8. Conclusion

In this chapter, I will first briefly summarize the results of preceding chapters. Subsequently, I reflect upon the recurring findings found throughout the studies. Finally, I sketch some of the potential directions for future research in terms of substantive research, theoretical development, and methodological development and issues.

8.1. Summary of the research

Social network analysis is a promising approach for the study of organized crime. It allows researchers to empirically study the structure of organized criminal groups with no other assumption than that organized crime is built from relations and interactions among a group of actors. Provided that researchers have access to data, they may use a wide range of theoretical concepts and methodological tools to uncover important actors, characterize the properties of networks, and identify mechanisms operating behind these structures and their dynamics.

Chapter 2 provides an introduction to the basic terminology of social network analysis together with the most frequently used measures and models. The use of all the introduced measures and models is reviewed with regard to their applications in criminology. This chapter concludes with identifying three main challenges in research on criminal networks – theory building, the use of appropriate methods, and data collection. The following chapters in this dissertation face these challenges in different ways.

Chapter 3 is a study of a Czech political corruption network known as the Rath affair. In this case, political actors were collaborating with businesspeople on manipulating public contracts and abusing European Union subsidies. The network is defined as a network of ties that have the content of collaboration and/or resource transfer. The results indicate that the network exhibits a perfect core-periphery structure. In such a structure the actor set is divided into a core and a periphery; the density of ties within the core and between core and periphery is very high, while the density within the periphery is very low. Within this structure for the Rath affair network, the collaboration ties are evenly split between core and core-periphery blocks, whereas the resource transfer ties are mostly located in the core-periphery block with pre-existing ties sparsely underlying a few of the collaboration or resource transfer ties. Collaboration and resource transfer ties rarely were overlapping. Actors are either clearly central or clearly
marginal in the network, corresponding with the core-periphery structure. The majority of actors have their ties evenly spread across multiple types of ties and none of them occupies a strategic position (i.e., having low amount of ties, but brokering a lot).

Chapter 4 is a study of a network of counterfeit alcohol distribution from the Czech Republic known as the methanol affair. Actors involved in this network manufactured and distributed poisonous alcohol beverages leading to tens of cases of death or permanent injuries. This network consisted of two components connected by a bridging tie. The two actors who were manufacturing the poisonous beverages did not have the shortest possible distance to other actors, suggesting that the dangerous beverages could have been distributed even more efficiently in network terms. Furthermore, results indicate that the structure of the network was brought about by triadic closure, translation of pre-existing ties into operational ties, and aversion against preferential attachment (i.e., the tendency against accumulating numerous ties). Other mechanisms are not found to be systematically operating in this network.

Chapter 5 tests a frequently cited and influential theory called the efficiency/security trade-off. The theory predicts that profit-driven and ideology-driven networks should differ structurally. Specifically, profit-driven networks are assumed to be inclined towards efficiency reflected by the proliferation of ties, whereas ideology-driven networks are thought to be inclined towards security reflected by the avoidance of redundant ties. This theory is tested on a sample of all available networks, in which ties refer to communication or cooperation: eleven profit- and nine ideology-driven networks. The testing is conducted by comparing the two types of networks in terms of four structural properties: density, centralization, closure, and brokerage. These tests find either no differences between the two types of networks, or differences that are opposite to the theoretical predictions. Furthermore, the implications of the theory for actor-level mechanisms are explored by using exponential random graph models. This is done because the intentions of actors (profit or security) may not necessarily translate to the network level, sometimes even triggering contradictory unintended consequences. No differences are found between the mechanisms that determine the structure of profit- and ideology-driven networks. Actually, there are considerable differences within rather than between these types of criminal networks.

Chapter 6 investigates the dynamics of two Dutch jihadi radical networks, in which some actors committed terrorist acts, which prompted law enforcement agents to disrupt this network. This study analyses the effect of law enforcement disruption on both network structure and individual tendencies. Disruption attempts are usually aimed at weakening or dismantling
network structure, but actors may respond to the disruption, which might in turn strengthen the network. For this reason, the dynamics of the two networks are studied both at the level of networks and actors. The network-level analysis shows that after the disruption, the first network of Dutch jihadi became less cohesive and remained a core-periphery structure, whereas the second network becomes more cohesive and changes from a cell-structured network into a core-periphery structured one. The analysis of relational mechanisms with stochastic-actor oriented models reveals that triadic closure was the main driving force behind the dynamics of both networks, together with translation of pre-existing ties into communication ties in the first network. Additional analyses reveal that actors with numerous ties are more likely to dissolve them in the first network, and some other actors become more central. All these findings contradict the information from the police and judicial documents which emphasizes the activity of highly central individuals as the main driver behind the network evolution.

