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The Governance of Goal-Directed Networks and Network Tasks: An Empirical Analysis of European Regulatory Networks

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Abstract

In this article, we answer the research question "What factors affect the structural complexity of network administrative organizations (NAOs)?" The question warrants further research because of the lack of empirical studies on the topic. We design a quantitative study of the structure of all 37 European regulatory networks. Using Bayesian statistics, we analyze the new data set and test hypotheses, derived from the literature, about the factors affecting the structural complexity of NAOs. We find that networks with rule-setting tasks are strongly related to less complex NAOs, whereas networks with member-sanctioning and rule-enforcing tasks are strongly related to more complex NAOs. Theoretically, network-level tasks appear to affect NAO complexity, particularly given the implied uncertainty of those tasks, as well as the network-level operational requirements related to them.

Introduction

Public goal-directed networks are increasingly popular nowadays (Agranoff 2007) and have attracted growing scholarly attention (Isett et al. 2011; Turrini et al. 2009). However, and despite these advances, some crucial dimensions still remain to be explored (Provan, Fish, and Sydow 2007), such as network evolution and change, the mechanisms that facilitate the emergence of collaborative outcomes, or how networks are governed. The governance of the whole network (Kilduff and Tsai 2003) is one of the key dimensions requiring further research, since it affects the success or failure of the collaborative endeavour (McGuire 2006). Governance encompasses joint decision-making processes, how power is shared within the network, and how collaboration is enforced among members (O'Leary and Vij 2012). Few scholars have taken up Provan and colleagues' (Provan and Milward 1995; Provan and Kenis 2008) initial work in this area further. Provan and colleagues argue that "network governance…is critical for effectiveness" (Provan and Kenis 2008, 231), and their proposed triad of ideal types of governance—shared, lead-member, and network administrative organization (NAO)—represents a sound first attempt at theorizing goal-directed network governance. However, there is still much to uncover about the mechanisms and structures enacted to effectively govern, manage, and operate these interorganizational sets. Only two studies have attempted to test Provan and Kenis's (2008) network governance typology empirically (Kenis, Provan, and Kruyen 2009; Raab, Mannak, and Cambré 2015).

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The general understanding of governance structure suggests a key theoretical and practical gap concerning goal-directed networks. Why do goal-directed networks set up different NAOs (or central secretariats) to govern themselves? Scholars report different types of NAOs, some of which make decisions through consensus, others by voting; some employ eight staff, others more than 20; some have a single board made up of network members; others have a plenary and an executive board (Agranoff 2007; Saz-Carranza and Ospina 2011). Our goal in this article is to address this void in our knowledge of NAOs. To achieve our aim, we study the universe of European regulatory networks.

Scholars studying the EU have been researching regulatory networks for at least a decade (Coen and Thatcher 2008; Kelemen 2002). However, these small-n qualitative studies have not explored in detail the form of governance, management, and brokerage of these regulatory networks. Instead, they have focused on the political dynamics among member states and European institutions (Bach et al. 2016; Boin, Busuioc, and Groenleer 2014). We differ from previous studies produced by EU scholars in that we look specifically at the form of network governance from a network and organizational perspective.

Our aim is to contribute to the advancement of existing knowledge on the governance of goal-directed networks, complementing Kenis, Provan, and Kruyen (2009), and Raab, Mannak, and Cambré (2015) by focusing on the NAO form. Instead of exploring when and why networks adopt one of the three ideal governance forms proposed by Provan and Kenis (2008), we research how and why NAOs differ in the complexity of their structure.

NAOs are purposively designed and set up by network members. The structure of the NAO is of great relevance since, as Greenwood and Miller (2010) assert, structure is a driver for the successful formulation and implementation of strategies. In goal-directed networks, NAO structure sets the preconditions to attain the collective aim of the collaborating members. Provan and Kenis (2008, 233) assumed “that there is a rationale for utilizing one form over another and that there are consequences for selection of each form of governance.” Similarly, we assume there is a rationale for selecting different NAO structures and specific consequences of doing so. By identifying and understanding better different NAO structures, we aim to deepen and complement Provan and Kenis’s (2008) shared/lead-member/NAO triad.

Our research question is: What factors affect the structural complexity of network administrative organizations (NAOs)? To address it, we create a new data set of all 37 European regulatory networks, that is, public goal-directed networks composed of European national regulatory authorities.

We find that tasks play a central role: rule-setting networks are strongly related to less complex NAOs, whereas networks with member-sanctioning and rule-enforcing tasks are strongly related to more complex NAOs. We also find weak evidence that mandated networks are related with less complex NAOs. Lastly, very weak evidence also points to economy, and finance-related networks, being less complex than networks operating in other sectors. Trust density and age do not seem to have any significant relationship with NAO complexity.

This article continues as follows. The first section develops our theoretical framework and concludes with a series of hypotheses related to the drivers of the structural complexity of NAOs. Before presenting our methods and results, we provide information about our data set and the criteria we followed to build it. In the final section, we report our results and discuss them in light of previous literature.

Theoretical Framework

The Governance of Goal-Directed Networks

Following Provan and Kenis (2008, 231), we define interorganizational goal-directed networks as “groups of three or more legally autonomous organizations that work together to achieve not only their own goals but also a collective goal.” Scholars have studied several such networks: for example, Agranoff and McGuire (2003) studied economic development networks; Isett and Provan (2005) mental health services delivery networks; and Raab, Mannak, and Cambré (2015) Dutch networks managing crime prevention services.

Goal-directed networks must be governed precisely because they aim to achieve a collective goal (Saz-Carranza and Ospina 2011). Specifically, the governance of goal-directed networks is “the use of institutions and resources to coordinate and control joint action across the network as a whole” (Provan and Kenis 2008, 231). Network governance has both a behavioral and a structural dimension (Saz-Carranza and Ospina 2011); in this article, we refer to the latter.

There are three ideal structural forms of governance for whole goal-directed networks: shared governance among all network members; governance by one of the members (i.e. lead organization); and delegation of governance to an NAO (Provan and Kenis 2008). Provan and Kenis (2008) also identify the key predictors of forms of network governance: namely, trust density, number of participants, goal consensus, and need for network-level competencies. In essence, low trust density, low consensus, large membership, and the need for network-level competencies all increase transaction costs (Williamson 1975) related to governing the network, thus making a central broker far more efficient than unbrokered multilateral coordination and implementation.

Choosing between both brokered forms—NAO or lead organization—will depend on the number of network members and the need for network-level competencies. When there are high values for both factors, the NAO will be the optimal form.

Two studies have looked at forms of network governance drawing on large or medium *N* samples. Raab, Mannak, and Cambré (2015) test which factors contribute to the effectiveness of Dutch mandated information-sharing networks in the field of crime prevention. They find that effective networks have high durability, system stability, centralized integration, and either resource munificence or NAO (as opposed to lead member) governance.

Kenis, Provan, and Kruyen (2009) conduct a meta-analysis of network research and find no relationship between task (whether exploitative/explorative and/or ambiguous/unambiguous) and governance form. However, they find that trust among parties may substitute for an NAO. This article is related to both these studies but deviates from both in that it focuses on the particularities of the NAO form.

The Structure of NAOs

Provan and Kenis's (2008) valuable typology does not delve deeply into specific NAO attributes nor into different NAO subtypes. Yet, empirical qualitative research on NAO-governed networks (Agranoff 2007; Saz-Carranza and Ospina 2011) casts light on the components of NAOs' structure and acknowledges the differences among them.

We start our exploration of the structure of NAOs with the traditional definition of organizational structure, defined as the recurrent set of organizational units composing the organization, relationships between them, the rules affecting behaviors, and decision-making and communication patterns (Galbraith 1987; Greenberg 2011; Pennings 1992). The study of traditional organizational structure is primarily concerned with issues related to the executive component of an organization: aspects such as number of units (Blau 1970; Blau and Schoenherr 1971; Modarres 2010), degree of departmentalization (Aiken, Bacharach, and French 1980), specialization (Christensen and Lægreid 2011), and degree of differentiation (Damanpour 1987; Hage and Aiken 1967). However, it is of crucial importance that research on the structure of NAOs explores and explains an NAO's organizational apex. "NAOs typically have board structures that include all or a subset of network members… The board addresses strategic-level network concerns, leaving operational decisions to the NAO leader (Provan and Kenis 2008, p236)." It is in the board where network members come together—in a governance board, plenary, general assembly, or equivalent—to make decisions and monitor the NAO's staff (Agranoff 2007; Graddy and Chen 2006; Rodriguez et al. 2007). Decision-making among the NAO's multiple principals (Miller 2005) and their relationship with their broker, the NAO's management and staff, is central to its functioning.

Compared to a traditional organization, the governing bodies of the NAO—a plenary composed of network members and, sometimes, an additional "executive" board—are disproportionally relevant in comparison to the NAO's management and staff, which tend to be small in numbers. For example, Saz-Carranza and Ospina (2011) study four goal-directed networks whose NAOs' plenary bodies bring together all their members—ranging from 16 to 164—but whose NAO staff headcount goes from 4 to 19. In other words, NAOs are organizations with oversized apexes in relation to their management and staff.

