks.

For what concerns collaboration, the findings underscore that the overlap between the *collaboration network* and the various dimensions was generally low, in line with previous research on multiplexity in organized crime (C. M. Smith and Papachristos 2016).

A notable exception is observed for the *same locale affiliation* dimension. As highlighted by the values of the Jaccard Index (Figure 10), this dimension was the most similar to the *collaboration network*, with 13% – 23% of the total ties across the two networks being shared in the three case studies. The direct overlap provides precise percentages about the extent of embeddedness (Table 16): 34.2% of the collaboration ties in *Infinito*, 23.0% in *Crimine*, and 25.7% in *Minotauro* occurred with members from the same *locale*. This result aligns with the findings on the cohesion of *locali* presented in Section 3.1.1., which pointed out that the majority of collaboration ties extended beyond the *locali* boundaries.

Kinship, which encompasses all familial connections, exhibited a limited similarity with collaboration (Figure 10), with varying degrees of direct overlap across the case studies (Table 16): 6.2% in *Infinito*, 4.1% in *Crimine*, and 2.4% in *Minotauro*. Compared to *Infinito* and *Crimine*, the relatively low percentages in *Minotauro* may be attributed to the larger volume of collaboration edges recorded in this network (E=4226) compared to those in *Infinito* (E=2036) and *Crimine* (E=1769). Focusing on immediate family ties (“family” in Table 16), which included only parent-child and sibling relationships, the observed overlaps were limited: around 2.0% in both *Infinito* and *Crimine* and slightly lower at 1.3% in *Minotauro*. A distinctive insight emerges in *Minotauro* if these figures are compared to the total kinship ties (*kinship*), where more than half (54%) of the existing ties were family ties, versus 32% for *Infinito* and 44% for *Crimine*, where third-degree kinship ties showed greater prevalence. Of the third-degree kinship ties, 32% in *Infinito*, 24% in *Crimine*, and 39% in *Minotauro* were kinship ties acquired through marriage, i.e., father-son-in-law or brothers-in-law (see Table Appendix B in Annex).

Regarding the co-charges dimension, which included ties among individuals who received at least a charge together in the pre-trial court order, the extent of overlap with collaboration varied a lot across case studies, being on average limited, as reflected by both the Jaccard Index and direct overlap percentages. In *Infinito*, 3.4% of collaboration ties occurred between individuals who had also committed a crime together, while the percentages were lower for *Minotauro* and *Crimine*, respectively equal to 1.0% and 0.4% (Table 16). The variance in the extent of overlap across the three case studies can likely be attributed to the source of data employed for the computation of this dimension. The number of charges and the extent to which they are connected to multiple individuals depends heavily on the prosecutorial approach and the availability of evidence. In the analyzed cases, 50 co-charge events were available for *Infinito*, 12 for *Crimine*, and 42 for *Minotauro*.

Other interesting patterns emerged shifting the focus and analyzing the overlap between co-charge and other dimensions, namely kinship and same *locale* affiliation. Figure 10 reveals that the *co-charge network* had very limited similarity to both the *kinship network* and the *same locale affiliation network*. The Jaccard Index values ranged from 0.003 in *Crimine* to 0.05 in *Infinito* for same *locale* affiliation, and from 0.01 in *Minotauro* to 0.07 in *Infinito* for kinship. However, these results must be interpreted cautiously due to the sparseness of the *co-charge network* in comparison to the other two networks (see Table Appendix B in the Annex for a detailed comparison). Indeed, distinct insights arise when examining the direct overlap, computed using *co-charge network* as the reference (Table 16). On the one hand, most co-charge ties occurred among members of the same *locale* – 77.4% in *Infinito*, 87.7% (6 out of 7 ties) in *Crimine*, and 62.5% in *Minotauro*. These findings align with previous knowledge on the autonomy of *locali* in carrying out illicit activities in the ‘Ndrangheta (Catino 2019). Compared to collaboration, the commission of crimes in all three cases primarily involved members from the same *locale*, potentially suggesting distinct dynamics between collaboration

and co-offending.

On the other hand, the overlap between co-charge and kinship ties was less consistent, with significant variation across case studies: 17% in *Infinito*, 57.1% (4 out of 7 ties) in *Crimine*, and 4.2% in *Minotauro*. This variability makes it challenging to draw conclusions about the role of kinship in co-charge relationships. In addition, while the direct overlap provides a more precise measure of embeddedness compared to the Jaccard Index, the small number of co-charge observations across the case studies limits the reliability of these findings. This raises questions about the robustness of the results and suggests that further data or additional analyses are needed to validate these patterns.

Table 16: Percentage of overlap between the collaboration and co-charge networks and the other network's dimensions, per case study

	% Ties Overlap Infinito (N=235)	% Ties Overlap Crimine (N=283)	% Ties Overlap Minotauro (N=208)
Collaboration	2036	1769	4226
Co-charge	3.4%	0.4%	1.0%
Kinship	6.2%	4.1%	2.4%
Family	2.0%	1.8%	1.3%
Third-degree kinship	4.2%	2.3%	1.1%
Same locale affiliation	34.2%	23.0%	25.7%
Co-charge	106	7	48
Kinship	17.0%	57.1%	4,2%
Same <i>locale</i> affiliation	77.4%	85.7%	62.5%

Figure 10: Jaccard Index heatmap of whole networks overlaps, by case study (excluding overlaps among kinship, family, and third-degree kinship)



The analysis of multiplexity across the whole collaboration network provided initial insights into the interrelations of same *locale* affiliation, kinship, and co-charge dimensions, with collaboration. In addition, exploring the overlaps between co-charge and kinship and same *locale* affiliation dimensions highlighted potential distinct patterns compared to collaboration, leaving room for further discussions. The focus now shifts to the analysis of intra-*locale* and inter-*locale* dynamics. Given that the previous results on the co-charge dimension show that it overlaps primarily occurred among members of the same *locale*, the intra- and inter-*locali* co-charge multiplexity is not discussed in further detail here.

Compared to the analysis of the whole collaboration network, granular analysis of intra-*locale* and inter-*locali* dynamics revealed distinct patterns. Results presented in Table 17 and Table 18 provide a comparative exploration of collaboration patterns within (*intra-collaboration network*) and across (*inter-collaboration network*) *locali*, highlighting variation in how kinship ties and collaborative relationships intersect. Figure 11 reports the results from the Jaccard Index.

Table 17 shows substantial overlaps between kinship (*intra-kinship network*) and intra-collaboration ties across case studies: 16.7% in *Infinito*, 15.0% in *Crimine*, and 8.8% in *Minotauro*. These figures, in line with the Jaccard Index results (Figure 11), underline that a significant proportion of collaborations within the same *locali* involved related individuals. In *Infinito*, most of these relations involved third-degree kinship (*intra-third-degree kinship network*) (11.1%). Family ties (*intra-family network*) were more prevalent in *Minotauro*, comprising 5% of the overlaps. This distinction was less pronounced in *Crimine*, where the presence of family and third-degree kinship ties was almost equivalent. Among the third-degree kinship ties, 31% in *Infinito*, 26% in *Crimine*, and 37% in *Minotauro* derived from marriages, signaling the relevance of marital relationships to establish kinship connections within *locali*

(see Table Appendix C).

A different scenario emerges from the analysis of the *inter-collaboration network* (Table 18, Figure 11). The direct overlap between inter-collaboration and kinship ties (*inter-kinship network*) was markedly limited across all three case studies. *Crimine* displayed the highest percentage, albeit only at 0.9%, followed by *Infinito*, with 0.7%, and *Minotauro* at a minimal 0.2%. These figures, all below 1%, underscore the rarity of kinship relations among members from different *locali*, with almost all recorded kinship relations being third-degree kinship (*inter-third-degree kinship network*) – 0.6% in *Infinito*, 0.7% in *Crimine*, and 0.2% in *Minotauro*. Of them, 3 in *Infinito* and *Minotauro* and 2 in *Crimine* were acquired through marriage (Table Appendix D). Family ties (*inter-family network*), including father-son and siblings, were extremely and consistently rare across *locali*: one in the *Minotauro*, and two each in *Infinito* and *Crimine*.

Results for the *kinship locale* dimension, which considers a tie between two individuals whose *locali* are connected by at least one kinship relationship, indicate a significant but variable overlap with collaborative ties across *locali*. Specifically, in the *inter-collaboration network*, 7.8% of ties in *Infinito* were between members of *locali* linked by at least one kinship connection, compared to 14.1% in *Crimine*, and only 4.6% in *Minotauro*. As can be seen from Figure 11, *kinship locale* was the most similar dimension to the *inter-collaboration network*.

Differences also arise concerning the overlap with the co-charge dimension. The comparison of results from Table 17 and Table 18 highlights that co-charge ties predominantly overlapped with collaboration ties within the same *locale* rather than across *locali*: 8.5% of collaboration ties in *Infinito* overlapped with the commission of at least one crime together (*intra-co-charge network*), compared to 2.7% in *Minotauro*, and 1.5% in *Crimine*. Conversely, in the *inter-collaboration network*, the overlap with the *inter-co-charge network* falls below 1%, across all

three case studies – 0.8% in *Infinito*, 0.4% in *Minotauro*, and 0.1% in *Crimine*. This result aligns with the findings on the large and consistent overlap between *co-charge network* and *same locale affiliation network* previously presented (Figure 10, Table 16).

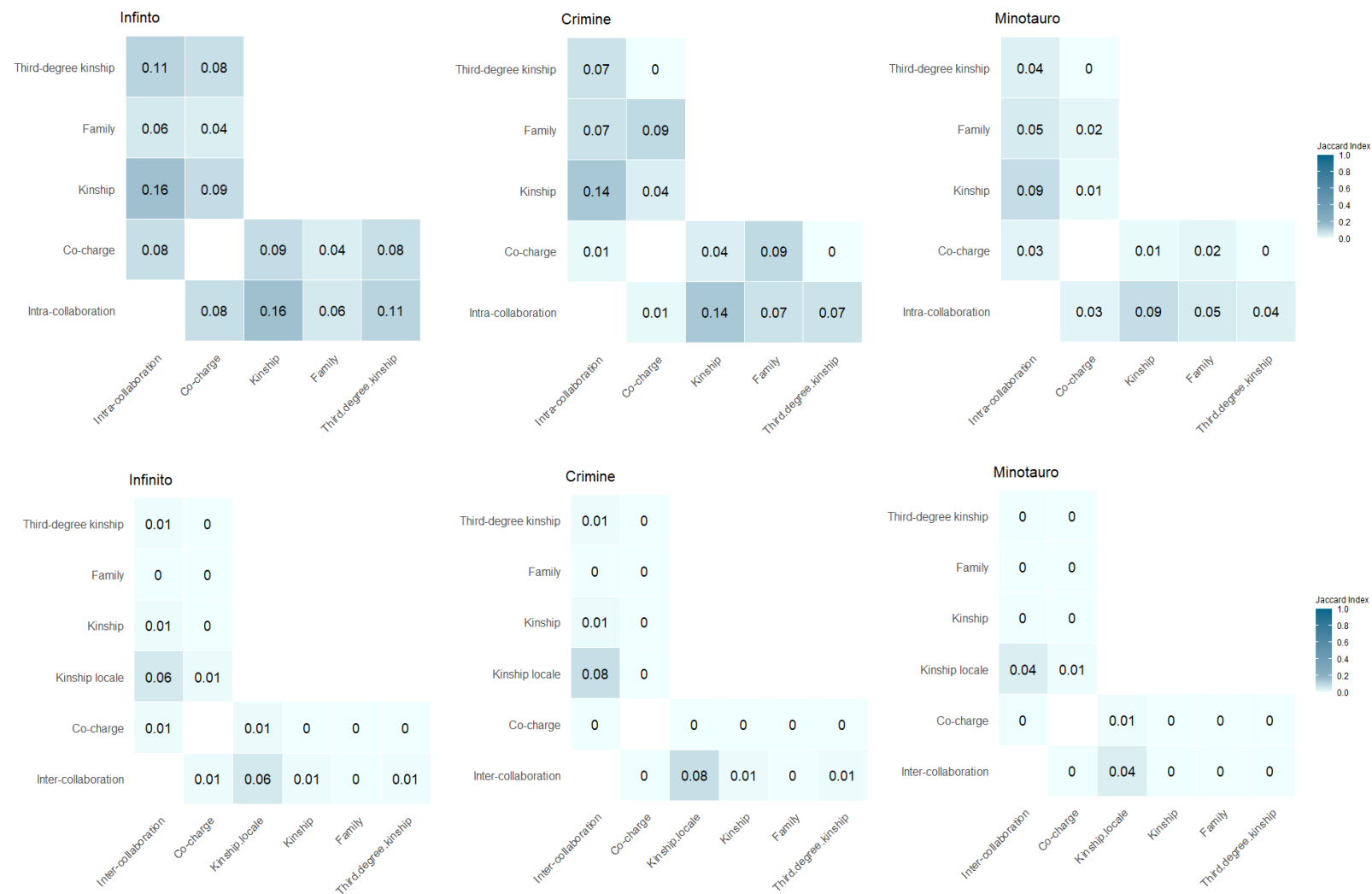
Table 17: Percentage of overlap between the intra-collaboration network and the other network's dimensions, per case study