Finally, chapter 7 reflects upon one of the most challenging issues in the research of covert and criminal networks - data collection. This study identifies six aspects of network data collection, namely nodes, ties, attributes, levels, dynamics, and context. Addressing these aspects presents challenges, but also opens theoretical opportunities. Furthermore, specific issues arise in this research context, stemming from the use of secondary data and the problem of missing data. While each of the issues and challenges has some specific solution in the literature on organized crime and social networks, the main argument of this chapter is that researchers should try and follow a more systematic and general solution to deal with these issues. To this end, three potentially synergistic and combinable techniques for data collection are proposed for each stage of data collection – biographies for data extraction, graph databases for data storage, and checklists for data reporting.

8.2. Recurring findings

Several findings were recurring throughout the studies in this dissertation. First, this concerned the role of pre-existing ties. These ties are usually defined as non-criminal relations among criminal actors established before the criminal activity in a given criminal network took place (Erickson, 1981; Morselli & Roy, 2008). Chapters 4 and 6 provide evidence for the mechanism in which pre-existing ties translate into operational ties, that is, when pre-existing ties become a basis for the interactions within the criminal activity itself. Chapter 3 shows that pre-existing ties in a corruption network were not numerous, but they were always underlying other ties.
None of these findings is surprising considering the fact that criminal networks are not isolated from the broader social context. Rather, criminal networks are embedded within broader social and institutional contexts (van de Bunt, Siegel, & Zaitch, 2014). Pre-existing ties are among the most important channels through which criminal relations are embedded in legitimate social settings. As such, they serve two roles in criminal networks. First, they provide a pool of potential co-offenders and pathways for recruitment. This is supported by evidence in chapter 4 when actors distributing poisonous alcoholic beverages were reaching out to their legitimate business partners or employees to advance the distribution network. Further evidence for pre-existing ties being recruitment pathways is in chapter 6, where some of the actors were initially drawn into the network by their friends or neighbours and radicalized afterwards.

The second role of pre-existing is in enhancing trust among co-operators in criminal settings. Although this argument is theoretically sound as there are no legal ways of enforcing contracts in criminal settings (Papachristos & Smith, 2014) and choosing to cooperate with untrustworthy partners may have even fatal consequences, there is empirical evidence that trust may not be a necessary condition of criminal collaboration. Criminal actors sometimes have no reasonable alternatives to untrustworthy partners or they may even find it exciting and entertaining to run risks (von Lampe & Ole Johansen, 2004). Thus while it may be assumed that pre-existing ties fulfilled a trust-enhancing role in the cases studied in chapters 3, 4, and 6, there is no empirical way how to reliably ascertain trust among actors from these data and thus there is also no incontestable evidence that pre-existing ties had the function of building trust among actors.

Triadic closure is another mechanism that has been shown to be important in the studies in this dissertation. Triadic closure is a relational mechanism denoting the tendency of actors to close open triads (Coleman, 1988; Rivera, Soderstrom, & Uzzi, 2010; Snijders, 2013). Statistical models controlling for other mechanisms revealed the effect of triadic closure in chapters 4, 5, and 6, supporting the existence of triadic closure in cross-sectional as well as longitudinal network data. Moreover, chapter 5 provides evidence for triadic closure on a larger sample of networks regardless of their collective goal (profit or ideology). Closure in criminal networks is usually explained by its effect on building trust (Coleman, 1988; Grund & Densley, 2014; Ouellet, Bouchard, & Hart, 2017). The fact that two collaborators share a common third partner is supposed to provide someone to oversee the interaction and someone who enables to overcome uncertainty in initializing the interaction. Similarly to the trust-enhancing role of pre-existing ties, closure enhancing trust may seem theoretically plausible, yet not necessary for criminal cooperation. There is no empirical evidence on trust in the data in chapters 4, 5, and 6,
and so the effect of triadic closure on enhancing trust can only be assumed as it currently stands. However, triadic closure is a general mechanism operating in human social networks across different empirical contexts where the content of ties is positive (Newman & Park, 2003; Rivera et al., 2010; Snijders, 2013) – from friendship networks in classrooms to cooperation networks in organizations. Before criminal networks analysts attribute a special function to closure in criminal settings, it should be clarified and empirically supported that the effect of closure is not just carried over from the general human propensity to interact in closed microstructures, which may even be “hardwired” on neural level in human brains (Zerubavel, Hoffman, Reich, Ochsner, & Bearman, 2018).