Given the relevance of the apex in NAO functioning, we build on the corporate governance literature (Bebchuk and Weisbach 2010; Larcker and Richardson 2004) and the limited available knowledge in the field of public and nonprofit organization governance (Monteduro Hinna, and Ferrari 2011). Corporate governance scholars have identified three relevant levels in organizations: shareholders, corporate directors (i.e. Board of Directors), and top management (Hermalin and Weisbach 1998, 2003; Adams, Hermalin, and Weisbach 2008). The interplay of ownership and management is the key vector driving the rationale behind governance choices (Fama and Jensen 1983) in for-profit organizations. Business-oriented corporate governance is concerned with the structure and processes that facilitate and determine the relationship between principal and agent (Jensen and Meckling 1976). Corporate governance determines the power delegated to the agent (Fields 2007) and the roles the board is to play: providing resources, safeguarding accountability, and controlling and monitoring the agent (Davis 2005).

This logic also plays a part in the public sector and nonprofit governance arrangements, since agency issues persist (Cornforth 2003; Hinna and Monteduro 2010). However, other issues such as transparency, compliance, stewardship, and a strong focus on stakeholders are more relevant (Edwards and Cornforth 2003). Since public organizations are concerned with the production of socially valuable outputs and outcomes, their governance is primarily concerned with combining simultaneously different political standpoints and social preferences in the decision-making process (Hinna and Scarozza 2015; Blair and Stout 1999; Rajan and Zingales 2000). Thus, delegation of strategic decision-making from the board to the agent—the organization's executive component—is limited in public sector and nonprofit organizations (Lynn, Heinrich, and Hill 2000; Ostrower and Stone 2006).

The governing bodies of public organizations are in charge of strategic decisions (Hinna and Scarozza 2015; Baysinger and Hoskisson 1990; Fields 2007), with important implications for the board's involvement in strategy (McNulty and Pettigrew 1999; Hendry and Kiel 2004). They also have to deal with the inherent challenges that arise from diverse and even conflicting goals (Wright 2004). It is noteworthy that these boards are often conceptualized as decision-making groups facing highly uncertain environments (Hambrick 1994) where the interests of diverse stakeholders must be safeguarded (Hinna and Monterudo 2016; Tirole, 2001). Thus, the board is also designed as a tool that can be used to pursue and balance the goals of the organization's stakeholders, rather than focusing solely on financial performance and holding the chief executive to account (Ellwood and Garcia-Lacalle 2015).

Collaborative contexts, and goal-directed networks in particular, experience tension between unity and diversity (Saz-Carranza and Ospina 2011), given that they bring together diverse members to accomplish a collective goal. The collaborative goals must be acknowledged by all members for the endeavor to be successful (Huxham and Vangen 2000; Robert and Michael 2001; Ansell and Gash 2008). However, differences in expectations and visions will hinder agreement and cooperation (Robert and Michael 2001; Bryson, Crosby, and Stone 2006). Therefore, networks, even more so than public organizations, need adequate governance to balance power and to manage, and eventually solve, group conflicts (Jehn 1997).

NAOs, in particular, face an acute collective action problem, involving a multiple-principals scenario (Miller 2005) in their governing bodies. Researchers propose that decision-making in networks happens through consensus rather than voting (Agranoff 2007; Saz-Carranza and Ospina 2011). Saz-Carranza and Ospina (2011), however, find that some networks with deep-rooted democratic and town hall-meeting cultures function via voting. And in multiorganizational settings with a large number of members—such as European regulatory networks (Saz-Carranza, Salvador Iborra, and Albareda 2016) and international governmental organizations (IGOs) (Lockwood Payton, 2010)—voting is often the norm. In NAO-governed goal-directed networks power balances affect NAO structure (Saz-Carranza, Salvador Iborra, and Albareda 2016). A NAO's structure must therefore provide a decision-making arena adequate to overcome problems of collective action and cope with the principal-agent dilemma between members and NAO staff, while keeping coordination costs at a minimum. Figure 1 shows an NAO prototype with its basic structural units.

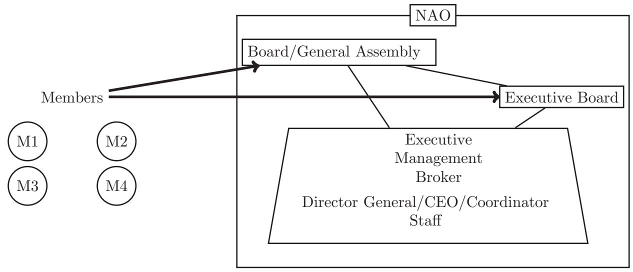

Figure 1. NAO Prototype (Own).

Qualitative studies have pointed out the differences in NAO structures (Saz-Carranza, Salvador Iborra, and Albareda 2016). Some NAOs have two boards, others just one. Some have large executives composed of tens of staff, whereas others merely have a one-person broker. So, NAOs may be more or less elaborate (i.e. more differentiated jobs and units, more developed administrative and governance components, more sophisticated decision-making rules)—just like any other organization (Mintzberg 1983).

Taking stock of Mintzberg's definition of structural organizational elaborateness (Mintzberg 1983), we build on Rescher (1998) to develop our conceptualization of the structural complexity of NAOs. In this article, we take complexity to comprise foremost the quantity and variety of constituent elements in the governance structure of the network. Complexity also reflects the degree of elaboration of the rules and norms governing a phenomenon. The complexity score of an NAO apex that we develop here represents an attempt to operationalize an aggregate of these different elements (i.e. the number and type of units and types of norms used in decision-making processes).

For example, a more complex NAO will have two boards rather than one, nonmembers on its boards, an appeal board, a director general, and sophisticated decision-making rules—i.e. double majority voting or weighted-voting as opposed to consensus — (see figure 2 for the two extreme NAO ideal types). The key question driving this research—What factors affect the structural complexity of NAOs?—aims to explore these differences among NAOs.

Factors Affecting NAO Structural Complexity

We identify four variables (network task, network age, mandated nature of the network, and trust density) plus a control variable (sector) that are theoretically expected to be associated with different levels of NAO structural complexity.

Task

Public goal-directed networks are consciously created to attain specific goals and are charged with executing certain tasks to that end (Popp et al. 2014; Raab

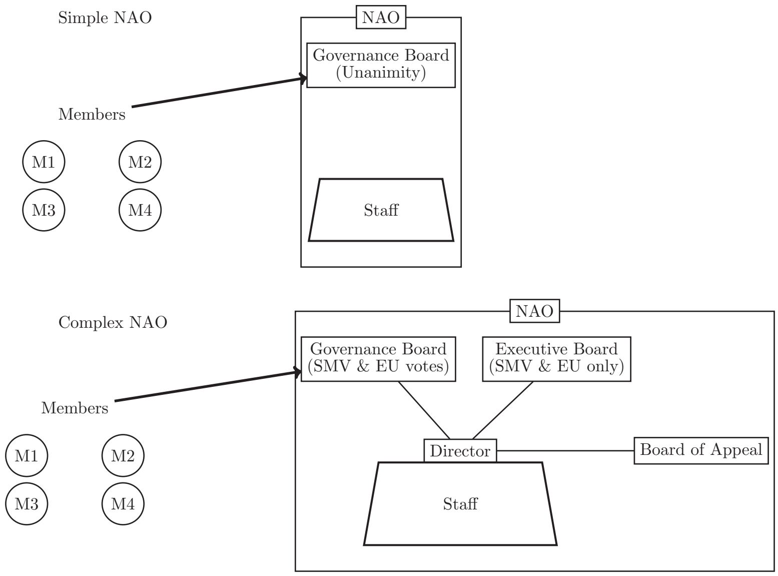

Figure 2. Simple and Complex NAOs. SMV = Simple Majority Voting.

and Kenis 2009). Organizational scholars have long since related organization structure to tasks executed (Lawrence and Lorsch 1967). Provan and Kenis (2008) also identify network-level tasks as a key contingency factor that affects the form of network governance. The more of these tasks there are, the greater the need for an NAO.

Different network tasks imply different degrees of interdependence among members (Alter and Hage 1993). Research on interorganizational relations (mainly corporate joint ventures and networks) has found that interdependences of (network) tasks affect how the NAO is structured. This is so because network-level tasks affect information requirements, coordination efforts and transaction costs (Bensaou and Venkatraman 1995; Dussauge, Garrette, and Mitchell 2000, 2004; Provan and Kenis 2008).

Agranoff (2007) identifies different types of public management networks that deal incrementally with exchange, concerted action, and joint production (Alter and Hage 1993). Agranoff (2007) distinguishes at one end of this continuum networks that only exchange information, and at the other end interagency adjustments that formally adopt collaborative courses of action. In between, his typology positions networks that deal with information exchange, produce member services, sequence programming, exchange resource opportunities, and pool client contacts.

Agranoff (2007) finds that networks institutionalize (i.e. have larger and more complex NAOs) as they move along the continuum toward joint production. He builds on organization theory-based work by Alter and Hage (1992), who maintain that the increasing institutionalization of collaborative ventures is based on the interdependencies implied by their purpose. Thus, joint-production networks imply far greater interdependencies than those that simply share information. This logic is used by Provan and Kenis (2008), who predict that networks that require network-level tasks will be more prone to adopt brokered governance mechanisms such as NAO or lead-member governance (as opposed to shared governance).