	% Ties Overlap Infinito (N=210)	% Ties Overlap Crimine (N=228)	% Ties Overlap Minotauro (N=172)
Intra-Collaboration	696	406	1084
Co-charge	8.5%	1.5%	2.7%
Kinship	16.7%	15.0%	8.8%
Family	5.6%	7.4%	5.0%
Third-degree kinship	11.1%	7.6%	3.8%

Table 18: Percentage of overlap between the inter-collaboration network and the other network's dimensions, per case study

	% Ties Overlap Infinito (N=184)	% Ties Overlap Crimine (N=241)	% Ties Overlap Minotauro (N=189)
Inter-Collaboration	1340	1363	3142
Co-charge	0.8%	0.1%	0.4%
Kinship	0.7%	0.9%	0.2%
Family	0.1%	0.1%	0.0%
Third-degree kinship	0.6%	0.7%	0.2%
Kinship locale	7.8%	14.1%	4.6%

Figure 11: Jaccard Index heatmap of intra-locali networks (upper panel) and inter-locali networks (lower panel) overlaps, by case study



These preliminary results of collaboration patterns within and across *locali* underscored a nuanced interrelation with kinship ties. The analysis of the *intra-collaboration network* exhibited significant overlap between collaboration and kinship ties, particularly in *Infinito* and *Crimine*, suggesting a potential association between familial bonds and cooperation within *locali*. However, the scenario shifts when considering the *inter-collaboration network*. Here, kinship ties were much less prevalent across the case studies, suggesting no association between kinship and cooperation beyond the *locale* boundaries. Nonetheless, indirect familial connections – highlighted by the *kinship locale* dimension – suggest a potential interrelation with collaboration between *locali*, which can be further investigated in the regression analysis.

3.2.2. Poisson MRQAP analysis

A set of Poisson MRQAP regression models was employed to identify the factors influencing collaboration in the whole network (*collaboration network*), collaboration within *locali* (*intra-collaboration network*), and collaboration across *locali* (*inter-collaboration network*). In addition to the dimensions explored in the descriptive analysis – i.e., kinship, family, third-degree kinship, and same locale affiliation (for the *collaboration network* only) – three additional factors were included as covariates in the analysis: “both leaders network”, including a tie if two actors held a leadership position, which is a proxy of the formal organizational structure employed to test hypothesis *H5*; “same age network”, including a tie if two actors have less than 4 years of difference (demographic factor); and “same residence”, including a tie if two actors lived in the same municipality (geographical factor).

The descriptive analysis for *inter-collaboration* presented in the previous paragraph already suggested a limited association between cooperation among *locali* and direct kinship ties. Considering that the limited overlap of cases might distort the results if included, *inter-kinship*

network, *inter-family network*, and *inter-third-degree kinship network* were not included as explanatory variables in the analysis for the *inter-collaboration network*, in which only the kinship ties at the *locale* level – *kinship locale network* – were used for analysis and to test hypothesis *H3*. In addition, given the limited overlap between co-charge and collaboration ties in all three case studies, co-charge was not included as a covariate in any analysis.

Table 19 reports the results of the MRQAP analysis on the whole *collaboration network*, including as main explanatory variables *kinship network*, *family network*, *third-degree network*, included alternatively, and as covariates *same locale affiliation*, *both leaders network*, *same residence network*, and *same age network*. Model I highlights a significant association between kinship and collaboration within the whole network, particularly in *Infinito* and *Crimine*. In *Infinito*, holding all other variables constant, being kin increased the expected number of collaboration events by a factor of 1.9 compared to individuals with no kinship relationship. In *Crimine*, the association was even stronger, with being kin associated with a rate of collaboration 6 times higher compared to non-relatives. Conversely, the impact of kinship in the *Minotauro* network showed a weaker, non-significant association, as one might have expected in light of the limited overlap between collaboration and kinship in this network (Table 16).

When disentangling the type of kinship relation (model II and III), results indicate that in *Minotauro*, being immediate relatives (variable “family”), i.e., parent-son or siblings, was positively and significantly associated with a rate of collaboration 1.4 times higher compared to non-immediate relatives. This suggests that immediate family ties were relevant for collaboration, but their impact was diluted when the broader kinship category was considered in model I. In *Infinito* and *Crimine*, the association between being immediate relatives and collaboration was weaker – respectively $IRR = 1.6$ ($p < 0.05$) and $IRR = 3.8$ ($p < 0.001$) –

compared to that observed in the case of third-degree relatives (variable “third-degree kinship”), which aligns with the higher prevalence of overlap between third-degree kinship ties and collaboration ties that emerged in the multiplexity analysis (Table 16). Specifically, in *Infinito*, the rate of collaboration among third-degree relatives was 1.8 times that of non-third-degree relatives. In *Crimine*, the association was even more pronounced, with collaboration between third-degree relatives occurring at a rate 6.1 higher than among those without such ties. In *Minotauro*, the association was weaker and not significant.

Regarding the two proxies of the formal organization (variables “same locale affiliation” and “both leaders”), both consistently exhibited a significant and positive association with collaboration across case studies. For what concerns the variable “same locale affiliation”, in *Infinito*, the results across the three models suggest that the collaboration rate between two members of the same *locale* was approximately 9 to 10 times higher compared to collaborations between members of different *locali*. This pattern was similarly observed in *Crimine*, with the rate of collaboration between members of the same locale being 5 to 6 times higher than across *locali*, and *Minotauro*, where the rate of collaboration was approximately 4 times higher compared to the one among members of different *locali*. Regarding the variable “both leaders”, the consistently high coefficients across all three case studies indicate a strong tendency towards leadership homophily among collaborating individuals. Specifically, if both individuals were leaders, the rate of collaboration was significantly higher: about 12 times in *Infinito*, 8 times in *Crimine*, and 10 times in *Minotauro*, compared to scenarios where only one or neither of the individuals was a leader, with all other conditions held constant.

The robust results for the variable “same locale affiliation” suggest that *locale* affiliation played a significant role in explaining collaboration in the whole network across case studies, in line with hypothesis *H4*. This result may seem a contrasting finding compared to the one on the

cohesion of *locali* presented in Section 3.1.1. Nonetheless, the cohesion ratio was computed at the *locale* level, while the MRQAP analysis focused on the single dyads. This result could suggest that a few individuals within the *locale*, mainly leaders, engaged in numerous collaborations with external members, while others primarily had a few collaborations but mainly with members of the same *locale*, potentially biasing the results at the *locale* level. This is also supported by the preliminary analysis conducted in Section 3.1.2.1 on the differences between leaders and non-leaders in internal and external strength.

Regarding demographic and geographical factors, the variable “same residence” consistently exhibited a positive and significant association with collaboration across all three case studies in all models. In *Infinito*, residing in the same municipality was significantly associated with approximately a 2.5 times higher collaboration rate compared to not residing in the same location across three models, holding all other conditions constant. In *Crimine* and *Minotauro*, this association was slightly weaker, with increases in the collaboration ratio of 1.6 and 2.0 respectively in model I. The variable “same age” also played a role in explaining collaboration in *Infinito* and *Crimine*. Holding other variables constant, having a similar age in *Infinito* and *Crimine* increased the collaboration rate by approximately 1.8 times and 1.3 times, respectively, compared to individuals with more than 4 years of difference. This effect was statistically significant across all models for *Infinito* and *Crimine*, but it did not reach statistical significance in any of the models for *Minotauro*.

Table 19: Results of the Poisson MRQAP on the collaboration network for Infinito, Crimine, and Minotauro (5,000 permutations, coefficients as IRR)

	Infinito			Crimine			Minotauro		
	I	II	III	I	II	III	I	II	III
Intercept	0.061	0.060	0.061	0.041	0.040	0.040	0.269	0.269	0.268
Kinship	1.861***			6.072***			1.189		
Family		1.632**			3.840***			1.417**	
Third-degree kinship			1.832***			6.069***			0.968
Same locale affiliation	9.343***	10.005***	9.561***	4.971***	5.736***	5.396***	4.167***	4.166***	4.219***
Both leaders	12.079***	12.352***	11.983***	8.131***	8.764***	8.232***	10.284***	10.293***	10.289***
Same residence	2.458***	2.601***	2.523***	1.573**	1.809**	1.677**	2.034***	2.017***	2.106***
Same age	1.802***	1.842***	1.808***	1.322**	1.320**	1.357**	1.126	1.120	1.125
BIC	45153	45306	45203	39181	39782	39401	80493	80472	80509
N	236	236	236	283	283	283	208	208	208
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$									

The preliminary analysis of the whole *collaboration network* confirmed a strong role of the formal organizational structure in driving cooperation across the three case studies, highlighted by a strong, positive, and significant association between collaboration and the variables “same locale affiliation” and “both leaders”. The analysis also confirmed an association between cooperation and kinship, though weaker compared to the previous two factors. To assess potential differences between collaboration within *locali* and across *locali*, the analysis was then conducted on the *intra-collaboration network* and the *inter-collaboration network*.

Table 20 reports the results of the MRQAP using as the dependent variable the *intra-collaboration network*. Similar to the previous model, the main explanatory variables were the *intra-kinship network*, *intra-family network*, and *intra-third-degree network*, included alternatively in models I, II, and III. Additional covariates were *both leaders network*, *same residence network*, and *same age network*, all computed as dimensions of the *intra-collaboration network* on the same set of nodes. Model I shows a strong, positive, and significant association between kinship and collaboration within *locali*, confirming what was posited in hypothesis *H3*. In *Infinito*, being kin increased the rate of cooperation by about 15 times compared to having no ties holding other variables constant, underscoring a very strong influence of familial bonds on cooperation within *locali*. Similarly, in *Crimine*, having a kinship relationship significantly increased the collaboration rate by about 10 times compared to having no kinship ties. For *Minotauro*, the association was also positive and significant, although the factor was smaller (about 5.4) compared to the other two case studies. The results from *Minotauro* emphasize that analyzing the entire collaboration network, without distinguishing between intra- and inter-collaboration, might obscure the role of kinship. Conversely, focusing on intra- and inter-group dynamics may unveil associations that are not as clear when analyzing the network as a whole.