With regard to structural properties of networks, a core-periphery structure is found in chapters 3 and 6. A core/periphery network consists of two types of nodes – core and peripheral. In an ideal case, core nodes have ties to one another and some ties to the periphery, whereas peripheral nodes have ties only to the core (Borgatti & Everett, 1999). In the corruption network study, the core/periphery model had a perfect fit with the network structure. In the study of two dynamic jihadi networks, the first one maintained a core/periphery structure after the disruption whereas the other transitioned into this structure after the disruption. The emergence of core/periphery structures may seem unexpected in criminal networks from the point of view of network theory as a core/periphery network is centralized with a dense core. Consequently, these properties contribute to increased visibility – something actors in criminal networks should try to avoid. However, core/periphery structure allows the core actors to directly control much of the network while enabling quick replaceability of actors who leave the network. Also, the peripheral actors may be engaged only ad hoc for specific tasks or occasions, therefore do not necessarily risk prolonged involvement in criminal activities. From the actors’ point of view, actors in possession of power (e.g., knowledge of public contracts in corruption or religious knowledge in religious extremism) may be inclined to densely connect to others with a similar status, thus forming a core. These high-status actors may prevent excess involvement of lower status actors by interacting with them only ad hoc, thus forming a periphery. The fact that structures emerging from these tendencies may have some undesirable qualities is something actors may not inherently perceive, as it would require them to be able to oversee the network structure. However, it is more realistic to assume that actors act based on properties of the network they can perceive (i.e., what they are able to “see”, such as direct control) instead of properties which they can not realistically perceive or understand (i.e., structure of the whole
network) and this may be the reason why core/periphery structures are regularly observed despite their vulnerability to detection.

One of the most prominent concepts in criminal network analysis is centrality of actors (cf. Bichler, Malm, & Cooper, 2017; Faust & Tita, 2019). I investigated centrality of actors in chapters 3 and 4 in this dissertation. In chapter 3, the analysis of actors’ centrality is combined with multiplexity of their ties. None of the actors is found to hold a strategic position (high betweenness and low degree) and all of them had their ties evenly spread across the types of ties under study. Interestingly enough, even though the whole corruption network was called the Rath affair after the actor who was supposedly the main actor, the centrality analysis does not find him to be the most central. In chapter 4, actors’ centrality is analysed in conjunction with their network distance from the actors who mixed the poisonous beverages. The analysis reveals that the manufacturers relied on distributors to get the batches of counterfeit alcoholic beverages across the network, which made the distributors the most central and also increased network distances to manufacturers. Thus, there were two distinct types of important actors; those with a crucial skill (manufacturers) and those with a critical network positions (high central distributors). On the one hand, these results show that even basic descriptive measures in SNA can provide non-trivial and unique information that would not be gained by simply reading through contextual or qualitative description of the case. On the other hand, even though clearly central actors were found in all the studies here, whenever results were accompanied by a statistical model, the model did not provide any evidence that this centralization was brought about by some endogenous centralizing mechanism such as preferential attachment (cf. Barabási & Albert, 1999). What this shows is that it is not only beneficial to complement qualitative accounts with centrality measures, but that it is also necessary to accompany centrality measures with statistical models controlling for other mechanisms. This prevents from making erroneous inferences about how the network structure emerged – although the network may be highly centralized, it might have not emerged by gradual concentration of ties around central actors but other mechanisms (e.g., related to actors’ attributes) might have been at play. An example of this is qualitative evidence highlighting the activity of central actors in the two jihadi networks in chapter 6, which was in contrast with model results that provided no evidence for operation of preferential attachment (the mechanism of accumulation of ties). Instead, triadic closure and translation of pre-existing ties into communication ties were found to be operating instead.

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8.3. Directions for future research

The recurring findings in this dissertation open up pathways for future research. In this section, I discuss some of the directions for future research that could extend studies in this dissertation in terms of substantive research, theoretical, or methodological development.