Focusing specifically on regulatory networks, Slaughter (2004) identifies three basic network functions: information sharing, rule setting, and rule enforcement. In a similar vein, and focusing on EU-regulatory networks, Coen and Thatcher (2008) distinguish regulatory networks along a soft-to-hard continuum, which runs from coordination to drafting secondary legislation at EU level. Thus, as the network moves from simply sharing information, toward setting rules, and even enforcing rules on regulated entities, the more complex we expect its NAO to become.[1] This is because the more tasks the NAO has to execute, the more it will require operational capacity, improved supervision by members, and streamlined decision-making (i.e. moving away from consensus). Scholars of IGOs have found that IGOs often use simple majority rules to avoid blockage (Snidal 1995). Additionally, if the network can sanction regulated entities or members, then we can expect an appellate body as well. In addition, more and different tasks might imply greater difficulties in monitoring operational performance (Gulati and Singh 1998) and in managing stakeholders'

1 Recall that complexity, in our study, means moving away from the basic model of a plenary working by consensus and directly overseeing the executive component of the NAO.

competing demands (Stone and Brush 1996; Green and Griesinger 1996; Herman and Renz 1998).

From this, we derive that, at the very least, all networks involve information sharing. Additionally, some may be charged with jointly producing awareness-raising campaigns, member training, or any other executive tasks (H1a). Regulatory networks may propose or even set regulations (H1b), as well as directly enforcing regulation on third-party entities (H1c). Lastly, networks are capable of sanctioning members if they do not comply with previously agreed commitments (H1d). Thus, we develop four task-related hypotheses:

- H_{1a} Networks that perform executive tasks will—ceteris paribus—have more structurally complex NAOs than those that do not.
- H_{1b} Networks that set rules will—ceteris paribus—have more structurally complex NAOs than those that do not.
- H_{1c} Networks that enforce rules on third-party entities will—ceteris paribus—have more structurally complex NAOs than those that do not.
- H_{1d} Networks that can sanction members will—ceteris paribus—have more structurally complex NAOs than those that cannot.

Age

As time passes and the network evolves, the relationships among members evolve as well (i.e. partner uncertainty decreases and trust is expected to increase). Raab, Mannak, and Cambré (2015), following Van Raaij (2006), point out that in intraorganizational networks the development of the right monitoring, accountability, and control mechanisms takes time. Young and old networks will therefore differ in terms of the mechanisms used to monitor and lead the network (Hite and Hesterly 2001; Human and Provan 2000). Mintzberg (1983) establishes age as a key contingent element affecting the degree of formalization and the enactment of more elaborate structures in organizations. Provan and Kenis (2008) also lean in this direction, since they expect the form of network governance to develop in a life-cycle manner over time, from shared to NAO-governed. In this regard, we expect NAOs to become incrementally complex as they age.

- H_2 Ceteris paribus, the older the network, the more complex the NAO.

Mandated Collaboration

In mandated networks, membership, overall goals, and network governance are not defined by network members but by the mandating party. During the design phase and prior to establishing the network (Rodriguez et al. 2007), network members and the mandating party interact to negotiate, among other things, the network's governance structures (Saz-Carranza, Salvador Iborra, and Albareda 2016). In mandated networks, membership is obligatory, rather than voluntary, and members in mandated networks do not have the option of "exiting" (Hirschman 1970). Thus, future members are very active in framing the safeguards and trying to maintain a "veto" power by advocating consensual decision-making and minimizing delegation to an executive board or an executive director (Saz-Carranza, Salvador Iborra, and Albareda 2016). In brief, in a mandated network, participants do not have an "exit" option, and thus take safeguards to protect their interests and are less likely to want to delegate to an NAO; thus, NAOs in mandated networks are likely to be less complex. We thus expect a less integrated, complex structure for NAOs of mandated networks.

- H_3 Ceteris paribus, the NAO structure is likely to be less complex when collaboration is mandated than when it is not.

Trust Density

In Provan and Kenis' typology of network governance modes, trust density (i.e. how trust is distributed among network members) is a contingency factor affecting a network's mode of governance. Trust, one's party confidence in the integrity and reliability of another party in face of a given exchange or relationship (Coote, Forrest and Tam, 2003, Yound-Ybarra and Wiersema 1999), lowers transactions costs (Williamson, 1985), and efficiently deals with the risk of opportunistic behavior between principals and agents (Jensen and Meckling, 1976). Trust then substitutes for formal mechanisms. Thus, Provan and Kenis (2008) expect a network with high trust density to be able to have a shared governance mode, whereas a network with low trust density to resort to a NAO governance mode. Raab, Mannak, and Cambré (2015) support this and find that effective networks may have either high trust density or a centralized governance structure such as an NAO. In a similar vein, we expect networks with higher trust density to have less complex NAO.

- H_4 Ceteris paribus, the lower trust density of a network, the more complex the NAO.

Policy Sector as a Control Variable

Different but interrelated organizations constitute a policy sector (Bähr 2010). Policy sector can affect the form of an NAO for several reasons. The characteristics of the interrelations among parties are specific to the policy sector and depend in a large part on interdependencies among them. Interdependence, in turn, has been found to be a good predictor of integration in interorganizational collaborations (Gulati and Singh 1998; Hillman, Withers, and Collins 2009; Kogut 1988; Oxley and Sampson 2004; Van de Ven, Walker, and Liston 1979).

Different policy sectors imply different interdependencies. As an illustration, physical operational interdependence among regulators is much higher in the rail and energy sectors than in environmental sectors (Saz-Carranza, Salvador Iborra, and Albareda 2016). In the former, national regulators have to agree on intensive reciprocal investments to build interconnections. Such interconnections are not necessary in the environment sector.

Policy sector can also have different political salience (Gormley 1986). Politicians tend to delegate to technical experts far less in sectors with greater political salience. For example, public safety (highly salient) tends to be delegated less to technical officers or civil servants than insurance regulation (low political salience)—however, this tendency is mediated by the technical complexity of the sector (Gormley 1986).

Table 1 summarizes our hypotheses. We acknowledge other factors that can determine NAO structure. Membership size and diversity among members may have an effect, but our empirical sample based on EU-regulatory networks kept both variables constant across the 37 networks.

Methods

To answer our research question and test our hypotheses, we constructed a new database of the NAOs of all EU-regulatory networks. We then used Bayesian statistics to analyze the results.

Sampling

To improve sample internal validity, we focus on regulatory networks. We started off our sampling using Levi-Faur's (2011) work on European regulatory networks and, secondly, on the European Union's official decentralized agencies' list.[2] Based on the two sources (i.e. Levi-Faur and EU list of decentralized agencies[3]), and after excluding cases appearing in both sources, we obtain 86 organizations, from which 37 comply with the sampling criteria of a NAO. The Appendix gives more information on the NAOs included in this study.

Our sampling criteria were:

- Following our characterization of NAOs, NAOs have board structures that include the network members. Thus, we considered an organization to be a NAO if national network members sat in the board and were collectively its top decisions-makers. This is how we distinguish a European-level agency from an NAO: on the basis of the unit's relationship with its principals. When the organization under consideration has a governance board, which incorporates all network members—that is, all national regulatory agencies or units that are members of the network—and where decisions are taken collectively, via consensus or voting, we consider it to be an NAO. Conversely, when the organization's principals sitting on its governance board are delegates from a European-level institution, such as the European Commission, the European Parliament, and/or the Council of the EU, we then consider the organization a European-level agency. Similarly, if the EU agency is accountable solely to the Commission, the Council, or the Parliament—as opposed to the network members collectively—then we do not consider it an NAO. Using this criterion, 24 out of the 49 excluded organizations have been removed because they are exclusively accountable to EU institutions (i.e. European Parliament, Commission or Council)—rather than national network members.
- Networks had to be regulatory in the sense that they bring together national regulatory authorities. The network itself may not have regulatory functions, it may simply aim at sharing information among members, but these members must be regulators themselves. Thus, networks whose members are executive agencies, such as national vocational training centers, were not included. Importantly, some of the NAOs studied also carried out executive tasks, in addition to the minimal regulatory task requirement. However, we were unable to distinguish what percentage of staff was dedicated to brokering the network as opposed to carrying out executive tasks. We take this issue up again in the discussion section. Eight organizations were excluded because they did not incorporate regulatory members, but rather national executive units.
- Our sample only considered active networks, that is, we excluded agencies or networks that had finalized their mandate or no longer existed for various reasons. Seventeen have been dropped because they do no longer exist.

We ignored terminology when selecting our sample. The diversity in use of terms and definitions did not allow us to use names and terms as selection criteria.

2 http://europa.eu/agencies/regulatory_agencies_bodies/index_en.htm.

3 Importantly, when the data were collected (i.e. 2011–2012), the EU list of decentralized agencies included 32 agencies. Since then, two decentralized agencies have been created (i.e. European Public Prosecutor's Office and the Single Resolution Board). Additionally, Office for Harmonisation in the Internal Market (OHIM) has been renamed as European Union Intellectual Property Office (EUIPO).