The disentanglement of the types of kinship in models II and III highlights that the association between the variable “third-degree kinship” and intra-collaboration (IRR=13.3, model III) was stronger than that of the variable “family” (IRR=7.9, model II) in *Infinito*. Conversely, *Crimine* and *Minotauro* exhibited opposite results with the variable “family” showing a stronger association (IRR=8.4 and IRR=5.4 respectively) with intra-collaboration than “third-degree kinship” (IRR=7.5 and IRR=3.7 respectively).

Regarding the variable “both leaders”, its association with intra-collaboration was not consistent across case studies and generally appeared weaker compared to previous findings from the *collaboration network* (Table 19), mainly in contrast with hypothesis *H5*. In *Infinito*, keeping all other variables constant, the variable “both leaders” was associated with a 3.4-fold higher collaboration rate across the three models, indicating leadership homophily in intra-collaboration. Similarly, in *Minotauro*, having both leadership positions was positively and significantly associated, increasing the collaboration rate by approximately 4.8 times across all models. In contrast, results in *Crimine* were less consistent; the correlation between being both leader and intra-collaboration varied in its significance across the different models, with a positive but modestly significant association (IRR=2.0, $p < 0.1$) observed only in model II.

For what concerns the geographical and demographic factors, the variable “same residence” consistently exhibited a positive, significant, and strong association with intra-collaboration across all three case studies and models (in model I, IRR= 6.3 in *Infinito*, IRR=18.2 in *Crimine*, and IRR=5.1 in *Minotauro*), underscoring a central role of geographical proximity in explaining collaboration within *locali* in all case studies. On the contrary, the variable “same age” was positively and significantly associated with intra-collaboration in *Infinito* only, with individuals of similar age collaborating at a rate 2.0 higher than those of dissimilar age. Results for *Crimine* and *Minotauro* were not statistically significant in any model, suggesting a less consistent

impact of age homophily on collaboration within *locali*.

The analysis of the *intra-collaboration network* confirmed the significant influence of kinship on collaboration within *locali* across case studies while suggesting a less pronounced tendency towards leadership homophily compared to the findings on the whole *collaboration network*. Additionally, geographical proximity was consistently identified as a significant factor, likely reflecting the territorial nature of the *locali*, which are defined by geographic boundaries. On the contrary, the impact of age homophily on intra-collaboration yielded inconsistent results.

Table 20: Results of the Poisson MRQAP on the intra-collaboration network for Infinito, Crimine, and Minotauro (5,000 permutations, coefficients as IRR)

	Infinito			Crimine			Minotauro		
	I	II	III	I	II	III	I	II	III
Intercept	0.050	0.052		0.013	0.013	0.013	0.161	0.164	0.163
Kinship	15.371***			10.319***			5.441***		
Family		7.868***			8.421***			5.429***	
Third-degree kinship			13.284***			7.501***			3.700***
Both leaders	3.404***	3.722***	3.099***	1.539	2.042*	1.801	4.664***	4.766***	4.741***
Same residence	6.367***	11.617***	8.872***	18.289***	23.888***	23.492***	5.095***	5.954***	6.747***
Same age	2.164***	2.263***	2.253***	1.084	1.067	1.223	1.000	0.968	1.009
BIC	25477	26849	26045	10852	11249	11254	39865	40188	40512
N	210	210	210	228	228	228	172	172	172
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$									

The last set of regressions was performed using the *inter-collaboration network* as the dependent variable. The main explanatory variable included was *kinship locale network* (where a tie exists between two actors if the *locali* they belong to share at least one kinship relation). Additional covariates included *both leaders network*, *same residence network*, and *same age network*. all computed as dimensions of the *inter-collaboration network* on the same set of nodes. Results are included in Table 21. Model I reports the bivariate analysis, including only *kinship locale*, while model II includes all covariates.

Model I and II show that the variable “kinship locale” exhibited a positive and significant association with inter-collaboration in *Infinito* and *Crimine*, while the association was not statistically significant in *Minotauro*, neither in the bivariate analysis nor in the full model. Model II shows that the association was stronger in *Crimine*, where being members of two *locali* that share at least one kinship relation was associated with a 5.2 times higher rate of collaboration compared to being members of two *locali* that do not share any kinship ties. In *Infinito*, being members of two *locali* connected by at least one kinship relation was associated with a 2.0 times increase in the inter-collaboration rate, although with lower significance compared to *Crimine*. Despite the lack of significant findings in *Minotauro*, the results from *Infinito* and *Crimine* generally suggest that *locali* connected by at least one kinship relation tended to collaborate more than those without any family ties in the two case studies, partially supporting hypothesis *H3*.

Model II highlights a strong, positive, and significant association between “both leaders” and collaboration across *locali* in all case studies, with an incidence rate ratio of 10.5 in *Infinito*, 8.2 in *Crimine*, and 10.6 in *Minotauro*. This result underscores a strong tendency toward leadership homophily in collaboration among different *locali* in the analyzed cases, which aligns with the analysis of brokerage presented in Section 3.1.2, underscoring the role of leaders as

intermediaries in the three networks, and confirm hypothesis *H5*.

For what concerns the geographical and demographic factors, residing in the same municipality was positively and significantly associated with a 4.5 higher collaboration rate in *Infinito* and a 1.9 higher rate in *Crimine*, compared to residing in different municipalities. Conversely, in *Minotauro*, the association was weaker and non-significant, suggesting an inconsistent effect of geographical proximity on inter-collaboration. As regards the demographic factor, having a similar age exhibited a consistent, positive, and significant association with higher rates of inter-collaboration compared to having different ages across all case studies, with IRR ranging from 1.2 in *Minotauro* to 1.7 in *Infinito*. This result may suggest an age homophily effect on collaboration across *locali*, possibly reflecting similar levels of experience among individuals.

Table 21: Results of the Poisson MRQAP on the inter-collaboration network for Infinito, Crimine, and Minotauro (5,000 permutations, coefficients as IRR)

	Infinito		Crimine		Minotauro	
	I	II	I	II	I	II
Intercept	0.146	0.078	0.059	0.043	0.344	0.280
Kinship locale	2.254**	2.044**	4.763***	5.160***	1.340	1.115
Both leaders		10.540***		8.233***		10.597***
Same residence		4.531***		1.859**		1.337
Same age		1.667***		1.387**		1.217*
BIC	37235	30982	32228	30155	66509	60337
N	184	184	241	241	189	189
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$						

Chapter IV. Discussion

The present study aimed to contribute to our understanding of collaboration within clan-based criminal organizations, i.e., organizations composed of multiple groups. Previous research has extensively explored how individuals within criminal organizations manage to cooperate despite inherent challenges, such as the lack of trust and the need to remain concealed from law enforcement. Less is known, however, about how these dynamics function within a context where multiple distinct groups must coordinate with each other. To this end, the study analyzed the interactions among *locali*, the formally defined subgroups of the ‘Ndrangheta. The investigation focused on assessing the extent to which different *locali* cooperate and identifying key individuals who facilitate this collaboration by acting as mediators between groups. Furthermore, the research explored the factors that foster cooperation both within and among *locali*, with a particular emphasis on the role of kinship compared to formal organizational factors.

4.1. Cohesion and integration of *locali*

The first research question aimed to investigate to what extent different *locali* of ‘Ndrangheta collaborate. From the literature, two contrasting hypotheses were identified concerning the closure and cohesion of *locali*. On the one hand, cross-group collaboration is expected to be difficult due to a lack of trust (Coutinho et al. 2020). In the criminal environment, which is inherently risky, individuals tend to cooperate based on strong ties (Granovetter 1973), which include those based on pre-existing relations, such as kinship but also shared affiliation to a group (Della Posta 2017; von Lampe 2016b). Due to the preference for relying on strong and trusted ties, and considering the operational role associated with formal subgroups, one could expect that ‘Ndrangheta *locali* exhibit strong internal cohesion, engaging primarily in intra-

locale interactions with limited collaboration with other *locali* (H1a), in line with previous studies on mafias (Battisti, Lavezzi, and Musotto 2022; Della Posta 2017). On the other hand, despite the tendency for closure and the operational cohesion of groups, there is evidence of inter-group collaboration. This cooperation is essential for the existence and unity of large, clan-based criminal organizations: it facilitates not only essential coordination and resource retrieval but also plays a role in managing reputational issues within the organization (Calderoni, Brunetto, and Piccardi 2017; Catino 2014b; 2019; Coutinho et al. 2020). For this reason, it may be posited that ‘Ndrangheta *locali* frequently establish collaborative ties with members from other *locali* (H1b).

The results from the three case studies challenge the first hypothesis, which suggested a preference to build cooperative relationships mainly within *locali*. Contrary to this assumption, the findings revealed a significant degree of inter-*locali* collaboration, indicating a dense network of interactions transcending individual *locali* boundaries. Despite some exceptions of *locali* with high internal cohesion, in *Infinito*, on average over 60% of collaboration interactions involved members from distinct *locali*, while this percentage increased to over 75% in *Crimine* and *Minotauro*. These findings support the alternative hypothesis, which posits that the operational needs of large criminal organizations require extensive cooperation across their constituent subgroups, requiring them to renounce part of the secrecy needs (Catino 2019).

Some factors may explain the observed results. In general terms, the need for extensive inter-*locali* collaboration may be attributed to the high degree of administrative and operational autonomy that each *locale* possesses (Paoli 2003), particularly in relation to businesses and criminal activities. The decentralization of day-to-day activities introduces risks to the security of the overall organization, as individual groups might engage in behaviors that serve their immediate interests but are harmful to the organization as a whole (Catino 2019). Consequently,

this situation generates a critical need for coordination and communication among the various parties, requiring some forms of centralization to identify shared strategies and resolve potential conflicts (Catino 2019).

As found and posited by Coutinho and colleagues (2020) in their study on Outlaw Motorcycle Gangs, more structured criminal organizations share common values, rules, and rites that allow them to have a higher capacity for self-organization and management (Catino 2014a; Paoli 2002; 2003). This may also be true for the ‘Ndrangheta. Being a member of the ‘Ndrangheta implies adherence to shared rules, codes of conduct – with related sanctions –, and rituals, which serve to maintain social order and facilitate cooperation by reducing uncertainty (Catino 2019). As discussed in the literature review on bonding strategies, rules and codes make behavior more predictable, while shared rituals help establish common knowledge about them, reinforcing a sense of unity and generating trust based on generalization (Catino 2019; von Lampe and Ole Johansen 2004; von Lampe 2016b; Skarbek and Wang 2015). This is not limited to the single group but potentially extends to all *men of honor*. As Paoli (2003, 81) underscores, “The obligation on mafiosi to correctness and solidarity does not concern only affiliates to the family to which the member belongs, but extends – at least in principle – to all mafia brothers.” The sharing of rules, codes, internal hierarchies, and sanctions deriving from being members of the ‘Ndrangheta may lay the foundation for trust based on generalization even beyond the single group, thus making cross-group coordination easier.