Substantive research

The case study of a corruption network in chapter 3 is one among only a small number of studies using network approach to analyse political corruption. As chapter 3 demonstrates, corruption at this scale bears resemblance to organized crime and thus it can be analysed with SNA (cf. Campana, 2016; McIwain, 1999). Network analysis has so far been mostly applied to terrorist, gangs, or profit-oriented criminal groups (e.g., drug trafficking, human trafficking; cf. Cunningham, Everton, & Murphy, 2016; Morselli, 2014). It is understandable that SNA has been applied by researchers predominantly to terrorism, gangs, mafias, and trafficking networks, because these problems present a considerable threat to security in Western countries, where most of the research is conducted. However, in other parts of the world, such as post-communist countries or Latin America, political corruption may be as threatening as gangs or terrorism, because of its far-reaching implications for development and welfare therein (Uslaner, 2008). The multiplex approach presented in chapter 3 may be just one possibility how to study corruption networks. Further aspects, such as studying the dynamics of corruption networks over time or the attributes or volumes of resources at stake, may be incorporated in future research.

Convergence or radical settings were touched upon in chapter 4 and explicitly studied in chapter 6. Recall that convergence settings denote spatial or social settings that provide criminal actors opportunities to meet and gain information and resources, which facilitate collaboration among them (Felson, 2006, 2009). In terrorism and radical movements, this concept has been reiterated as radical settings, that is, settings facilitating dissemination of radical ideas and resources (Wikström & Bouhana, 2017). As I propose in chapter 7, bipartite or two-mode networks may be used to empirically test the effect of convergence settings and their attributes on network structure. In this case, two-mode networks capture actors in one mode and settings as another mode with ties representing co-attendance or co-affiliation of actors to the settings. Operationalizing convergence settings as a distinct mode in a two-mode network allows to
specifically address how these settings facilitate criminal collaboration or how different types of settings (e.g., public or private settings) differ in the structure of the network. Deeper understanding of the role played by convergence settings in criminal networks may be not only scientifically important, but it may also have substantial practical implications. Unlike actors, settings cannot run or hide and thus they are easier to target for law enforcement surveillance. Knowing their structural importance may in turn help to uncover important actors or ties among them.

The last substantive area I want to discuss here is the study of individual attributes in criminal networks. Chapters 4 and 6 have explicitly looked at some of the individual characteristics (such as experience with entrepreneurship) and how they affect the structure of criminal networks with the underlying reasoning that attributes like these represent preconditions and predispositions towards acting in a certain way (Robins, 2009). However, individual attributes do not only affect network structure, they are also affected by the structure (see the discussion about selection and influence; Steglich, Snijders, & Pearson, 2010). For instance, there is some research on leadership in criminal networks showing how leaders in criminal networks minimize risk (Calderoni & Superchi, 2019; Hofmann & Gallupe, 2015). This research can be fruitfully extended by theorizing not only how leaders shape the networks, but also how networks shape the leaders, or even how network structure and leadership co-evolve. Similarly, research on terrorism has attempted to explain how actors become involved in terrorism or how they come to commit acts of terror (Horgan, 2008; Sageman, 2004, 2014). As these researchers point out, relying solely on individual factors to explain these phenomena falls short. Including network structure and network positions of actors among potential explanations and, subsequently, testing these explanations with proper models on empirical data may be a way forward here.

**Theoretical development**

As I mentioned throughout this dissertation, the lack of theoretical development in criminal network analysis has been criticized by some researchers as a serious problem for development of the field (Bright et al., 2012; Carrington, 2011; van der Hulst, 2011). The efficiency/security trade-off theory (Morselli, Giguère, & Petit, 2007) has assumed a position of a widely accepted theory about the structure of criminal networks. This theory posits that profit-driven networks are structured for efficiency allowing their members to make profit on regular basis, whereas
ideology-driven networks operate in longer time frames, planning towards high-impact actions (e.g., bombings or kidnappings). This implies that while profit-driven networks should exhibit proliferation of ties, their ideology-driven counterparts should instead be geared towards reduction of redundant ties. However, recent research (de Bie et al., 2017; Ünal, 2019) together with the study in chapter 5 found evidence against some of the hypotheses deduced from this theory, specifically that there are either no structural differences between networks driven by profit and networks driven by ideology or these differences are even opposite to what the theory would imply.