Table 1. Summary of Hypotheses

Variable		Hypothesis
Network task: Executive	H_{1a}	Networks that perform executive tasks will—ceteris paribus—have more structurally complex NAOs than those that do not.
Network task: Rule-setting	H_{1b}	Networks that set rules will—ceteris paribus—have more structurally complex NAOs than those that do not.
Network task: Rule-enforcement	H_{1c}	Networks that enforce rules on third-party entities will—ceteris paribus—have more structurally complex NAOs than those that do not.
Network task: Member-sanctioning	H_{1d}	Networks that can sanction members will—ceteris paribus—have more structurally complex NAOs than those that cannot.
Network age	H_2	Ceteris paribus, the older the network, the more complex the NAO.
Mandated (–ve)	H_3	Ceteris paribus, the NAO structure is likely to be less complex when collaboration is mandated than when it is not.
Trust density (–ve)	H_4	Ceteris paribus, the lower trust density of a network, the more complex the NAO.

The entities studied have the following terminologies: agency, network, body, office, center, authority, foundation, institute, college, council, unit, group, conference, committee, and platform. Provan, Fish, and Sydow (2007, 480) acknowledge that goal-directed networks may be named partnership, strategic alliance, interorganizational relationship, coalition, cooperative arrangement, or collaborative agreement. As the Appendix shows the NAOs studied are very diverse in form and structure—such as staffing 100 people and having complex oversight structures. It is precisely this variation among NAOs what we explore in this study. We acknowledge that the most complex NAOs approach the fuzzy boundary of the hierarchical ideal type.

It is worth noting that the 37 European regulatory networks included in our analysis gather together different types of actors. This reinforces our assumption that the 37 cases are independent and identically distributed and enables us to use a pooled variance model, as described below. More specifically, 12 regulatory networks incorporate members that are independent national regulatory agencies, 24 networks incorporate both independent national regulatory agencies and national ministries in different proportions, and only one regulatory network is composed exclusively of national ministries. Moreover, depending on the sector and policy area we focus on, we find significantly different independent national agencies and national ministries in terms of capacities, resources, and size. As an illustration, even though the European Regulators Group for Postal Services and the European Banking Authority only group independent regulatory agencies, their members come from different policy areas and their resources and capacities are highly divergent. Importantly, membership overlap among the 37 European regulatory networks only occurs with the seven mandated regulatory networks that also have parallel voluntary networks (see table A1 in the Appendix).

Data Collection and Coding

Thematic analysis, a method of identifying, analyzing, and reporting patterns or themes within qualitative sources of data (Boyatzis 1998; Braun and Clarke 2006), is well suited to our research proposal. Previous studies indicate the robustness and suitability of this method for analyzing the broad and complex topic of governance (Dooley 2007; Cicon et al. 2012). Consequently, we took each network's statutes and legal documents as sources for the database we constructed. We complemented these sources with publicly available information from the organizations' websites and through direct contact with the organizations when information was unclear or unavailable. Data collection was completed during the second semester of 2012; the information included in our database refers to 2011.

Based on previous research and building on the literature of corporate governance, we codified a total of 16 NAO structural characteristics (i.e. outcomes) (see table 2).[4] The variables were codified mostly as binary (i.e. 0 signifying absence of the characteristic; 1 its presence). The data set also contained information about the number of seats on the governance board, budgets, number of staff, and categorical information about the policy sector of each organization (see table A1 in the Appendix).

During the data collection, we also coded the independent variables that, according to our hypotheses, we expected to play a role as drivers of NAO complexity. Thus, we collected data on their tasks (binary indicator); their age (i.e. years passed since the

4 Although our focus in this study is on structural characteristics, we also collected information on 28 accountability variables, allowing us not only to use this information if necessary, but also to capture the specificity of our data set—European regulatory networks of national regulators—which, to a greater or lesser degree, maintain links to EU institutions (European Commission, European Parliament and European Council).

Table 2. Structural Items Included in the Analyses

Binary items
1. Observers on the governance board
2. The NAO has an executive board
3. Observers on the executive board
4. The NAO has an appeal board
5. The NAO has a chairperson
6. The NAO has an executive director
7. The executive board appoints the executive director
8. The executive board/executive director approves the budget
9. The executive board/executive director approves the WP
10. Governance board voting rule based on simple majority
11. Executive board voting rule based on simple majority
12. EU presence on the governance board
13. EU presence on the executive board
14. The EU has the right to vote on the governance board
15. The executive board is not a reduced version of the governance board
16. Expert committees

Table 3. Covariates Included in the Analysis

Label
Task: propose sanctions on national regulators
Task: authorizations
Task: sets rules and regulations
Task: executive capacities (research, training, joint operations, or campaigns)
Age
Mandated without a voluntary network in domain [low trust density]
Mandated with a voluntary network in domain [high trust density]
Sector: justice and law
Sector: economy and finance
Sector: others[a]

[a]Other sectors are services, health, energy and transport, environment, employment, social affairs, and culture.

first institutionalized collaboration—irrespective of any change in name); their mandated or voluntary nature (binary indicator); and policy sector (categorical indicator). Two researchers coded tasks based on the networks' statutes and founding regulations. Both researchers coded all networks and sorted out any inconsistencies in a second round to strengthen the reliability of the codes. Table 3 provides a list of the indicators used as covariates or independent variables.

In relation to age, we counted the years passed since the first institutionalized collaboration. This is important for mandated networks, which do not evolve organically but are created and transformed legally. Mandated networks can be refounded and artificially reset to age zero by the mandating party. This is the case with telecoms: ERG (with a simple NAO) was created mandatorily in 2001 and later refounded as BEREC (with a much more complex NAO) in 2009. To be able to capture the temporal effects in these cases, we took the creation of the first mandated network as the founding date.

Following the proxy logic of Raab, Mannak, and Cambré (2015), we measure trust density indirectly. They use network plenary formal meetings as a proxy for trust density: i.e. the more plenary meetings the more relationally dense they assume the network to be. Similarly, we operationalized network trust density as a binary indicator—high versus low—but only for the mandated networks. We coded as high trust density those mandated networks, whose members had also created an equivalent voluntary network. Our rationale was that members of a mandated network are more densely interconnected if they have voluntarily set up a network prior to the EU institutions mandating the creation of an official regulatory network. Thus, we coded mandated networks that had an equivalent voluntary network incorporating the same national regulators as 1 (i.e. high trust density). This proxy only applies to mandated networks and thus we substantially reduce our sample in relation to this measure. The above operationalization also covers the mandatory/voluntary variable. Hence, our measure is categorical, distinguishing among three categories: (a) voluntary networks, (b) mandated networks with a voluntary network alongside it, and (c) mandated networks without a voluntary network alongside it. In our analysis (see further below), voluntary network is our reference category. Our logic is the following: comparing "mandated networks with voluntary networks" with "mandated without voluntary networks" gets at whether trust density is relevant, while comparing both mandatory categories with the voluntary reference category sheds light on the mandated versus voluntary dichotomy.

Lastly, regarding our control variable, we used three policy sectors: justice and security, economy and finance, and others (services; health; energy and transport; environment; employment, social affairs, and culture). This classification was derived from the data. As we tried several different categorizations, these three groupings consistently emerged. Table 3 provides an overview of our covariates.

Data Analysis

In this study, we use a Bayesian regression model to analyze our data: we regress NAO complexity—modeled via Item-Response Theory (IRT)—on nine covariates (seven hypotheses and two control terms). Our encompassing analysis uses a single model with two differentiated parts: measurement and explanation.

Measurement is based on item-response modeling technique. We use our binary outcomes (whether a certain institutional characteristic of the NAO's structure is present or absent) to estimate a score of "structural complexity" based on the number of characteristics each organization has. But, instead of adding up all the characteristics and counting the raw number, we employ a more refined measure using IRT. Developed in psychology, item-response models allow us to generate a score of "structural complexity" that gives different weights (or discrimination) to each of the characteristics. So, instead of assuming that the significance of each characteristic is equal to its score, we let the model estimate the discrimination, based on the number of NAOs that have such a characteristic (difficulty) and their relative position in the final score (discrimination).

Formally, we are interested in ξ_n, which represents the structural complexity score of each NAO (n) in a standardized scale that has, by definition, mean 0 and standard deviation 1. The two-parameter (α for discrimination and β for difficulty) logistic model for data on n NAOs that have a different set of X characteristics (1 having the characteristic j and 0 not having it) can be expressed as follows:

$$logit\left(X_j\right) = \alpha_j\left(\xi_n - \beta_j\right) \qquad (1)$$

Once the scores are obtained, we explore their associations in the second part of the process using a mixed linear model against a set of covariates based on our variables (task, age, mandated, density, and sector—see table 3). Our main goal is to explain the structural complexity score based on the NAO's set of common covariates. The second part of the formal model describes the association between the structural complexity score and the covariates X by means of the θ parameters, which are our ultimate parameters of interest.