A second consideration, related to the first, concerns the type of activities monitored during the investigations and the objectives of the operation themselves. In all three operations, the main charge in the pre-trial court orders was for mafia-type association (416bis in the Italian penal

code).²² During the investigations, many of the meetings recorded did not appear to have criminal objectives at first sight and did not usually involve the daily criminal activity of groups. These gatherings were frequently social events such as bar meetings, dinners, weddings, and funerals. However, during these occasions, ‘Ndrangheta members discussed crucial matters including the allocation of ranks, the resolution of internal conflicts, and other organizational issues – definable as governance-type activities (Campana and Varese 2018). Given that the operations aimed not merely to track the day-to-day illicit activities of each *locale* but also to unveil the organization's structure and rituals across various territories, the observed low cohesion of *locali* and high *locali* integration is justifiable, arguing that likely the type of activities monitored led to an underestimation of the *locali* cohesion.

As highlighted by previous studies, the operational structure of the same group may vary based on the nature of the activities being conducted (Calderoni 2012; 2014a; Calderoni and Superchi 2019; Paoli 2002). Mafias, including the ‘Ndrangheta, are multifunctional organizations (Paoli 2020), that act separately for certain goals and remain united for others (Paoli 2003). As said before, *locali* and their members benefit from a high degree of autonomy in everyday criminal activities (Paoli 2003). This is also demonstrated in the multiplexity analysis of co-charge

²² According to the 416bis article of the Italian penal code, a mafia-type association consists of three or more individuals who “[...] use of the power of intimidation afforded by the associative bond and the condition of subjugation and omertà (code of silence) which results from such a bond to commit crimes, to acquire directly or indirectly the management or control of economic activities, concessions, authorizations or public contracts and services, or to achieve unjust profits or advantages for themselves or others, or in order to prevent or obstruct the free exercise of voting or to obtain votes for themselves or others during elections.”

presented in Section 3.2.1. Here, co-charge, used as a proxy for co-offending excluding the mafia association charge, largely overlapped with the same *locale* affiliation dimension: 77.4% of co-charge ties in *Infinito*, 87.7% (6 out of 7 ties) in *Crimine*, and 62.5% in *Minotauro* occurred among members of the same *locale* (Table 16). However, in the context of governance-type activities, where the goal is the formulation of shared organizational strategies, conflict resolutions, and the conduct of rituals, this autonomy is balanced, and the unity of the ‘Ndrangheta becomes apparent through the integration and collaboration across *locali* (Catino 2019; Sergi and Lavorgna 2016b), frequently through events with symbolic meaning, such as weddings and funerals (Catino, Rocchi, and Vittucci Marzetti 2022; Catino 2019; Tribunale di Reggio Calabria 2010), where ranks are allocated and high-level matters are discussed. These events serve not only to set shared strategies and resolve conflict but also to reinforce cultural codes and organizational formulas that make the ‘Ndrangheta united and reinforce the sense of belonging among its members (Catino 2019; Paoli 2003; 2020).

When isolating and focusing on criminal activities, the patterns seem to differ, with individuals showing a tendency to commit crimes with members of the same *locale*, conforming more with what was posited in hypothesis *H1a*. Two considerations can be drawn from this. First, this tendency may stem from the high level of trust required when engaging in inherently risk, illegal activities. As discussed in the literature, shared membership establishes a shared identity and “generalized reciprocity” which generates trust and solidarity among members of the same group (Paoli 2003; Skarbek and Whang 2015). In addition, repeated social interaction within the group fosters emotional bonds and a sense of predictability (Von Lampe & Ole Johanson 2004). Second, once again, the type of criminal activity observed could play a role. As previously noted, *locali* exhibit large autonomy when carrying out illegal activities. Even within the *locali*, individual members are often free to engage in certain profit-driven activities independently, i.e., without direct leadership directives (Paoli 2003; 2020). However, in the

three case studies analyzed, most charges against defendants primarily pertained to firearms, extortion, violence and threats, and corruption offenses (Tribunale di Milano 2010; Tribunale di Reggio Calabria 2010; Tribunale di Torino 2011) – i.e., crimes instrumental to maintaining control over territory. These activities are critical to the functioning of the *locale*, enabling it to establish political dominance and governance in the areas under its influence (Paoli 2020). Given the functional importance of these crimes for the *locale* and its reputation, it is plausible that they were undertaken by its members on behalf of the *locale* itself.

Alongside these considerations, it is important to emphasize that any comparison between collaboration and co-charges should be interpreted with caution. Indeed, the limited number of co-charge observations across the case studies weakens the reliability of these findings, raising doubts about the robustness of this interpretation and highlighting the need for further analysis to validate them.

Further insights to interpret the result of *locali* cohesion stem from the preliminary analysis of brokerage conducted to address Objective 1.2. Indeed, the cohesion analysis revealed strong and consistent collaboration across *locali* over the years for all three case studies. However, participation was not uniform among all individuals, with leaders notably more involved in these collaborations. Analysis of the median values of external strength (which measures the intensity of inter-collaboration) revealed that leaders had significantly higher scores – approximately 11.6 in *Infinito*, 5.7 in *Crimine*, and 6.7 in *Minotauro* – compared to non-leaders (Table 12). These findings highlighted a strong concentration of external interactions at the leadership level, suggesting that the results on the *locali* cohesion were largely driven by leaders' robust collaboration with external parties. This implies that *H1a* might still hold for non-leader members to some extent, as their cross-group interaction is less pronounced. RQ1 and Objective 1.1 aimed to assess the extent of collaboration at the *locale* level, and in this

sense, the results confirm frequent cross-*locale* cooperation, as suggested by *H1b*. However, when taking another perspective and distinguishing between leaders and non-leaders, *H1a* and *H1b* appear more complementary than mutually exclusive, suggesting strategic intermediation through leaders to balance the underlying needs – secrecy and trust vs effective coordination – represented by the two hypotheses.

Exploring the relationship between intermediation among *locali* and leadership positions was the second objective of the first research question. A vast literature has shown that brokerage positions are associated with multiple advantages, also in the criminal environment (Baker and Faulkner 1993; Burt 1992; 2007; Granovetter 1973; Morselli and Tremblay 2004; Morselli 2010), and that leaders frequently opt for brokerage positions, at least at the individual level (Calderoni 2014a; Calderoni and Superchi 2019; Morselli 2009a; 2005).

The study examined strategic brokerage roles among *locali* in three ways: a) the individuals intermediating between two distinct *locali* (liaison); b) the individuals bridging between their own *locali* members and members from different *locali* (representative); c) the individuals with homogenously distributed relationships among multiple *locali* (participation coefficient). The findings from the regression analyses (Section 3.1.2.2) indicated a significant link between leadership and brokerage roles. Specifically, leaders showed a much higher rate of intermediation between two distinct *locali* across case studies compared to non-leaders: a 10.9 times higher rate in *Infinito*, 7.7 times in *Crimine*, and 4.2 times in *Minotauro* (Table 13). While the association was statistically weaker in *Crimine*, leadership still correlated with liaison brokerage. The analysis of the representative role showed mixed results, with positive associations in *Infinito* and *Minotauro* (IRR=4.2 and IRR=3.0, respectively), but no significant correlation in *Crimine* (Table 14). Lastly, leaders were found to have significantly higher participation coefficients compared to non-leaders, indicating a greater propensity to form a

wide and balanced network of relations across multiple *locali* (Table 15). This positive association highlights leaders' roles in fostering extensive inter-*locali* connections.

The findings suggest that leaders not only act as strategic brokers at the individual level but also among *locali*, at the meso-level, in line with previous research (Calderoni, Brunetto, and Piccardi 2017; Della Posta 2023). Multiple factors help to interpret these findings, both from the organization and individual point of view. As previously mentioned, decentralization of *locali* requires coordination and a certain level of efficiency in communication exchanges across *locali*. However, the need to communicate decreases the security of the organization, exposing individuals to the risk of arrest – a trade-off that Gambetta (2009) defines *communication problem*. Catino (2019) argues that effective decentralization in criminal environments and coordination among parties requires formalization, consisting of strict rules and procedures. In the context of mafias, this formalization is facilitated through strongly regulated information sharing, based on the hierarchical level within the organization. When concerning multiple groups in the 'Ndrangheta, this information sharing is facilitated by the existence of high-level bodies of coordination (Paoli 2003). These structures were defined by the 'Ndrangheta to enhance the organization's security, limit information circulation, and reduce violence after the law enforcement interest rose during the 1990s (Catino 2019).

The results from the three case studies underscore an operational structure of the 'Ndrangheta reflecting the formal function of these coordination bodies, with leaders identified as the ones keeping control over the flow of information and mediating with other leaders. The analysis showed that individuals with the highest score in brokerage for liaison, representative, and participation coefficient measures were leaders who were part of, or had a strong connection to, the organization's high-level coordination bodies. In *Crimine*, N0113 was the one with the strongest broker position, holding the highest scores. At the time of the investigation, he was

the head of the *Provincia* (or *Crimine*), the collegial body with temporary ranks that coordinates *locali*, legitimatizes their existence, identifies shared strategies, and manages potential conflicts. Within the organization, he also acted as the point of reference for ‘Ndrangheta members located in northern Italy and abroad – a formal role of broker that was reflected in the operational structure revealed by the analysis. In *Infinito*, individuals with the highest scores, such as N064 and N105, were connected to the “*La Lombardia*”, the chamber of control established in the Lombardy region in the will of the *Provincia* and acting as an intermediary body between the *locali* based in the region and the Calabrian members. N064, the *Mastro generale* of *La Lombardia*, played a pivotal role in mediating among *locali* and managing conflicts within the region, acting as the liaison for the Calabrian members. N105, the leader of the *Cormano locale*, participated in the *La Lombardia* summit, contributing to the definition of shared strategies and the allocation of ranks, and served as the contact point for other members based in Calabria. In *Minotauro*, N065, the individual with the highest liaison score, was among the apical members of the chamber of control that was planned to be constituted during the investigation in Piedmont. N033, who recorded the highest scores for representative and liaison, was responsible for the coordination of the *locali* in Piedmont with regard to the Calabrian *locali*.

The results confirmed a significant difference between leaders and non-leaders in occupying intermediary roles among *locali*. However, the analysis of the scores revealed that some non-leaders also exhibited quite high scores, albeit less frequently. These individuals, while not classifiable as leaders, occupied significant positions, holding high *doti*²³ within the

²³ *Doti* are a system of ranks within the ‘Ndrangheta which denote the merit and accomplishments accumulated by members throughout their criminal career (Catino 2019).

organization. This, along with the results on leadership, suggests a relationship between criminal career experience and criminal maturity (Morselli 2009b) and the role of brokers among *locali*. This consideration is further supported by the positive and significant association between the brokerage measures and age in the bivariate models (Table Appendix N, O, P), which aligns with previous research on the role of brokerage at the individual level (Morselli 2009b).

Therefore, the centralization of the role of brokers among *locali* in the figure of leaders ensures a strong compartmentalization of information sharing, which, in turn, allows the organization to balance the need for efficient communication and coordination among *locali* with the need to ensure security. This is also underscored by the evidence from the wiretaps, where many members do not precisely know the ranks of other individuals or their membership to specific groups. For the organization, leaders have the social obligation to serve as intermediaries. Participating in events where shared objectives are defined, conflicts are discussed, and ranks are allocated – open to high-status members – is not a choice, and non-attendance may imply losing recognition from other groups and reputation (Calderoni 2018; Catino 2019; Sciarrone 2014). This is what leaders, acting as brokers, do for the organization.