Nevertheless, as both chapter 4 and 6 demonstrate, the efficiency/security trade-off may still be a good starting point for formulating a theory of criminal networks. However, instead of deriving wide network-level implications from the efficiency/security trade-off, it may be used in line with the approach of analytical sociology (Hedström, 2005; Hedström & Bearman, 2011; Manzo, 2014a) as a basis for a theory of action which deduces how and why actors would act (i.e., form ties in networks) in specific cases under more general expectations. The role of a theory of action in analytically oriented criminal network research would be to formulate hypotheses and subsequently confront them with available data instead of post-hoc explain observed results. The theory of action could be used to explain why actors in criminal networks would be motivated for or against forming ties in certain ways which are captured by relational mechanisms (Rivera et al., 2010). I attempted to proceed this way in chapters 4, 5, and 6. There is a great benefit to such an approach in that it may borrow explanations and findings from other network research subdisciplines, which helps building theory and also allows to contribute back to the study of networks in general. The efficiency/security trade-off does not have to be the only theory of action; network modifications of other theories, such as Hedström’s (2005) desires-beliefs-opportunities theory or Lindenberg’s (2008) goal-framing theory, may be used instead. Multiple theories of action can even be tested against each other, helping us to formulate hypotheses and explanations and to eliminate those with little or no empirical support.

All empirical studies in this dissertation (chapters 3, 4, 5, and 6) distinguish between the analytical levels of individual actors and whole networks. Having a plausible and testable theory of action is just one part of the explanatory puzzle of how network structures arise. If we admit that network structures arise as a consequence of overlap and accumulation of individual ties (Robins, Pattison, & Woolcock, 2005; Snijders & Steglich, 2015), we also need to specify how exactly these ties overlap and accumulate to give rise to a network structure. In other words, it is necessary to specify the micro-macro link (cf. Coleman, 1990). To this end, specification of
relevant relational mechanisms together with their empirical testing using appropriate models should provide a solid basis for disentangling the network structure into its constituent micro-level elements. In order to advance our understanding of emergent network level properties, more theorizing about consequences of different relational mechanisms should be done and these consequences should be subsequently investigated in simulation studies (akin to Robins et al., 2005; Snijders & Steglich, 2015). A specific example is the mechanism of brokerage. There has been a lot of emphasis on the importance of brokers in criminal networks suggesting that brokerage provides brokers with profit while allowing them to not expose themselves and that it helps to interconnect different regions of the network (Bright, Koskinen, & Malm, 2018; Morselli, 2010; Morselli & Roy, 2008; Robins, 2009). However, the conceptualization of brokerage is not entirely clear from the extant literature, as on the one hand, it may be viewed as a tendency of actors for maintaining structural holes among their partners (Burt, 1992, 2005), while on the other hand, brokerage may be viewed as a tendency of actors to assume positions bridging between different regions of the network (DellaPosta, 2017; Morselli, 2010; Morselli & Roy, 2008). These two dimensions of brokerage may also yield different structural outcomes, as the one emphasises neighbouring actors whereas the other considers the network as whole. Only more theorizing about their similarities, differences, preconditions, and outcomes together with empirical research may shed light on which one is more prevalent, in what circumstances they occur, and which structural outcomes they yield.

*Methodological development*

Even though the research on criminal networks is still largely descriptive (Campana, 2016; Stys et al., 2019), criminologists are starting to adopt statistical models for networks. These models are methodological cornerstones of chapters 4, 5, and 6. Descriptive analysis in SNA can go a long way to uncover structure and central actors in criminal networks. However, descriptive analysis cannot be used to draw inferences about mechanisms and processes that brought about observed outcomes. For instance, claiming that a network was brought about by a process of gradual tie accumulation akin to cumulative advantage or preferential attachment, just because it is descriptively highly centralized, is potentially erroneous as descriptive analysis does not account in any way for other potential mechanisms that might have played a part in formation of a given network. Statistical models are designed to separate effects of multiple competing mechanisms, which is one of the reasons why they have become so popular in all domains where network approach is used. Nevertheless, the context of criminal networks is specific
enough that straightforward adoption of these models from other areas may not be without problems.