We use Bayesian inference following Gill and Witko (2013) for several reasons. First, the ratio of available data to hypotheses is low (37 organizations and seven variables plus a sector identification), and Bayesian inference is especially suited to such an endeavor. Second, we incorporate the uncertainty of the scores obtained in the measurement part to the associations with the covariates through a transparent process. This strengthens our confidence in the results, as we do not rely on the organizations having a simple value for their structural complexity; instead, we assume that our uncertainty about their positions is passed on to the inferences about the parameters of interest. In other words, the uncertainty of the estimation of the complexity of the NAOs via the IRT model is automatically passed to the explanatory section modeled via a linear regression. Third, our data are drawn not from a sample but from the entire universe of European regulatory networks, making assumptions of repeated sampling unnecessary and not having to rely on the "flawed" and "arbitrary" null hypotheses significance test typical of frequentist statistics (Gill and Witko 2013, 4 & 8). Finally, Bayesian inference allows us to "systematically include [...] previous information, both qualitative and quantitative" (Gill and Witko 2013, 4) as formal priors, which we do in our model.

No evidence of nonconvergence is found in the chains, according to formal and visual Markov Chain Monte Carlo (MCMC) convergence tools (Fernández-i-Marín 2016): this implies that inferences from the parameters can be extracted safely.

$$\begin{aligned}
\xi_n &\sim N(\mu_n, \sigma) \\
\mu_n &= C\theta + \gamma_s \\
\sigma &\sim C(0, 1) \\
\theta &\sim N(0, 10) \\
\gamma_s &\sim N(\mu_\gamma, \sigma_\gamma) \\
\mu_\gamma &\sim N(0, 1) \\
\sigma_\gamma &\sim C(0, 1)
\end{aligned} \qquad (2)$$

The equation for the explanatory model can be read as follows: each NAO score on complexity (ξ_n) is distributed normally with a systematic component μ and standard deviation σ. The systematic component is explained by a linear combination of the covariates (C) and their effects (θ), which are the relevant parameters of interest, plus a varying intercept (also known as random effect) for the three sectors. The last five lines in equation (2) are the noninformative priors necessary for the Bayesian set-up. We use informative priors for age and trust density (operationalized as mandated networks with voluntary networks alongside it), as they are the only variables that have been empirically tested previously. (In the appendix, we also include a model without priors and a restricted model including only the variables that, in the full model without priors, show values above or below one interquartile range (0.6745 standard deviations) away from zero in the absolute scale; results are stable across all models.) We use rather strong informative priors in both cases, where age is a priori expected to have a positive association with complexity (Hite and Hesterly 2001) and trust density a negative one (Raab, Mannak, and Cambré 2015). The priors are normally distributed with mean 1 and −1, respectively, and standard deviation 0.5, giving only around five percent probability of having an association the reverse of that found by previous research. Continuous variable age is standardized to half standard deviation to be able to compare its effect directly with the binary variables.

Findings

Item-Response Modeling

Using the 16 structural characteristics included in our analysis (see table 2), we develop a structural complexity score for each NAO. Structural complexity refers to the number of governance units an NAO has in addition to a governance board (executive board, appeal board, executive director, and expert committees); who approves the budget and working program; who appoints the executive director; whether the board departs from unanimous decision-making (simple majority voting); and whether the mandating party (that is, any EU institution, in essence the Parliament, the Commission, or the Council) is present and votes in the governance units. The aim is to identify the relationship between the contingent elements we include in the analysis (i.e. age, tasks, mandated nature, trust density, and sector) with the networks' complexity score.

Figure 3 shows the median of the estimated discrimination value, along with the 95 percent credible interval.[5] The median value of the parameters indicates how strongly having that item increases (or decreases if negative) the complexity of the NAO. High discrimination means that the indicator conveys more information about the complexity of an NAO. As the figure shows, the best single indicator to provide information about whether an NAO has high or low complexity is whether the NAO's executive board appoints the executive director.

The most highly discriminating parameters are: the executive board appoints the executive director, the executive board is not a reduced version of the governance board, and the existence of observers at the executive board. These parameters convey a great deal of information to give an NAO a high or low score in the latent trait of complexity.

At the opposite end of the nondiscriminating parameters, we find that the EU has the right to vote on the governance board. This item does not convey any significant information to enable us to calculate whether the NAO will be complex or not.

By applying the discrimination scores to the items each NAO has, the model produces scores for the estimated latent complexity of the NAOs. Figure 4 shows the median of estimated complexity along with the 95 percent credible interval. Recall that the score has an arbitrary scale restricted to having a mean of zero and standard deviation of 1.

5 Bayesian credible intervals can be understood as frequentist confidence intervals.

There are five NAOs with substantially higher complexity, namely the Agency for the Cooperation of Energy Regulators (ACER), the European Securities and Markets Authority (ESMA), the European Insurance and Occupational Pensions Authority (EIOPA), the European Banking Authority (EBA), and Body of European Regulators for Electronic Communications (BEREC).

According to our analysis, the most complex NAO by a significant margin is ACER's governance structure. ACER has a two-tier structure with a plenary (the Board of Regulators) and executive board (the Administrative Board). The board of regulators gathers together a senior representative of each of the European national regulatory agencies and one representative of the EU Commission, the mandating party. However, the Commission does not vote on the governance board. The executive board's central role in the governance structure of ACER is notable: the executive board is in charge of supervising the administrative and budgetary activities of ACER, and of appointing its director. Interestingly, this second board is not a reduced version of the plenary but a significantly different structure whose members are appointed by the EU institutions. ACER's structure is completed with an appeal board. This third board, composed of six members selected from senior staff at national regulatory agencies (i.e. the network members), decides independently on appeals presented by national regulatory agencies, individuals, or legal entities. Decision-making in ACER is not by consensus or unanimity. Both the board of regulators and the administrative board act on a two-thirds majority of members present. The appeal board decides by qualified majority.

At the other end of the scale, the European Police College (CEPOL) is the least complex NAO, significantly lower than the rest. CEPOL is governed by one governance board that comprises the head of each national police college. The governance board gives strategic guidance and also decides on the budget and work program. Its decisions are taken by a two-thirds majority. Figure 5 illustrates the structure of both CEPOL and ACER.

Support for Hypotheses

In classical or frequentist statistics, hypotheses are either accepted or rejected. In Bayesian statistics, researchers directly report its degree of support (see Gill and Witko 2013, 8–9). Figure 6 shows the values for the θ parameters in equation (2). The dots represent the median of the posterior density and the thick and thin lines correspond to the 90 and 95 percent credible intervals (or highest posterior densities). Given that all variables have been standardized, the values of the parameters are directly comparable. Table 4 reports similar information, namely the probability that every hypothesis is true given the data and the model, in a one-tailed test (versus the two-tails intervals shown in figure 6).

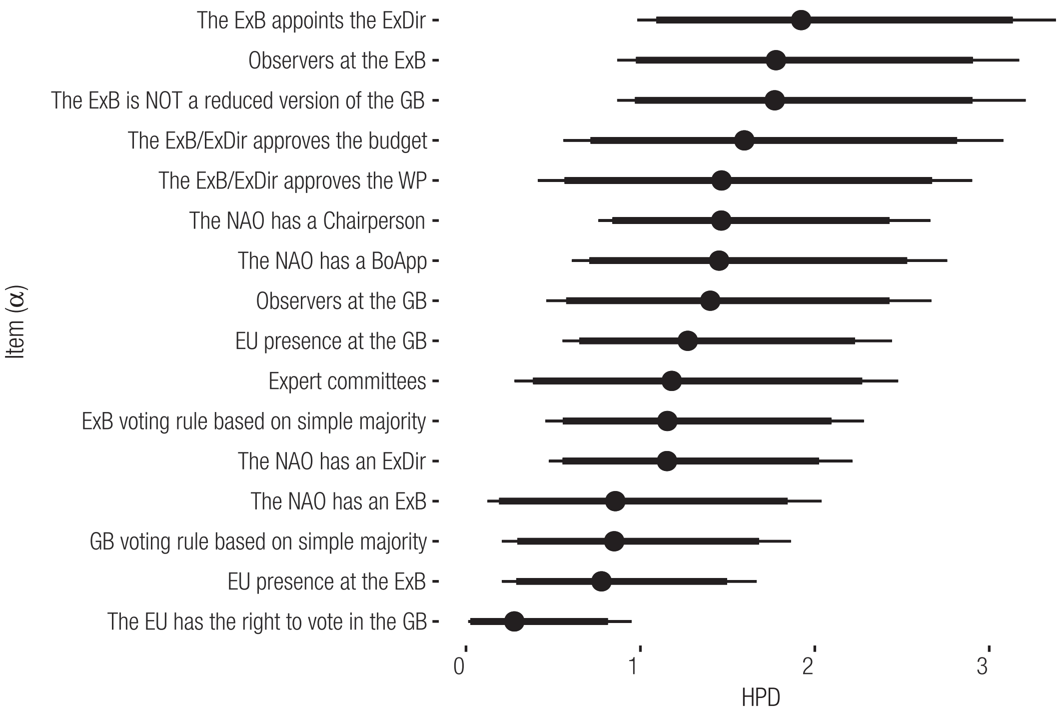

Figure 3. Discrimination Weight Assigned to Each Item in the Model (α).