From the individual perspective, playing this brokerage role offers various personal advantages. In this position, leaders are the ones having and exploiting the *bridging* social capital, i.e., the social capital deriving from between-group connections (Putnam 2000). By promoting the integration of different groups, they gain access to information and resources external to the group and have the power to control their spread (Granovetter 1973; 1983; Burt 1992; 2007). Bridging social capital is fundamental for “getting ahead” (Putnam 2000, 23), as it offers the social opportunity structure that allows access to profitable criminal opportunities (Kleemans and de Poot 2008) and get ahead in the criminal career. Being a broker among *locali* allows

leaders to increase their recognition and prestige: some symbolic events are open to high-status members only, and the participation strengthens their stature within the organization.²⁴ Bridging social capital therefore also increases the leader's *symbolic* capital, constituted by his reputation (Santoro and Solaroli 2017), that can, in turn, be leveraged in the commission of illegal activities.

4.2. Drivers of collaboration within and across *locali*

The second research question explored the factors influencing collaboration in the 'Ndrangheta and examined whether there are distinct dynamics between intra- and inter-*locali* collaboration. While belonging to the same criminal organization might suggest an inherent likelihood of collaboration, this alone does not fully explain how members end up cooperating (von Lampe 2016b; Wood 2016). Trust is the main factor driving individual decisions for cooperation (Berlusconi 2021); in the context of organized crime, familial, cultural, and hierarchical ties reinforce trust among members, giving solidity to the organization and allowing security while favoring efficiency (Berlusconi 2021; Paoli 2003).

²⁴ The relevance attributed to taking part in these symbolic and exclusive events by leaders is exemplified in an episode documented in the *Infinito* case, where N161, at the time an apical member of the *La Lombardia*, was not invited to the wedding of the daughter of a Calabrian leader. This omission caused N161 immediate concern, as evidenced by wiretaps. The implication of this exclusion became apparent a month later when N161 was killed by order of the *Provincia* due to his autonomous aspirations. The non-invitation was interpreted as a formal exclusion and ending of recognition of N161's role (Tribunale di Milano 2010).

Although the factors reinforcing trust in single criminal groups have been extensively studied, the exploration of these dynamics within environments comprising multiple groups has received less attention. The second objective of the study focused on assessing the role of kinship in driving collaboration within and among *locali*, comparing it to the effect of proxies of the formal organizational structure – group membership and formal hierarchy – of the 'Ndrangheta.

The findings from the descriptive analysis of the multiplexity highlighted a modest overlap between collaboration and kinship (Table 16), consistent with previous findings of generally low multiplexity in organized criminal groups (C. M. Smith and Papachristos 2016). However, when disentangling intra- and inter-collaboration, distinct patterns emerged. Specifically, a significant overlap of collaboration and kinship ties was observed within *locali* – 16.7% in *Infinito*, 15.0% in *Crimine*, and 8.8% in *Minotauro* (Table 17). In contrast, the overlap between collaboration and kinship across different *locali* was consistently limited, never exceeding 1% (Table 18).

The results from the statistical analysis showed that within the whole collaboration network, the formal organization factors – same *locale* affiliation and being both leaders – were the most influential on collaboration, with kinship also showing a positive effect, albeit weaker (Table 19). When focusing on collaboration within *locali*, the pattern was reversed, with kinship having a strong influence on cooperation rates, higher than the ones of the formal hierarchy, which showed weaker and non-consistent effects across the case studies (Table 20). On the other hand, the analysis of collaboration among *locali* confirmed a strong role of hierarchy in driving collaboration, revealing a strong tendency towards homophily in leadership (Table 21) consistent with the results of the first research question. Although the direct effect of kinship ties was not tested due to the limited overlap, an indirect effect was observed in the *Infinito* and

Crimine case studies. In these instances, members belonging to *locali* connected by at least one kinship tie showed a higher collaboration rate compared to members of *locali* without family ties.

The strong and positive results of shared *locale* membership suggest that *locale* affiliation played a significant role in explaining collaboration in the whole network across case studies, thereby confirming hypothesis *H4* and aligning with previous research on criminal collaboration (Bright et al. 2024; Krajewski, DellaPosta, and Felmlee 2022). As the hypothesis proposes, the positive association between shared *locale* membership can be attributed to both formal organizational obligations and the need to rely on trusted, strong ties. On the one hand, individuals may have obligations to participate in internal meetings and carry out criminal (and non-criminal) activities on behalf of the *locale* (Catino 2019). These obligations could drive members in the same *locale* to collaborate, even regardless of their personal willingness. As Paoli (2020, 178) explains, “subordinates in a regime of generalized reciprocity have no choice whether to execute superiors’ orders”. On the other hand, this generalized reciprocity, coupled with the sense of shared identity generated through affiliation rituals to the group, builds trust and solidarity among members, potentially making cooperation easier even beyond leadership orders (Paoli 2003; Skarbek and Wang 2015). In addition, it is possible to assume that trust is further strengthened by repeated social interactions within the group, which foster emotional bonds and a sense of predictability in the actions of members (Bright et al. 2024; Catino 2019; von Lampe and Ole Johansen 2004).

This result may seem to contrast with the findings on the cohesion of *locali*, which highlighted the strong propensity of *locali* to establish cross-group interactions. However, while the cohesion ratio was computed at the *locale* level, the MRQAP analysis focused on the single dyadic relationships. Combined with the strong association between inter-*locali* collaboration

and leadership, these findings support the previously mentioned argument on the complementary nature of *H1a* and *H1b*: a few individuals within the *locali*, i.e., the leaders, engaged in numerous collaborations with external members, while others maintain collaborations but mainly with members of the same *locale*, potentially biasing the results at the *locale* level.

Shifting the focus and disentangling intra- and inter-*locali* dynamics, kinship bonds emerged as a crucial factor in fostering collaboration within the *locali*. These findings validate hypothesis *H3*, which posits a positive association between collaboration and kinship within *locali*, and align with two aspects confirmed by previous judicial and academic evidence. First, they reflect the intrinsic blood-based nature of the *'ndrine*, the organizational units comprising the *locali* (Catino 2014a; Ciconte 2014; Paoli 2003; Sergi 2021). Trust within *'Ndrangheta* is guaranteed by recruitment based on blood ties, where sons – but also daughters – become crucial for preserving the family's influence (Sergi 2018). The embeddedness of the criminal group within strong, pre-existing ties (Granovetter 1973), fosters trust, reciprocity, and responsibility (Kadushin 2012; von Lampe and Ole Johansen 2004; Papachristos and Smith 2013), which are scarce resources in the criminal environment yet necessary to maintain secrecy (Catino 2019). Von Lampe and Ole Johansen (2004) note that trust among family members arises from two sources: individualized trust, which develops through ongoing interactions, and generalized trust, which is rooted in shared norms and values. Transposing from Sutherland's differential association theory (1947), the family in the *'Ndrangheta* allows constant interaction through which individuals learn values, attributes, norms, and motivations for criminal behavior. Outside Calabria, kinship bonds help members preserve a strong cultural identity, enabling the adaptation of *'Ndrangheta* behaviors in non-traditional territories (Sergi and Lavorgna 2016a).

Second, the results also corroborate previous research and knowledge on the strategic employment of familial ties across *'ndrine* (Catino, Rocchi, and Vittucci Marzetti 2022; Ciconte 2014). The analysis highlighted that kinship relationships among members within the same *locali* often involved acquired kinship, i.e., in-law relationships, which accounted for 20.7% of cases in *Infinito*, 13.3% in *Crimine*, and 15.8% in *Minotauro* of the total number of kinship ties overlapping with collaboration ones (Table Appendix C). Marriages are strategically employed to create new family ties and foster trust, and, in turn, cooperation, between families. As stressed by Varese (2017, 125) “Marriage is a formality, a duty devoid of love. [...] Marriage is always strategic, never the culmination of a genuine passion”. Specifically, marriages aim, on the one hand, to seal alliances, and avoid potential conflicts with families involved in similar illicit activities; and on the other hand, to expand the influence of the *'ndrina* and its control of the territory, as well as to broaden the activities in which it is involved (Catino, Rocchi, and Vittucci Marzetti 2022; Ciconte 1996; Paoli 2003).

The observed weaker and non-consistent effect of the formal hierarchy in influencing collaboration within *locali* partially contrasts hypothesis *H5*, which posited no discernible effect of leadership on collaboration between members of the same *locale*. The decision-making process within the *locali* is often vertical and centralized around leaders (Catino 2019), particularly for matters more related to the *locale* as a whole and governance-type activities, such as the use of violence. This vertical and centralized nature of the *locale* may explain the leadership homophily observed in *Infinito* and *Minotauro*. These effects, however, are lower compared to kinship, and non-consistent across case studies, leaving room for additional considerations. The vertical differentiation of the *locali* requires an extent of top-down flow of information. To implement group directives and coordinate activities, a certain degree of vertical collaboration is needed, involving both high-status and lower-status members (Krajewski, DellaPosta, and Felmlee 2022). In addition, not all activities within the *locale* are

direct expressions of leadership. Some are carried out with more autonomy by individual members (Paoli 2020). In these contexts, the formal hierarchy of the ‘Ndrangheta may play a less prominent role, especially in illicit market activities (Calderoni 2012). Instead, horizontal collaboration, embedded in kinship ties, may allow for looser direct control and less dependency on formal hierarchy while still ensuring a high level of security. These interpretations might also shed light on the observed inconsistency in age homophily across the three case studies (Table 20), suggesting that cooperation extends across individuals with varying levels of criminal experiences and maturity. However, further detailed classification and analysis of the activities undertaken and ranks beyond leadership are required to confirm this hypothesis.

The formal hierarchy, on the contrary, significantly enhanced collaboration across *locali*, as posited in hypothesis *H5* and in line with *H2*. This result is in contrast with previous research which found formal rank similarity to have little relevance in explaining tie formation within and between American Cosa Nostra families (Krajewski, DellaPosta, and Felmlee 2022). Krajewski and colleagues noted that the collaboration primarily involved people with similar informal status, i.e., similar centrality scores, rather than those with similar formal rank. The distinction in the result of the present study can be attributed to the different types of activities analyzed. Krajewski et al. reconstructed the network based on criminal associations, which entail the commission of criminal acts together. In contrast, the activities recorded during our three investigations were primarily governance-oriented, where meetings, frequently legitimate at first sight, were aimed at coordinating *locali* activities or participating in rituals and symbolic events, rather than co-offending. These differences underscore, once again, the importance of activity type in the interpretation of network dynamics and organizational structure of criminal organizations.

In line with the findings of the first research question, the MRQAP results confirmed a tendency toward leadership homophily across the three case studies. Contrary to cooperation within *locali*, collaboration among *locali* relies on strongly formalized associational criminal structures, composed of defined rules, codes of conduct, and roles, that aim at reducing uncertainty and mistrust by making behavior predictable (Catino 2015; 2019; von Lampe 2016b). When managing governance-type activities, the leaders are the spokespersons (Chopin and Dupont 2024), who coordinate *locali* activities and pursue common objectives on behalf of the group, and the elite members who possess specific qualities – namely long and affirmed criminal careers as denoted by their high-ranks – that allows them to take part in the rituals of integration and aggregation of the organization (Catino 2019).