One of the promising types of models for criminal networks are autologistic actor attribute models. Autologistic actor attribute models (ALAAM; Daraganova & Robins, 2013; Robins, Pattison, & Elliott, 2001) are in principle similar to exponential random graph models (ERGM; Lusher, Koskinen, & Robins, 2013) – they also use configurations as explanatory variables and simulate distributions of outcomes, but the outcome in this case are individual attributes (unlike tie variables in ERGMs). These models have not been used nearly as much as ERGMs – one of the few studies is Kashima and colleagues' (2013) study on adoption of norms and there is only one example in criminal networks comparing the structural position of men and women in organized criminal networks (Diviák, Coutinho, & Stivala, 2019). Other potential uses for ALAAM includes explaining the structural and individual factors behind leadership in criminal networks.

In a similar vein to modelling categorical individual attributes, a model-based approach to centrality measures would greatly aid the research on criminal networks. As I argued in the section on future substantive research, this is central to the development of the whole subfield of criminal network analysis, in which huge attention is paid to identifying central actors. Formulating a model for centrality of actors would contribute not only to identifying central actors, but also to explaining what makes them central and quantifying the uncertainty of the results. For instance, is centrality of actors in a terrorist network affected by a specific skill (an individual attribute), the centrality of their neighbours (a network predictor), or by the amount of pre-existing ties they have (a dyadic predictor)? Having a model that could answer these questions without relying on violated assumptions (e.g., independence of observations) would increase our understanding of central actors in criminal networks and would also give us a more powerful tool in designing interventions against criminal networks.

Another avenue for extending existing models for specificities in criminal networks research is constituted by models for network dynamics. As discussed in chapter 6, one of the key differences of criminal networks from their overt counterparts is that the node set (‘population’) is usually not stable. New actors join and previously active actors drop out or are removed from the network. This makes modelling dynamics of these networks challenging, as stochastic actor-oriented models (SAOM; Snijders, 1996; Snijders, van de Bunt, & Steglich, 2010) assume a stable node set. Even though some change can be accommodated using the change composition method (Huisman & Snijders, 2003), actors joining or leaving the network are not just a
nuisance. The change in composition of the node set may be due to theoretically important reasons such as constraints or opportunities for criminal cooperation. In other words, criminal network analysis could use models that can account for actors joining or leaving the network, and for the way they create or drop ties. Two possible steps towards such models may be models for network growth (cf. Bell et al., 2017; Fellows, 2018) or models for relational events (Butts, 2008; Stadtfeld & Block, 2017; Stadtfeld, Hollway, & Block, 2017), although both these types of models are currently restrained by some assumptions that limits some of the criminologically interesting applications. For network growth models, some of them build on the assumption that nodes and ties can only be added (Fellows, 2018), but criminologists may be equally or even more interested in deletion of nodes and ties as chapter 6 demonstrated. The models for relational events currently only consider dyadic events (Stadtfeld et al., 2017), yet for criminologically interesting applications, triadic events (such as three actors together robbing a bank) may be crucial. Overcoming these limitations may help not only the study of criminal networks, but network science as a whole.

Successful application and further development of statistical models suited for criminal network data is predicated upon availability of valid data. The issues related to data in criminal networks can be considered an Achilles heel of the whole subdiscipline (Berlusconi et al., 2016; Gutfraind & Genkin, 2017; Rostami & Mondani, 2015). In this dissertation, I used data from media sources, court files, data combining court files with police investigation and surveillance, and data collected by other researchers. All these sources have different advantages and disadvantages, which sometimes makes research of some aspects of criminal networks (such as dynamics or multiplexity) impossible due to information not being available in the given source. As chapter 7 suggests, the situation is not hopeless and there are many things that may be done in order to improve the accessibility, validity, and reliability of the data in criminal network analysis. There are two fundamental directions which seem especially important for further development of the field as a whole.

The first direction is development of data collection techniques. In chapter 7, I propose to use biographies, graph databases, and checklists as tools for systematic data collection from data extraction, through data storage, to data reporting. In theory, using these tools should increase transparency and also validity and reliability of data in the context of criminal network studies. This needs to be tested by using these tools in practice. However, we should also increase our knowledge about the procedures and techniques used by practitioners (e.g., law enforcement or media) in order to adequately capture how the secondary data we work with are primarily
created. In other words, we should use our contacts with the practitioners and specifically study the ways they use to collect the information for primary data sources. If we know the data generating process, we can then employ corresponding methods for analysing the data or at least introduce appropriate controls to distinguish genuine properties of criminal networks from artefacts induced by data collection. Thus, it may be important to systematically study the way law enforcement agents collect the data. For instance, the way police surveillance generates the pool of individuals to observe may closely resemble snowball sampling, where new individuals are included based on their contact with those already under surveillance. If we have enough evidence that snowball sampling is a good approximation of the process generating given dataset, suitable measures and models for snowball samples may be used to analyse such data (Heckathorn & Cameron, 2017; Pattison et al., 2013; Spreen, 1992).