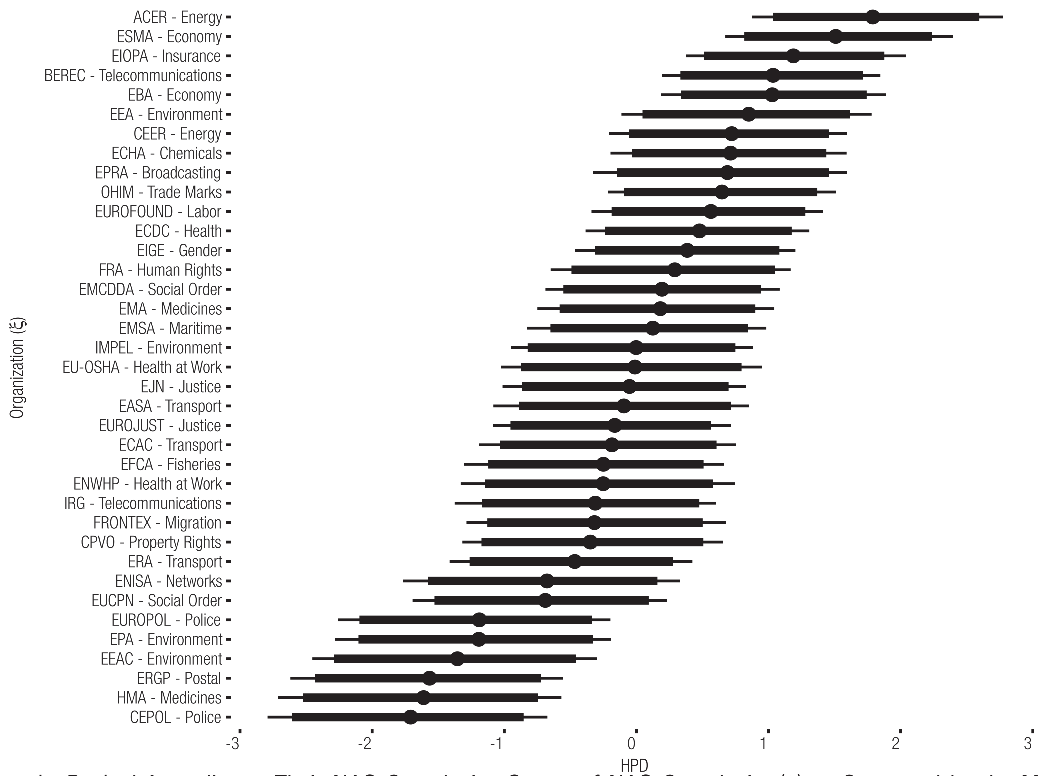

Figure 4. Networks Ranked According to Their NAO Complexity. Scores of NAO Complexity (ξ) as Computed by the Model. The Dot Represents the Median Point Estimate and the Line the 95 Percent Credible Interval.

The strongest effect corresponds to the network task of rule-setting (99%). It is strongly related to NAO complexity, albeit negatively—contrary to our expectations. We find moderate support for the other two network tasks: authorizations (i.e. rule enforcing) and (network member) sanctioning are both associated with higher complexity (92% and 97%, respectively). Although the task-related findings have strong support and low

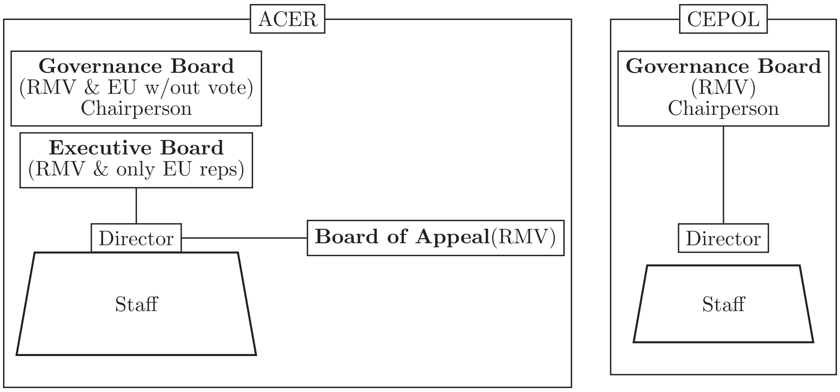

Figure 5. Organigraphs of the Two Extreme (Most/Least Complex) NAOs Found. RMV = Reinforced Majority Voting.

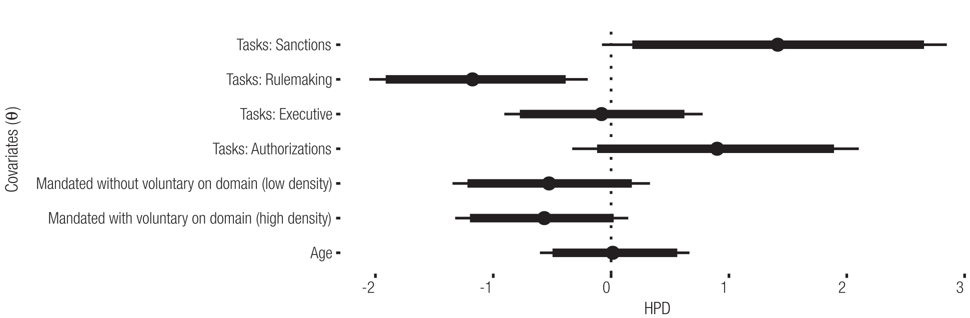

Figure 6. Results per Parameter (Contingency) on NAO Complexity for Full Model With Priors. Highest Posterior Density of θ Parameters for the Full and the Restricted Models. The Dot Represents the Median Point Estimate, and the Thick and Thin Lines the 90 and 95 Percent Credible Intervals.

uncertainty (probabilities of these effects occurring range from 92% to 99%), regarding the other hypotheses we find no support or very weak support.

Mandated networks with and without a voluntary network alongside it are both associated with low NAO complexity, yet the former have a higher probability than the latter of having low NAO complexity (93.8% as opposed to 88%). In interpreting these results, then, we find weak evidence that being mandated is associated with lower complexity NAOs. In fact, trust density is not associated with NAO complexity.

Although age has no relevant relationship with NAO complexity, sector differences do. The results (see figure 7 and table 4) show that the lowest complexity corresponds to NAOs in the economy and finance sector, followed by the justice and law enforcement sector, and the remaining NAOs have higher complexity. NAOs in the economy and finance sector are less complex than NAOs in other sectors by 0.6 ± 0.57, which indicates that although there may be a systematic difference, we do not have enough variation in the data (too few organizations in the sector) to make a strong claim.

This Bayesian model with priors has an explanatory power of 18.4 percent (residual standard deviation of 0.8).[6]

6 Regarding the other models included in the appendix, the full noninformative model has an explanatory power of 25 percent (residual standard deviation [RSD] of 0.754) and the restricted model has an explanatory power of 28 percent (RSD of 0.72).

Discussion

Network Tasks and NAOs

Among our first four hypotheses (H1a–d), related to tasks, rule-setting has a significant (albeit negative) effect on NAO structural complexity. Rule-enforcing and member-sanctioning both have a strong positive effect while in the case of nonregulatory executive tasks carried out by the network, we find no relationship to less complex NAOs. One explanation for this is that different logics are at play. Our definition of NAO complexity implies that more integration and fewer control points are available to individual members. Our findings suggest network members prioritize control over tasks whose outputs are uncertain, such as rule-setting: members want to control and avoid negative rules. Following agency theory, a network member tends to value its control points in situations of uncertainty or contract incompleteness (Hooghe and Marks 2014; Lake and McCubbins 2006), both of which could affect it adversely. Uncertainty and incompleteness regarding the behavior of fellow members or the broker (i.e. the agent, in this case the NAO executive) are expected to make members guard their capacity to block decisions (Hooghe and Marks 2012). They will try to maintain a "veto" power by advocating consensual decision-making in networks where new rules are to be designed, more so than in networks that merely implement regulations.

Table 4. Summary of Results for Full model with priors (Probabilities of Having a More Complex NAO, According to the Posterior Distributions of Parameters θ and γ)

Hypotheses	Full, priors	Support
1a: networks that perform executive tasks will have more structurally complex NAOs than those that do not	0.44	No.
1b: Networks that set rules will have more structurally complex NAOs than those that do not.	**0.01**	Opposite effect. Strong
1c: Networks that enforce rules will have more structurally complex NAOs than those that do not.[a]	0.92	Yes. Moderate
1d: Networks that can sanction members will have more structurally complex NAOs than those that cannot.	**0.97**	Yes. Strong
2: The older the network, the more complex the NAO.	0.54	No.
3: The NAO structure is likely to be less complex when collaboration is mandated than when it is not.[b]	0.062 [mandated w/vol.]	Yes. Weak
4: The lower trust density of a network, the more complex the NAO.[c]	0.095 [mandated w/out vol.]	No.
Control: sector		
Economy and finance is less complex than others	0.89	Yes. Weak
Justice and law is less complex than others	0.75	No.

[a]Measure: authorizes regulated entities.
[b]Three-item categorical measure: mandated network with an equivalent voluntary network and mandated network without an equivalent voluntary network (and reference category = voluntary network).
[c]Three-item categorical measure: mandated network with an equivalent voluntary network and mandated network without an equivalent voluntary network (and reference category = voluntary network).