The results on collaboration among *locali* also suggest a weaker indirect, yet not consistent, influence of kinship in fostering collaboration, finding support to *H3* in two of the three case studies. Individuals belonging to two *locali* which share at least one kinship relation tended to collaborate more compared to those belonging to *locali* without any family relationships in *Infinito* and *Crimine*. Marriages in the ‘Ndrangheta are strategically employed to seal alliances and increase the power of the group, extending beyond *locali* boundaries. This practice is particularly relevant in Aspromonte, a Calabrian region with a long-standing tradition of such strategic alliances (Sergi 2023a), which may also account for the strong findings in the *Crimine* case study. An illustrative example of this practice is also reported in Operation *Crimine*, where the son and daughter of two powerful mafia families from Platì and San Luca celebrated a symbolic marriage to seal the alliance between the two factions (Tribunale di Reggio Calabria 2010). One interpretation of these results may be that such strategic use of kinship, particularly outside the ‘*ndrine* which mainly recruit through blood ties, aims not necessarily at fostering dense familial networks but at establishing symbolic connections. Paoli (2003, 88) underscores the symbolic power of marriage bonds by highlighting the potential power disequilibrium rising

from them:

“[...] the symbolic strength of the marriage bond is such that by creating an alliance between two blood families, a wedding may dangerously weaken the cohesion of the overall mafia association. In other words, a marriage between the members of two blood families belonging to the ‘Ndrangheta establishes such close ties of generalized reciprocity that they may well overturn the mafia equilibrium of a local territorial context [...]”.

In other words, it is not a matter of quantity but a matter of the presence and quality of a strong connection. This interpretation is also in line with Catino and colleagues (2022), who found that the median number of interfamily marriages per ‘Ndrangheta family is one. Therefore, to reduce uncertainty in inter-group dynamics, trust is further reinforced through symbolic family ties despite the presence and strong reliance on the formal organizational structure.

Alongside kinship and formal hierarchy, geographical proximity emerged as another important element fostering collaboration within and across *locali*. Two main interpretations are identified. On the one hand, operating within restricted geographical boundaries is strategically important for criminal organizations to maintain security and control the flow of information (Reuter 1983). By collaborating with individuals in nearby locations, individuals can coordinate their activities more effectively and safely, relying on face-to-face communication that mitigates the risks associated with written communications (Calderoni and Superchi 2019; Catino 2019). In addition, *locali* are geographically defined, and this contributes to making sense of the results of collaboration within *locali*. On the other hand, being active in the same area not only facilitates but also requires careful coordination to prevent conflicts and to seek territorial recognition from other groups, both within and across *locali*. Geographical proximity enhances the socialization of individuals and groups, enabling them to gain recognition for both their presence and the activities they conduct within a territory (Sergi 2023b).

4.3. Limitations and contributions of the study

The thesis acknowledges several limitations, some of which were partially anticipated throughout the dissertation. The first limitation concerns the type of data used for the analysis, i.e., judicial documents. Organized crime groups are covert organizations that strive to remain hidden to evade detection, a characteristic that makes the collection of primary data almost impossible (Diviák 2020). For this reason, most research leverages secondary data from various sources, including electronic surveillance data from judicial documents. The use of these data in the study of criminal organizations has become a well-established approach in the last decades (Baker and Faulkner 1993; Bright et al. 2015; Calderoni 2012; 2014a; Calderoni and Superchi 2019; Campana 2011; Campana and Varese 2013; Ficara et al. 2020; Natarajan 2000). Wiretaps and the surveillance of meetings allow for the collection of extensive information on individuals, their connections, and the activities they carry out. Additionally, the objective of these documents – i.e., to prove the culpability of the defendants for the listed charges – ensures that the reported facts are pertinent to the criminal activities conducted by the individuals involved. Nonetheless, they are also subject to some limitations.

Judicial documents are not collected for research purposes, but to monitor the activities of specific individuals or groups to prove their involvement in illicit activities. Consequently, the data and information they contain may exhibit biases related to the objectives and priorities of law enforcement agencies, leading to non-random sampling that may reflect the interests of law enforcement (Berlusconi 2013; Bright, Brewer, and Morselli 2021; Diviák 2020; Rostami and Mondani 2015). The attention of law enforcement toward specific individuals may lead to issues related to the accuracy and completeness of data (Berlusconi 2013).

In the cases examined here, missing information was largely “not at random” (Rubin 1976), driven primarily by the objectives of the investigation, and concerning both actors and

relationships. For example, the investigations did not cover all members of the monitored *locali*, resulting in a puzzled and incomplete knowledge of the composition of the *locali*. Similarly, kinship data was not consistently reported in the three main sources of data. This information was usually included when deemed relevant to contextualize certain events or stress the importance of family relationships, resulting in an unsystematic reporting of these details.

To cope with these limitations, several strategies were adopted. First, the information from the three pre-trial court orders was integrated by relying on external sources of data, including other judicial documents of other operations, and media news, to complete as much as possible missing information on the attributes and the family relationships. In addition, the information on kinship relationships was indirectly retrieved, as detailed in Section 2.2.2.4. This integration of information with additional sources of data should have led to more reliable data to be employed in the analyses (Campana and Varese 2012; Rostami and Mondani 2015). Furthermore, the study took into account the criteria used by law enforcement to conduct the three operations (Campana and Varese 2012). On the one hand, the classification of leaders considered the geographical scope of the operation and the inability of leaders to participate in meetings or phone calls due to their death during the investigations or incarceration. On the other hand, the analysis at the *locale* level focused on those *locali* based in the region where the operation was mainly taking place. Eventually, the validity of the sample was examined by assessing the three requirements identified by Campana and Varese (2012) for wiretap data, as detailed in Section 2.2.3.

Nonetheless, some shortcomings persisted. As previously discussed, it is plausible that the focus of the investigation – specifically the aim to reconstruct internal structures and monitor governance-type activities – may have led to an underestimation of the connections between individuals within the same *locale*. This issue did not, however, hinder the analysis of robust

collaboration across *locali*; in addition, given the emphasis on inter-group relationships, it is likely that individuals central to these governance dynamics were thoroughly documented in the investigation. Nevertheless, caution should be exercised when comparing and interpreting the intensity of intra- and inter-*locali* interactions, always bearing in mind the nature of the activities monitored. Future research should assess whether the patterns of interaction between distinct groups change based on the activities performed, as suggested by existing research on single criminal groups (Calderoni 2012; Calderoni and Superchi 2019; Catino 2019; Paoli 2002).

Similar considerations apply to the results on brokerage among *locali*, related to RQ1, and on the role of leadership in driving intra- and inter-*locale* collaboration. Given limited economic and human resources, police investigations may prioritize high-level individuals. For this reason, findings on the positioning of leaders and the role of leadership may be partially influenced by law enforcement agencies' focus on the most prominent members of the 'Ndrangheta, which may have led to an overestimation of their role at the expense of non-leaders. Unfortunately, there are no methods to specifically isolate and control this bias towards leaders in the analysis; thus, no definitive answers can be provided. However, some reflections can be elaborated.

First, leaders were only a fraction of the individuals charged in the pre-trial documents. Specifically, they represented 21% of individuals charged in *Infinito*, 23% in *Crimine*, and 12% in *Minotauro*. Considering that the pre-trial documents primarily detail facts related to the charges for which the judge requests restrictions on the suspects' freedom before trial, it is reasonable to assume that these documents reported facts focusing on all defendants. Related to this, the sensitivity analysis on the brokerage analysis, which included the mafia association charge as an additional control variable, was intended to address this potential bias and

confirmed the robustness of the results for leaders. While this analysis does not specifically isolate bias towards leaders, it accounts for the general focus of law enforcement on individuals (leaders included) charged with the most relevant crime – being mafia members – who were also the ones likely more closely monitored during the investigations.

Second, as emphasized in the discussion of the results, an alternative factor that may explain the overrepresentation of leaders compared to non-leaders is the type of activities monitored during the three investigations. These operations primarily focused on governance-type activities, such as the definition of shared strategies, rank assignment, and the resolution of internal conflicts, contexts in which the role of leaders is pivotal. As highlighted by Calderoni and Superchi (2019, 433) in a previous study on the ‘Ndrangheta, “criminal leaders do not attend just more meetings than non-leaders”; rather, they have the role of brokers when involved in governance-type activities. This role, formally reflected in high-level bodies of coordination composed of high-status affiliates (Catino 2019), appears to be reflected in the operational structure of the ‘Ndrangheta and the interaction patterns of leaders compared to non-leaders. In support of this argument, previous studies on the involvement of the ‘Ndrangheta in illicit market activities, specifically drug trafficking (Calderoni 2012), revealed different patterns. High-status individuals often occupied brokerage positions but were less active compared to lower-status individuals. This may suggest that law enforcement attention on leaders was not disproportionately higher than on lower-status individuals, despite their awareness of the leaders’ formal prominent role within the organization. This difference likely reflects the limited direct involvement of leaders in the specific activities monitored during the drug trafficking operations and their deliberate strategy of detachment (Calderoni 2012). This comparison reinforces the idea that the nature of the activity may drive law enforcement focus. However, these arguments call for further research to disentangle the potential differences in the involvement of leaders across various types of activities and, in any case, do not rule out

the possibility of law enforcement bias towards leaders in the present dissertation.

While there are limitations in the use of surveillance and wiretap data for academic purposes, the present study has significantly benefited from such data, which provide unique and otherwise inaccessible information to the researcher. Wiretaps and surveillance offered unobserved communication among members of the ‘Ndrangheta, allowing a rare insight into their interactions, decision-making processes, and the informal dynamics within the organization. Particularly when investigating collaboration dynamics, this type of data transcends what can be gathered, for example, from co-offending records, which often only provide lists of crimes and individuals involved without the necessary context. By contrast, wiretap and surveillance data enable researchers to investigate cooperation and relational ties that are not unlawful per se but are essential to the functioning and existence of the organization. Moreover, the qualitative information available from these data offers interpretative insights that facilitate complementing and contextualizing the quantitative findings.

Beyond the type of data used for the analysis, another potential limitation concerns the methodological strategy adopted to isolate intra- and inter-group ties (detailed in Section 2.3.1), particularly in its application in the MRQAP analyses conducted to address RQ2. This procedure did not allow to distinguish collaboration events that occurred exclusively within individuals of the same *locale* or among members from different *locali*. As noted in Section 2.3.1, this alternative approach was considered and tested; however, it failed to effectively isolate the influence of kinship on inter-collaboration and was therefore discarded. Despite the limitations, the chosen approach isolated the dyadic effects of kinship and other factors, making it the best available option, though not optimal, to meet the study’s objectives.

An additional limitation of the research pertains to the case study approach and its limited external validity. The findings, while insightful for the analyzed case studies, cannot be

generalized to broader contexts or different criminal organizations. The inclusion of case studies on different criminal organizations was not taken into consideration as it would not, anyway, enhance the external validity substantially. Instead, the focus remained on identifying potentially recurrent patterns within the same organization. Future research should replicate the analysis of collaboration in clan-based criminal organizations, analyzing both mafia-type associations and less structured criminal organizations, to identify potential recurrent patterns.

Despite these limitations, the study contributes to the literature in several directions. First, it adopted a hybrid approach to group dynamics (Ouellet and Hashimi 2019), underscoring the importance of studying the strategies adopted by criminal organizations to succeed from a meso-level perspective and separately analyzing the factors that promote intra- and inter-group cooperation. As highlighted by the findings, these factors can vary significantly, suggesting the importance of *ad hoc* analysis and interpretations of how trust is built within and beyond the group's boundaries. In recent years, several scholars have emphasized the importance of adopting a hybrid approach to analyze criminal network dynamics, urging a shift from focusing solely on micro-level networks and individual dynamics to including broader meso-level analyses (Duijn 2016; Ouellet and Hashimi 2019). Although previous studies have explored cross-group collaboration, there has been no systematic comparison of the differences between intra-group and inter-group dynamics.