The second direction for future research regarding data about criminal networks is the ubiquitous problem of missing data. More research needs to be done on how missing data affect criminal networks and how to deal with it. In terms of the effect of missing data on criminal networks, future studies should investigate how different missing data mechanisms (such as missing completely at random and missing not at random; Rubin, 1976) affect network structure, i.e., where these ties are located in the structure (e.g., bridging ties) or which actors are incidental to them (e.g., leaders). In a similar vein, different approaches towards imputing the data may be examined and their performance compared, such as by comparing model based imputation (Krause et al., 2018; Robins et al., 2004), with imputation based on classification of reliability of information (e.g., confirmed versus unconfirmed ties, Sparrow, 1991), and with imputation based on combining different data sources (Berlusconi et al., 2016).

As it is apparent, there is still a lot to be done in terms of theoretical as well as methodological work in the research on criminal networks. Analytical sociology, statistical models for network data, and systematic approaches to data collection have much to offer in this regard. The studies in this dissertation may be seen as small contributions from these positions to our knowledge of criminal networks, uncovering positions of actors in criminal networks, mechanisms through which they relate to other actors, and how these mechanisms translate into network structures. This dissertation thus provides a few more pieces into the mosaic of our understanding of the fascinating, yet dangerous phenomenon of organized crime.
Samenvatting

Sociale netwerkanalyse is een veelbelovende discipline die veel kansen biedt voor de studie van georganiseerde misdaad. Haar methoden maken het mogelijk om de structuur van criminele netwerken te bestuderen, vanuit het gezichtspunt dat deze tot stand komt door de keuzes van, en interacties tussen individuele actoren. Onderzoekers hebben beschikking over een breed scala aan theoretische concepten en methodologische tools om invloedrijke personen te identificeren, netwerkkenmerken te kwantificeren, en mechanismen bloot te leggen, die verantwoordelijk zijn voor de totstandkoming en de ontwikkeling van criminele netwerken.

In hoofdstuk twee van dit proefschrift wordt de basisterminologie, en de meest gebruikte meetinstrumenten en statistische modellen van sociale netwerkanalyse geïntroduceerd. Daarnaast geeft dit hoofdstuk enkele voorbeelden van toepassingen van deze meetinstrumenten en modellen binnen de criminologie. Het hoofdstuk wordt afgesloten met het aanwijzen van de drie belangrijkste problemen binnen het onderzoek naar criminele netwerken: theorievorming, keuze van analysemethoden, en dataverzameling. De hierop volgende hoofdstukken gaan hier elk op hun eigen manier op in.

Hoofdstuk drie betreft het netwerk rondom de zogeheten "Rath affaire" – een politiek corruptieschandaal in Tsjechië. In deze affaire misbruikten enkele politici hun macht bij de gunning van overheidsopdrachten en werkten ze samen met zakenmensen om onder valse voorwendselen Europese subsidies te bemachtigen. De analyse toont dat het netwerk een perfecte kern-periferie structuur laat zien. In een dergelijke structuur is de groep actoren verdeeld in een kern en een periferie. Relaties binnen de kern evenals tussen kern en periferie zijn heel dicht, terwijl relaties tussen actoren in de periferie vrijwel niet voorkomen. De overdracht van hulpbronnen vindt vooral plaats binnen de kern en tussen de kern en periferie. Relaties die samenwerking tussen actoren aangeven overlappen slechts zelden met relaties voor de overdracht van hulpbronnen. De scheiding tussen kern en periferie is heel duidelijk. Voor de meerderheid van de actoren zijn hun relaties evenredig verdeeld over verschillende typen, en geen van de actoren neemt een uitgesproken strategische positie in (d.w.z. een positie met weinig relaties, maar waarvan de bestaande relaties belangrijk zijn om andere actoren met elkaar te verbinden).

Hoofdstuk vier is een studie naar een netwerk van personen betrokken bij de verspreiding van namaak alcohol, in Tsjechië bekend als de "methanol affaire". Dit netwerk produceerde en verspreidde giftige alcoholische dranken, met tientallen doden en ernstig gewonden tot gevolg.