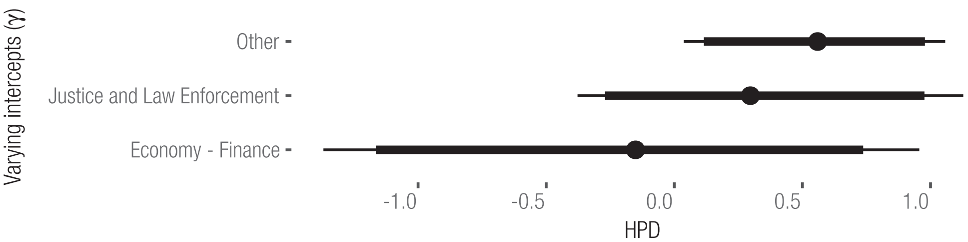

Figure 7. Varying Intercepts (γ).

Recall that the boards of public organizations are collective decision-making arenas where different viewpoints, political preferences, and values interact (Hinna and Scarozza 2015). This is even more the case for NAO boards, due to the diversity of members represented. For this reason, members in those public networks tasked with rule-setting—where collective decision-making is extremely relevant when adopting a new rule—will want to retain maximum control. Information-sharing, executive and enforcement tasks involve far fewer options and narrower span, and so represent a much lower threat or risk to members.

In the case of regulatory enforcement (i.e. measured via authorizations) and member-sanctioning, uncertainty is low and rules are known. Moreover, once rules regarding regulated entities and members are set, authorizations (rule-enforcement) and member-sanctioning become routinized activities that require operational capacity. This is particularly true for regulatory enforcement—perhaps the most operationally intensive of the three regulatory tasks (rule-setting, enforcement, and member-sanctioning). The four most complex NAOs are all tasked with delivering authorizations for regulated entities and sanctioning members.

All in all, coordination and organizational prerogatives drive NAO complexity whenever there is relatively low uncertainty about outcomes. Conversely, the cautious attitude of members will prevail in settings with uncertainty (rule-setting).

We find no effect for nonregulatory executive tasks. This is because our sample was made up of regulatory rather than executive networks, where nonregulatory executive tasks are secondary in importance.

Other Variables

We find no relationship between age and NAO structural complexity despite the top five most complex

NAOs all belong to networks whose history of collaboration is average to short, starting between 1997 and 2004, and the first network studied started in 1955 (the European Aviation Safety Agency). Despite the priors applied to age give only five percent probability to older networks being negatively related to NAO complexity, no association seems to exist. The regulatory nature and context (i.e. EU) of the networks included in the analysis might well offer an explanation for this. Many of these regulatory networks are mandated, and hence do not evolve organically but rather through legislative action. Such legalization does not allow the network to follow the premise in classic contingency theory which posits that organizations grow more complex over time.

Being a mandated network negatively relates to NAO complexity. This result is aligned with previous findings (Saz-Carranza, Salvador Iborra, and Albareda 2016). Qualitatively, we see that the top five most structurally complex NAO belong to mandated networks, yet the least complex NAO is CEPOL, which is mandated. Additionally, we cannot state that trust density is associated with lower complexity, thus we are unable to confirm a major premise of network theory, where relational informal density and formal centralized coordination are substitutes (Kenis, Provan, and Kruyen 2009; Raab, Mannak, and Cambré 2015). An explanation to our findings related to trust may be methodological. Arguably, our measure of trust density is improvable since it reduces our sample significantly: we compared mandated networks from regimes where there is an equivalent voluntary network (involving the same network members as the mandated one) to mandated networks from regimes where there are no voluntary networks. This reduced our sample to 26 (mandated networks), out of which only seven mandated networks coexist in a regime with an equivalent voluntary network.

Conclusions

This article is a medium *N* analysis of NAOs. The aim of our study is to go beyond the Provan and Kenis's (2008) shared/lead-member/NAO triad by identifying and understanding better the different NAO structures.

In essence, we find that network-level tasks strongly affect NAO configuration. Networks with rule-setting capacities have less complex NAOs, whereas networks with member-sanctioning and rule-enforcing tasks are mildly related to more complex NAOs. The other variables have no or weak relations to NAO complexity. Theoretically, what seems at play with NAO complexity is operational capacity and management of uncertainty.

Reducing uncertainty seems to push regulatory networks toward less complex NAOs where members retain control and veto points. An uncertainty reduction strategy for rulemaking seems to operate here, where to avoid negative outcomes network members retain individual control and veto points and do not delegate decision-making to a board. This might explain our finding that networks tasked with rule-setting have less complex NAOs.

Alternatively, the most cumbersome regulatory task is supervising regulated entities. When networks take on such tasks, they need to delegate to a large and complex NAO. Networks capable of member-sanctioning will also require the necessary safeguards, such as a board of appeal (see figures 2 and 6).

Limitations and Future Research

We identify three further avenues of research related to (a) the type of goal-directed network, (b) the causality relation between task and NAO complexity, and (c) the effects of network membership on NAO governance.

EU-regulatory networks have specificities that affect the generalizability of this study. International regulatory networks are more politically sensitive than service provision (Isett and Provan 2005) or economic development (Agranoff 2007) networks, the traditional subjects of research on public management networks. Further research involving these other types of goal-directed networks is still required.

We have not been able to disentangle causality relations in this article—our methods do not allow it. This would be another avenue of future research. Do tasks drive structure or does NAO complexity drive network task adoption?

Finally, Provan and Kenis (2008) draw on classical transaction cost economics (Williamson 1975), particularly when they predict that networks with more members (i.e. with higher coordination costs) are best governed by an NAO. Unfortunately, we were not able to analyze the effects of membership or diversity as these were fairly consistent in our sample (one member per EU member state or associate state). Future studies might redress this.

As the world becomes more fragmented and interrelated, the relevance of goal-directed networks will continue to increase. This form of organizing will be used to coordinate public action. It is thus fundamental to understand how these networks can best be governed. This research is an initial building block in understanding this crucial topic better.

Appendix

Table A1. Networks Included in the Analysis

Sector	Networks	Year of initial collaboration	Year of Establishment	Staff	Budget 2011 (€)	Mandated / Voluntary
Economy & Finance	European Banking Authority (EBA)	2004	2009	100	12,683,000	Mandated
	European Insurance and Occupational Pensions Authority (EIOPA)	2003	2010	46	10,667,000	Mandated
	European Securities and Markets Authority (ESMA)	2001	2009	101	16,962,000	Mandated
	Office for Harmonization in the Internal Market (Trade Marks and Designs) (OHIM)		1994	730	50,000,000	Mandated
Employment, Social affairs & Culture	European Foundation for the Improvement of Living and Working Conditions (EUROFOUND)	1975	1975	113	20,440,000	Mandated
	European Institute for Gender Equality (EIGE)	2006	2006	23	5,819,800	Mandated
Energy & Transport	Agency for the Cooperation of Energy Regulators (ACER)	2000	2009	40	5,119,000	Mandated—with voluntary
	Council of European Energy Regulators (CEER)	2000	2000	150	1,025,000	Voluntary
	European Aviation Safety Agency (EASA)	1955	2002	600	139,554,113	Mandated—with voluntary
	European Civil Aviation Conference (ECAC)	1955	1993	14	2,200,000	Voluntary
	European Railway Agency—promoting safe and compatible rail systems (ERA)	2004	2004	500	25,983,000	Mandated
	European Environment Agency (EEA)	1990	1990	217	50,330,092	Mandated—with voluntary
Environment	European Environmental and Sustainable Development Advisory Councils (EEAC)	1990	1993	n/a	n/a	Voluntary
	Community Plant Variety Office (CPVO)	1995	1995	43	12,000,000	Mandated
	European Fisheries Control Agency (EFCA)	2005	2005	56	11,013,000	Mandated
	European Maritime Safety Agency (EMSA)	2002	2009	101	16,962,000	Mandated
	European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL)	1990	1992	1	726,000	Voluntary
	Network of the Heads of Environment Protection Agencies (EPA)		2003	1	n/a	Voluntary

Table A1. *Continued*

Sector	Networks	Year of initial collaboration	Year of Establishment	Staff	Budget 2011 (€)	Mandated / Voluntary
Health	European Agency for Safety and Health at Work (EU-OSHA)	1994	1994	70	15,372,768	Mandated —with voluntary
	European Network for Workplace Health Promotion (ENWHP)	1996	1996	6	1,085,155	Voluntary
	European Medicines Agency (EMA)	1995	2002	600	208,863,000	Mandated—with voluntary
	Heads of Medicines Agencies (HMA)	1996	1996	n/a	n/a	Voluntary
	European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)	1993	1993	100	15,400,000	Mandated
	European Centre for Disease Prevention and Control (ECDC)	2004	2004	270	58,107,183	Mandated
	European Chemicals Agency (ECHA)	2006	2006	129	86,481,700	Mandated
Justice & Law	The European Union's Judicial Cooperation Unit (EUROJUST)	2000	2002	186	31,700,000	Mandated—with voluntary
	European Judicial Network (EJN)	1998	2001	5	522,000	Voluntary
	European Agency for the Management of Operational Cooperation at the External Borders (FRONTEX)	2004	2004	272	88,410,000	Mandated
	European Crime Prevention Network (EUCPN)	2001	2001	3	296,552	Voluntary
	European Police College (CEPOL)	2005	2005	32	8,300,000	Mandated
	European Police Office (EUROPOL)	1995	1995	700	83,949,000	Mandated
	European Union Agency for Fundamental Rights (FRA)	2007	2007	7	20,000,000	Mandated
Services	Body of European Regulators for Electronic Communications (BEREC)	1997	2009	18	5,500,000	Mandated—with voluntary
	Independent Regulators Group (IRG)	1997	1997	2	472,500	Voluntary
	European Network and Information Security Agency (ENISA)	2004	2004	47	8,102,920	Mandated
	European Platform of Regulatory Authorities (EPRA)	1995	1995	n/a	n/a	Voluntary
	European Regulators Group for Postal Services (ERGP)	2010	2010	2	n/a	Mandated