Second, in doing it, the study also expands beyond merely examining co-offending and delinquency, which comprise only a portion of the activities within criminal groups (Kleemans and Van de Bunt 1999; Malm, Bichler, and Van De Walle 2010; Ouellet and Hashimi 2019; C. M. Smith and Papachristos 2016). Collaboration, understood here as an interaction that may not necessarily be aimed at committing criminal acts, is conceptualized and analyzed as embedded within a broader spectrum of relationships: co-offending, but also other associational

organizational structures (von Lampe 2016b) such as familial relationships, group membership, and the sharing of same attributes. Disentangling these different types of relationships and adopting a multiplex approach is essential for achieving a more comprehensive understanding of the structure and strategies of criminal organizations (Diviák, Dijkstra, and Snijders 2019).

Furthermore, the study suggests how a meso-level approach may support the identification of key players within criminal networks, reinforcing previous research indicating that leaders are strategically positioned not only at the individual level but also across groups as well (Calderoni, Brunetto, and Piccardi 2017; Della Posta 2023). The findings underscored the critical role of brokers among *locali* in integrating the overall criminal organization, coordinating activities, and controlling information flow. These insights point to potential disruption strategies that future research and practitioners could explore, extending beyond the boundaries of individual criminal groups in clan-based criminal organizations (Duijn, Kashirin, and Sloot 2014; Ficara et al. 2021; Morselli and Petit 2007; Toledo et al. 2023). That said, it is worth noting that, in the case of the ‘Ndrangheta, what is most relevant is not necessarily the specific individuals occupying certain positions – particularly since some of them are sometimes filled through periodic horizontal elections – but rather the established roles they play within the organization’s structure. These roles persist regardless of the individuals who occupy them. In this context, removing leaders (i.e., the meso-level brokers), even those with charismatic influence, may not be the most effective strategy, as the organization’s set of rules, its functionally diffuse nature, and its main function – providing mutual aid (Paoli 2003)– are designed to ensure its adaptability and resilience.

Eventually, this dissertation contributes to the existing empirical literature on the ‘Ndrangheta, enriching the knowledge of its internal dynamics (Calderoni 2012; 2014a; Calderoni, Brunetto, and Piccardi 2017; Calderoni and Superchi 2019; Grassi et al. 2019) and the social environment in which it is embedded (Catino, Rocchi, and Vittucci Marzetti 2022). To the best of my knowledge, this is the first study to explore these aspects by focusing on the ‘Ndrangheta’ formal subdivision into *locali*, further expanding our understanding of its complex internal functioning.

The topic discussed in the present dissertation goes beyond the sole interest of the academic community. In the report *Decoding the EU’s Most Threatening Criminal Networks*, Europol (2024) recently highlighted the need for further analysis of the extent to which, in large criminal organizations, all members form part of the criminal network. More specifically, the report devotes great attention to a matter especially central to this dissertation: *what glues networks together*, i.e., the factors that bind individuals together within such networks, highlighting more practical implications beyond academic interest. In this regard, the present study contributes by examining how members cooperate in a large clan-based criminal organization and analyzing some of the factors identified by Europol as critical – leadership, family ties, and geographical proximity. The findings emphasize the need to account for two critical considerations. On the one hand, it is crucial to distinguish between intra-group and inter-group dynamics when analyzing the factors that make clan-based criminal organizations cohesive. This distinction is necessary to avoid generalizations and grasp the different dynamics in place in complex environments. On the other hand, beyond intra- and inter-group differences, the role of these factors should always be interpreted in relation to the type of activity under investigation – the same factor may indeed hold significant relevance when investigating illicit market activities but may diminish in importance when the focus shifts to governance-related dynamics.

Conclusions

The empirical research on criminal organization has significantly advanced our understanding of how criminals come to collaborate, and the strategies adopted to survive and succeed in the criminal environment. To date, however, limited attention has been paid to how collaboration extends beyond individual group boundaries, especially in contexts where multiple distinct groups must coordinate with each other, such as clan-based criminal organizations.

This study contributes to the current knowledge of collaboration in clan-based criminal organizations by investigating inter-group interactions among *locali*, the formal subgroups of the ‘Ndrangheta. The findings highlighted strong cooperation among *locali*, supporting the argument that the operational needs of the organization require extensive cooperation across its constituent subgroups, requiring to renounce part of the secrecy needs (Catino 2019). Mafias, including the ‘Ndrangheta, are multifunctional organizations, acting separately for certain goals and remaining united for others (Paoli 2003; 2020). When conducting governance-type activities, the autonomy of the groups needs to be balanced with the operational and symbolic needs of the organization. This external cooperation is mainly handled by the leaders, who act as brokers between *locali*, reflecting their formal roles within the high-level bodies of coordination in the operational dynamics.

The study further demonstrated that the factors driving collaboration within *locali* are distinct from those that foster cooperation across *locali*. While formal hierarchy emerged as a key factor in promoting cooperation among *locali*, kinship emerged as the most significant element in facilitating collaboration within *locali*, with its effect also indirectly influencing interactions across *locali*. In the ‘Ndrangheta, formalization and embeddedness in a broad social environment converge to regulate different types of interactions, ensuring a balance between

different organizational needs.

Building on these findings, several advancements can be made to further expand our understanding of collaboration in clan-based criminal organizations. Future research should examine whether collaboration patterns hold when considering involvement in different activities. Prior studies suggest that in higher-risk criminal activities, hierarchical structures may become less significant, and leaders may tend to stay more detached leveraging the group's social structure (Calderoni 2012; Scaglione 2011). Second, investigating other clan-based criminal organizations, and opening to less structured criminal organizations, could broaden the scope of the current understanding and reveal common or divergent patterns in the management of cross-group interactions. Eventually, while this research focused exclusively on internal relationships within the same criminal organization, it is important to note that these groups also engage in collaborations with external criminal organizations (DIA 2022b). Future research could explore how external interactions are managed, examining the strategies adopted and the relationships (e.g., kinship, resource transfer) that underpin this cooperation.

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Appendix

Table Appendix A: Number of members, cohesion ratio, and z-score per locali, by case study

<i>Infinito</i>	N	α_k	z-score
Seregno	29	0.82	18.1
Desio	21	0.67	16.5
Milano	18	0.65	17.37
Erba	13	0.54	16.3
Cormano	24	0.48	10.41
Pioltello	19	0.47	11.93
Bresso	15	0.42	11.51
Bollate	14	0.33	8.96
Mariano Comense	11	0.3	9.35
Pavia	5	0.22	9.45
Rho	6	0.21	8.01
Legnano	11	0.2	5.72
Corsico	5	0.15	6.09
Solaro	5	0.08	3.12
<i>Crimine</i>	N	α_k	z-score
Cardeto	6	0.58	24.23
Società di Rosarno	45	0.44	6.92
Marina di Gioiosa Jonica	26	0.42	9.52
Società di Siderno	26	0.33	6.66
Società di Melito Porto Salvo	5	0.28	12.73
Grotteria	10	0.25	8.21
Roghudi	6	0.19	7.8
Piscopio	5	0.16	6.35
San Luca	12	0.14	4.31
Croce Valanidi	9	0.13	4.04
Oliveto	9	0.11	3.41
Gioiosa Jonica	7	0.07	2.18
<i>Minotauro</i>	N	α_k	z-score
Bastarda	9	0.62	30.3
Natile di Careri a Torino	42	0.50	7.99
Cuorgné	35	0.40	6.63
Siderno a Torino	25	0.39	8.98
Crimine di Torino	10	0.25	10.3
Chivasso	11	0.13	4.11
Volpiano	16	0.12	2.14
San Giusto Canavese	7	0.1	4.4
Rivoli	6	0.06	2.56
Moncalieri	7	0.05	1.58

Table Appendix B: Descriptives of the network' dimensions - number of nodes, number of edges, and number of edges overlapping with collaboration network

	Infinito			Crimine			Minotauro		
	N	E	E Overlap	N	E	E Overlap	N	E	E Overlap
Collaboration	235	2036		283	1769		208	4226	
Co-charges	53	106	70	10	7	7	31	48	42
Kinship	121	166	126	95	126	73	130	158	101
Family	82	56	41	65	48	32	90	69	55
Third-degree kinship	103	110	85	63	78	41	95	89	46
Acquired kinship²⁵	42	32	27	31	18	10	42	30	18
Same <i>locale</i> affiliation	233	1683	696	270	1773	406	194	2111	1084

²⁵ Acquired kinship includes those ties from the third-degree kinship dimension which are acquired kinship only, i.e., father/mother-son-in-law, and brothers-in-law. This dimension is not used for the analysis but is employed to contextualize some results.

Table Appendix C: Descriptives of the network' dimensions - number of nodes, number of edges, and number of edges overlapping with intra-collaboration network

	Infinito			Crimine			Minotauro		
	N	E	E Overlap	N	E	E Overlap	N	E	E Overlap
Intra-collaboration	210	696		228	406		172	1084	
Co-charges	47	82	59	8	6	6	24	30	29
Kinship	108	143	116	77	95	61	107	125	95
Family	69	47	39	52	41	30	73	58	54
Third-degree kinship	86	96	77	49	54	31	74	67	41
Acquired kinship	35	26	24	20	11	8	29	22	15

Table Appendix D: Descriptives of the network' dimensions - number of nodes, number of edges, and number of edges overlapping with inter-collaboration network

	Infinito			Crimine			Minotauro		
	N	E	E Overlap	N	E	E Overlap	N	E	E Overlap
Inter-collaboration	184	1340		241	1363		189	3142	
Co-charges	18	19	11	2	1	1	18	18	13
Kinship	19	12	10	23	16	12	11	7	6
Family	6	3	2	8	4	2	2	1	1
Third-degree kinship	16	9	8	16	12	10	10	6	5
Acquired kinship	6	3	3	8	4	2	8	4	3
Kinship locale	111	660	105	148	1198	192	132	696	146

Table Appendix E: Correlation matrix of the continuous variables employed in the regression analyses of RQ1, Infinito

	Liaison	Representative	Participation coefficient	Age	N. kinship	N. call
Liaison	1	0.65***	0.36***	0.18**	0.12	0.54***
Representative		1	0.38***	0.16**	0.22***	0.67***
Participation coefficient			1	0.30***	0.01	0.24***
Age				1	-0.10	0.09
N. kinship					1	0.23***
N. call						1

Table Appendix F: Correlation matrix of the continuous variables employed in the regression analyses of RQ1, Crimine

	Liaison	Representative	Participation coefficient	Age	N. kinship	N. call
Liaison	1	0.87***	0.21***	0.13**	0.42***	0.66***
Representative		1	0.15***	0.14**	0.46***	0.46***
Participation coefficient			1	0.18***	-0.06	0.17***
Age				1	-0.02	0.09
N. kinship					1	0.43***
N. call						1

Table Appendix G: Correlation matrix of the continuous variables employed in the regression analyses of RQ1, Minotauro

	Liaison	Representative	Participation coefficient	Age	N. kinship	N. call
Liaison	1	0.69***	0.36***	0.32***	0.08	0.45***
Representative		1	0.34***	0.30***	0.23***	0.46***
Participation coefficient			1	0.14*	0	0.18**
Age				1	-0.07	0.09
N. kinship					1	0.14*
N. call						1

Table Appendix H: Sensitive analysis controlling for mafia association - zero-inflated negative binomial models for liaison, per case study (10,000 Y-permutations)