Table A2. Tasks Performed by the Networks

Networks	Tasks			
	Sanctions	Rule-setting	Authorizations	Executive
European Banking Authority (EBA)	X	X	X	
European Insurance and Occupational Pensions Authority (EIOPA)	X	X	X	
European Securities and Markets Authority (ESMA)	X	X	X	
Office for Harmonization in the Internal Market (Trade Marks and Designs) (OHIM)			X	
European Foundation for the Improvement of Living and Working Conditions (EUROFOUND)				
European Institute for Gender Equality (EIGE)				X
Agency for the Cooperation of Energy Regulators (ACER)	X	X	X	
Council of European Energy Regulators (CEER)				
European Aviation Safety Agency (EASA)		X	X	X
European Civil Aviation Conference (ECAC)				
European Railway Agency—promoting safe and compatible rail systems (ERA)		X		X
Community Plant Variety Office (CPVO)		X	X	
European Environment Agency (EEA)				
European Environmental and Sustainable Development Advisory Councils (EEAC)				
European Fisheries Control Agency (EFCA)				X
European Maritime Safety Agency (EMSA)		X		X
European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL)				
Network of the Heads of Environment Protection Agencies (EPA)				
European Agency for Safety and Health at Work (EU-OSHA)		X		X
European Medicines Agency (EMA)		X	X	
European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)				
European Network for Workplace Health Promotion (ENWHP)				X
Heads of Medicines Agencies (HMA)				
European Centre for Disease Prevention and Control (ECDC)				X
European Chemicals Agency (ECHA)		X	X	
European Agency for the Management of Operational Cooperation at the External Borders (FRONTEX)				X
European Crime Prevention Network (EUCPN)				
European Judicial Network (EJN)				
European Police College (CEPOL)				X
European Police Office (EUROPOL)		X		X
The European Union's Judicial Cooperation Unit (EUROJUST)		X		
European Union Agency for Fundamental Rights (FRA)				X
Body of European Regulators for Electronic Communications (BEREC)				
European Network and Information Security Agency (ENISA)		X		
European Platform of Regulatory Authorities (EPRA)				
European Regulators Group for Postal Services (ERGP)				
Independent Regulators Group (IRG)				

Table A3. Network Parameters

Network	The NAO has an ExB	The NAO has a BoApp	The NAO has a Chairperson	The NAO has an ExDir	The ExB appoints the ExDir	The ExB/ExDir approves the budget	The ExB/ExDir approves the WP	GB voting rule based on simple majority	ExB voting rule based on simple majority	EU presence on the GB	EU presence on the ExB	The EU has the right to vote in the GB	The ExB is NOT a reduced version of the GB	Observers on the GB	Observers on the ExB	Expert committees
ACER	1	1	1	1	1	1	1	0	0	1	1	0	1	1	0	1
BEREC	1	0	1	1	0	1	1	0	0	1	1	0	0	1	1	1
CEER	1	0	1	1	0	1	1	0	1	1	0	0	0	1	1	0
CEPOL	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CPVO	0	1	1	1	0	0	0	1	0	1	0	1	0	0	0	0
EASA	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	1
EBA	1	1	1	1	0	1	1	1	1	1	0	0	0	1	0	1
ECAC	1	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0
ECDC	0	0	1	1	0	1	1	1	0	1	0	1	0	1	0	1
ECHA	0	1	1	1	0	1	1	0	0	1	0	1	0	1	0	1
EEA	1	0	1	1	1	0	1	0	0	1	1	1	1	0	0	1
EEAC	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
EFCA	0	0	1	1	0	1	1	0	0	1	0	1	0	0	0	1
EIGE	0	0	1	1	0	1	1	1	0	1	0	1	0	0	0	1
EIOPA	1	1	1	1	0	1	1	1	1	1	0	0	0	1	0	1
EJN	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	0
EMA	0	0	1	1	0	0	1	0	0	1	0	1	0	1	0	1
EMCDDA	1	0	1	1	0	0	0	0	0	1	1	1	0	1	0	1
EMSA	0	0	1	1	0	1	1	0	0	1	0	1	0	1	0	0
ENISA	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	1
ENWHP	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0
EPA	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
EPRA	1	0	1	0	0	1	1	1	0	1	1	0	1	1	0	0
ERA	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0
ERGP	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
ESMA	1	1	1	1	0	1	1	1	1	1	0	0	0	1	1	1
EU-OSHA	1	0	1	1	0	0	0	0	0	1	1	1	0	1	0	1
EUCPN	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
EUROFOUND	1	0	1	1	0	1	1	0	0	1	1	1	0	1	0	0
EUROJUST	0	0	1	1	0	0	0	1	0	1	0	0	0	1	0	0
EUROPOL	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0
FRA	1	0	1	1	0	1	0	0	1	1	1	1	0	1	0	0
FRONTEX	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	1
HMA	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
IMPEL	1	0	1	1	0	1	1	0	0	0	0	0	0	1	0	0
IRG	1	0	1	0	0	1	1	0	0	0	0	0	0	1	0	0
OHIM	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1

Table A4. Summary of Results (Probabilities of Having a More Complex NAO, According to the Posterior Distributions of Parameters θ and γ)

	Model		
Hypotheses	Full	Full, priors	Restricted
1a: networks that perform executive tasks will have more structurally complex NAOs than those that do not	0.41	0.44	
1b: Networks that set rules will have more structurally complex NAOs than those that do not.	0.0023	0.01	0.001
1c: Networks that enforce rules will have more structurally complex NAOs than those that do not.[a]	0.95	0.92	0.96
1d: Networks that can sanction members will have more structurally complex NAOs than those that cannot.	0.95	0.97	0.96
2: The older the network, the more complex the NAO.	0.067	0.54	0.062
3: The NAO structure is likely to be less complex when collaboration is mandated than when it is not.	0.51	0.062	
4: The lower trust density of a network, the more complex the NAO.[b]	0.14	0.095	0.053
Control: sector			
Economy and finance is less complex than others	0.87	0.89	0.88
Justice and law is less complex than others	0.65	0.75	0.64

[a]Measure: authorizes regulated entities.

[b]Three-item categorical measure: mandated network with an equivalent voluntary network and mandated network without an equivalent voluntary network (and reference category = voluntary network).

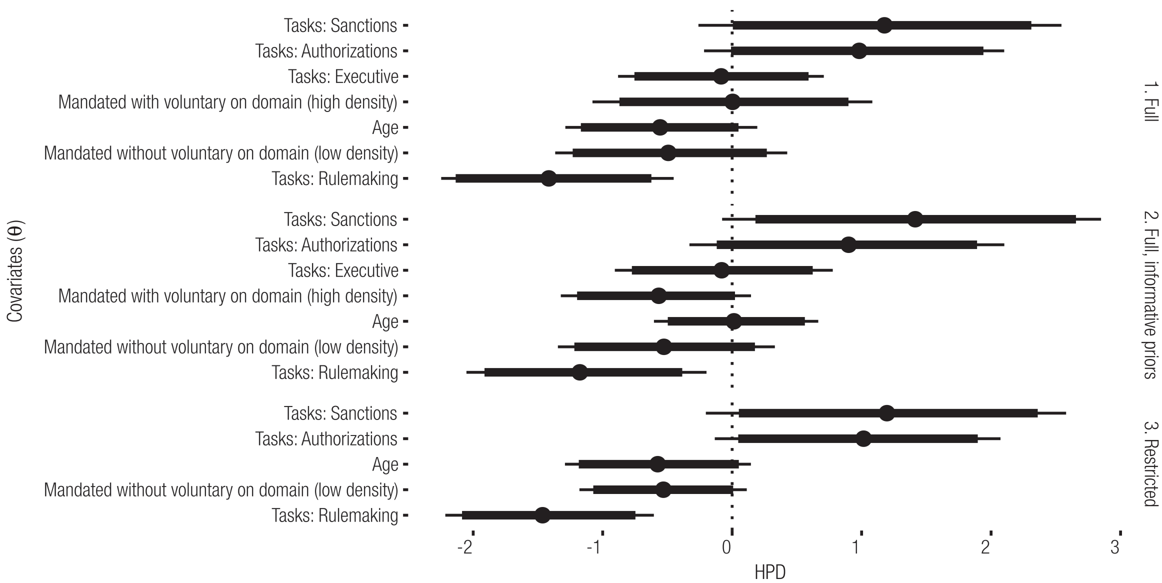

Figure A1. Results per Parameter (Contingency) on NAO Complexity. Highest posterior density of θ parameters for the full and the restricted models. The dot represents the median point estimate, and the thick and thin lines the 90 and 95 percent credible intervals.

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