	Infinito	Crimine	Minotauro
<i>Negative binomial</i>	III	III	III
Intercept	3.621	3.214	6.591
Leader	2.118***	1.860*	1.433**
Age	0.005	0.010	0.050
N. kinship	-0.100	0.212	-0.110
Locale_size2	0.096	-0.060	0.343
Locale_size3	-0.311	0.461	-0.105
Mafia association	1.347**	0.813	-0.041
Log(theta)	-0.780*** (0.197)	-1.368*** (0.194)	-0.824*** (0.152)
<i>Zero-inflated</i>			
Intercept	1.554*** (0.355)	1.631 (0.261)	0.880*** (0.235)
High_meet	-3.458*** (0.657)	-4.538 (3.097)	-3.130*** (0.673)
N. call	-0.032 (0.054)	-1.010** (0.388)	-0.092 (0.068)
Log-likelihood	-741.2	-598.6	-903.7
N	183	277	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$			
VIF			
<i>Infinito</i>	leader=2.8; age=1.4; n. kinship=3.0; locale_size=7.8; mafia association=7.7		
<i>Crimine</i>	leader=2.0; age=1.5; n. kinship=1.6; locale_size=1.9; mafia association=2.6		
<i>Minotauro</i>	leader=1.8; age=1.2; n. kinship=3.4; locale_size=4.6; mafia association=11.5		

Table Appendix I: Sensitive analysis controlling for mafia association - zero-inflated negative binomial models for representative, per case study (10,000 Y-permutations)

	Infinito	Crimine	Minotauro
<i>Negative binomial</i>	I	I	I
Intercept	1.795	1.356	3.631
Leader	1.467***	1.750	1.067*
Age	0.005	-0.006	0.037***
N. kinship	-0.045	0.175	-0.001
Locale_size2	1.799***	-0.229	0.762
Locale_size3	1.542***	1.221	1.577***
Mafia association	0.920**	1.227	0.837*
Log(theta)	-0.555*** (0.171)	-0.908*** (0.185)	-0.421** (0.145)
<i>Zero-inflated</i>			
Intercept	1.373*** (0.345)	1.571*** (0.249)	0.802*** (0.231)
High_meet	-2.762*** (0.522)	-2.272*** (0.639)	-3.822*** (0.857)
N. call	-0.166* (0.081)	-1.067*** (0.319)	-0.060 (0.063)
Log-likelihood	-677.7	-484.5	-825.8
N	183	277	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$			
VIF			
<i>Infinito</i>	leader=2.3; age=1.3; n. kinship=2.3; locale_size=8.4; mafia association=8.0		
<i>Crimine</i>	leader=2.1; age=1.4; n. kinship=1.6; locale_size=2.0; mafia association=2.6		
<i>Minotauro</i>	leader=1.7; age=1.3; n. kinship=3.2; locale_size=4.9; mafia association=9.7		

Table Appendix J: Sensitivity analysis controlling for mafia association – OLS models for participation coefficient, per case study (10,000 Y-permutations)

	Infinito	Crimine	Minotauro
	III	III	III
Intercept	0.504	0.516	0.352
Leader	0.236***	0.190***	0.222***
Age	0.002	0.002	0.000
N. kinship	-0.004	-0.007	-0.025
Locale_size2	-0.050	0.099	0.018
Locale_size3	-0.303***	-0.067	0.076
Mafia association	0.156***	0.010	0.260***
R ²	0.34	0.10	0.27
Adj. R ²	0.32	0.08	0.24
N	183	277	185
Significance: *** = p < 0.01; ** = p < 0.05; * = p < 0.1			
VIF			
<i>Infinito</i>	leader=1.4; age=1.2; n. kinship=1.2; locale_size=1.4; mafia association=1.2		
<i>Crimine</i>	leader=1.3; age=1.2; n. kinship=1.3; locale_size=1.3; mafia association=1.3		
<i>Minotauro</i>	leader=1.2; age=1.1; n. kinship=1.2; locale_size=1.3; mafia association=1.3		

Table Appendix K: Correlation matrix between collaboration network and the other dimensions used as variables in the MRQAP, Infinito case study

	Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Same locale aff.	Same residence	Same age	Both leaders
Collaboration	1	0.13***	0.14***	0.06***	0.12***	0.19***	0.13***	0.06***	0.19***
Co-charge		1	0.15***	0.06***	0.15***	0.17***	0.07***	0.02***	0
Kinship			1	0.57***	0.81***	0.28***	0.13***	0.02***	0
Family				1	0	0.16***	0.11***	0.02***	0
Kinship3					1	0.22***	0.08***	0.01***	0
Same locale aff.						1	0.17***	0.03***	-0.03***
Same residence							1	0.04***	0.01
Same age								1	0.051
Both leaders									1

Table Appendix L: Correlation matrix between collaboration network and the other dimensions used as variables in the MRQAP, Crimine case study

	Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Same locale aff.	Same residence	Same age	Both leaders
Collaboration	1	0.19***	0.17***	0.09***	0.15***	0.12***	0.10***	0.02***	0.10***
Co-charge		1	0.15***	0.24***	0	0.05***	0.07***	0.01***	0
Kinship			1	0.62***	0.79***	0.21***	0.17***	0.02***	0.01***
Family				1	0	0.15***	0.11***	0.02***	0
Kinship3					1	0.15***	0.12***	0.01***	0.01
Same locale aff.						1	0.59***	0.01***	-0.02***
Same residence							1	0.01***	-0.02***
Same age								1	0.02***
Both leaders									1

Table Appendix M: Correlation matrix between collaboration network and the other dimensions used as variables in the MRQAP, Minotauro case study

	Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Same locale aff.	Same residence	Same age	Both leaders
Collaboration	1	0.21***	0.10***	0.09***	0.05***	0.22***	0.12***	0.02***	0.3***
Co-charge		1	0.01***	0.02***	0	0.08***	0.05***	0.03***	0.01***
Kinship			1	0.66***	0.75***	0.24***	0.19***	0	0.01
Family				1	0	0.17***	0.16***	0	0
Kinship3					1	0.18***	0.11***	0	0
Same locale aff.						1	0.16***	-0.01***	0
Same residence							1	0.03***	0
Same age								1	0.01***
Both leaders									1

Table Appendix N: Correlation matrix between intra-collaboration and inter-collaboration network and the other dimensions used as variables in the MRQAP, Infinito case study (intra-collaboration and its dimension in the upper right part; inter-collaboration and its dimensions in the lower left part)

	Inter-Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Kinship locale	Same residence	Same age	Both leaders
Intra-Collaboration	1	0.22***	0.24***	0.13***	0.20***	-	0.17***	0.05***	0.06***
Co-charge	0.08***	1	0.18***	0.07***	0.17***	-	0.08***	0.02***	-0.01*
Kinship	0.1***	0	1	0.57***	0.82***	-	0.14***	0.02***	0
Family	0	0	0.5***	1	0	-	0.11	0.02***	0
Third deg. kinship	0.12***	0	0.87***	0	1	-	0.09	0.01***	0
Kinship locale	0.03***	0.06***	0.13***	0.07***	0.11***	1	-	-	-
Same residence	0.05***	0	0	0	0	0.03***	1	0.04***	0.01***
Same age	0.04***	0.02***	0.02***	0.02***	0	0	0.03***	1	0.05***
Both leaders	0.19***	0	0.02***	0	0.02***	0	0	0.05***	1

Table Appendix O: Correlation matrix between intra-collaboration and inter-collaboration network and the other dimensions used as variables in the MRQAP, Crimine case study (intra-collaboration and its dimension in the upper right part; inter-collaboration and its dimensions in the lower left part)

	Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Kinship locale	Same residence	Same age	Both leaders
Collaboration	1	0.30***	0.30***	0.20***	0.20***	-	0.20***	0.01***	0.01
Co-charge	0.19***	1	0.18***	0.28***	0	-	0.07***	0.01***	0
Kinship	0.19***	0	1	0.66***	0.75***	-	0.18***	0.01***	0
Family	0.02***	0	0.50***	1	0	-	0.13***	0.02***	0
Third deg. kinship	0.21***	0	0.87***	0	1	-	0.13***	0	0
Kinship locale	0.07***	0	0.12***	0.06***	0.1***	1	-	-	-
Same residence	0.02***	0.04***	0.04***	0	0.05***	0.06	1	0.01***	0
Same age	0.02***	0.01***	0.02***	0.02	0	0	0.01	1	0.01***
Both leaders	0.11***	0	0.03***	0	0.03***	-0.02***	-0.01***	0.02***	1

Table Appendix P: Correlation matrix between intra-collaboration and inter-collaboration network and the other dimensions used as variables in the MRQAP, Minotauro case study (intra-collaboration and its dimension in the upper right part; inter-collaboration and its dimensions in the lower left part)

	Collaboration	Co-Charge	Kinship	Family	Third-deg. kinship	Kinship locale	Same residence	Same age	Both leaders
Collaboration	1	0.34***	0.16***	0.15***	0.08***	-	0.15***	0	0.08***
Co-charge	0.05***	1	0.02***	0.03***	0	-	0.03***	0.03***	0
Kinship	0.04***	0	1	0.68***	0.73***	-	0.20***	0	0
Family	0	0	0.38***	1	0	-	0.17***	0	0
Third deg. kinship	0.05***	0	0.92***	0	1	-	0.11***	0	0
Kinship locale	0.02***	0.04***	0.09***	0.03***	0.08***	1	-	-	-
Same residence	0.02***	0.04***	0.01***	0	0.02***	0.06***	1	0.04***	0
Same age	0.03***	0.02***	0	0	0	0	0.03***	1	0.02***
Both leaders	0.32***	0.01***	0.04***	0	0.04***	0.03***	0	0.01***	1

Table Appendix Q: Bivariate zero-inflated negative binomial models for covariates (model I) and models with covariates excluding “leader” (model II) with liaison as the dependent variable, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
<i>Negative binomial</i>	I	II	I	II	I	II
Age	0.042**	0.044**	0.048**	0.042*	0.061***	0.064***
N. kinship	0.100	0.100	0.371*	0.404*	0.065	0.107
Locale_size2	-0.006	-0.034	0.665	0.641	-0.229	0.062
Locale_size3	-0.719	-0.812	1.002	-0.391	-0.222	-0.376
Log-likelihood		-761.1		-608.5		-911.2
N	183	183	277	277	185	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$						

Table Appendix R: Bivariate zero-inflated negative binomial models for covariates (model I) and models with covariates excluding “leader” (model II) with representative as the dependent variable, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
<i>Negative binomial</i>	I	II	I	II	I	II
Age	0.021	0.022	0.058**	0.027	0.057***	0.048***
N. kinship	0.136*	0.089	0.397*	0.347	0.204*	0.113
Locale_size2	1.439***	1.336***	0.685	0.603	0.514	0.552
Locale_size3	1.375***	1.300**	1.904**	0.493	1.747***	1.413***
Log-likelihood		-691.6		-498.8		-834.1
N	183	183	277	277	185	185
Significance: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.1$						

Table Appendix S: Bivariate OLS models for covariates (model I) and models with covariates excluding “leader” (model II) with participation coefficient as the dependent variable, per case study (10,000 Y-permutations)

	Infinito		Crimine		Minotauro	
	I	II	I	II	I	II
Age	0.007***	0.006***	0.004***	0.003**	0.003*	0.003*
N. kinship	0.002	0.012	-0.010	0.000	0.000	-0.009
Size_locale2	-0.079	-0.065	0.134	0.144	0.073	0.101
Size_locale3	-0.316***	-0.286***	-0.120***	-0.098**	0.158***	0.160***
R ²		0.21		0.06		0.07
Adj. R ²		0.19		0.04		0.05
N	183	183	277	277	185	185
Significance: *** = p < 0.01; ** = p < 0.05; * = p < 0.1						