Decision-making networks across political systems

Florence Metz*[1, 2] and Laurence Brandenberger[2,3]

[1]Natural Resource Policy Group, Institute for Environmental Decisions, ETH Zürich, Zürich, Switzerland
[2]Institute of Political Science, University of Bern, Switzerland
[3]Department of Environmental Social Sciences, Swiss Federal Institute of Aquatic Science and Technology (Eawag), ETH Domain, Switzerland

Abstract

Institutions matter in policy-making. Political systems shape power structures and interaction patterns between actors in decision-making processes. Although the social fabric of decision-makers' interactions is key to successful policy-making, it remains unclear which relational structures can typically be found across political systems. This paper uncovers the ways in which macro-political institutions shape political processes by adopting a network approach.

We analyze differences in power structures and interaction patterns across four different decision-making networks in German and Swiss consensual-federal, French majoritarian-unitary, and hybrid Dutch consensual-unitary democracies. We surveyed 199 state and non-state actors on their network interactions in decision-making processes on water protection. We fit exponential random graph models and calculate predicted probabilities to compare the structural composition of those four networks. Results show that our cases of consensus democracies tend to institutionalize neighborhoods of networks where several network members are central and share power. Actors tend to exhibit close-knit collaborative interactions and to seek compromise with opponents. Our case of a majoritarian democracy shows power concentration with few highly centralized actors. The competitive style of policy-making restrains access to competitors, thereby limiting the need to interact and search for compromises with opponents.

The paper uncovers how political structures translate into network interactions during decision-making processes and ultimately produce social environments that produce (or fail to produce) policy outputs.

Keywords: decision-making process, political systems, comparative politics, policy network, interaction pattern, water protection policy

*Corresponding author at: ETH-NARP, Swiss Federal Institute of Technology Zurich, Universitätstrasse 22, 8092 Zurich, Switzerland, +41 (0)44 63 388 68
E-mail address: florence.metz@usys.ethz.ch

Introduction

Analyzing the structures of policy-making networks is key to understanding decision-making across political systems. Political systems provide opportunity structures for the emergence of certain network structures over others. Uncovering interaction and power patterns in decision-making networks, we shed light on the social environment that produces (or fails to produce) policy outputs. The network perspective is a powerful tool to uncover how political structures (i.e., polity) translate into political processes (i.e., politics) and shape policy content in a distinctive manner across political systems.

It is uncontested today that *institutions matter* in shaping policy content (Aoki, 2011). Political systems institutionalize the distribution of power and interaction patterns among actors taking policy decisions (Immergut, 1992; Lijphart, 2012; North, 1990). Despite uncontested institutionalism, the literature has difficulties establishing a systematic link between a country's overall political structure and its policies across time and policy fields. Rather than establishing a direct link some authors suggest instead an indirect impact, mediated via decision-making networks (Bressers and O'Toole, 1998; Kriesi et al., 2006). Decision-making networks serve as maps of policy-making processes. Policy-making has been described as a black box where a societal problem 'goes in' and a solution 'goes out' in the form of a policy. To uncover the social processes in the black box of policy-making, scholars have relied on the network approach (Easton, 1965; Immergut, 1998; Ingold, 2011; Metz, 2017). The network approach provides a synthetic overview of the actors involved in policy-making, their power dependencies (Ingold and Leifeld, 2016), and interactions (Dowding, 1995, 157). We define decision-making networks as snapshots of the aggregated result of multi-actor interactions in the policy-making processes over time. By analyzing network interactions in more detail, we capture the impact of diverse formal institutions on decision-making.

The words institutions or institutional structures are commonly used to refer to polity, i.e. rules that characterize a political system by defining political structures of power-sharing in decision-making (Knill and Tosun, 2012). It is important to note that there are diverging definitions of the term institution in scientific literature (Aoki, 2011; Immergut, 1998; North, 1990). Here, a narrow definition is chosen according to which *institutions are a set of formal rules defining the functioning and composition of a country's political architecture* (adapted from Knill and Tosun, 2012).

A country's macro-political architecture impacts on the structure of decision-making networks by defining participation mechanisms or attributing decision-making power to specific policy actors. In general, constitutions formally define the structure of political systems by determining electoral and party systems, as well as the horizontal and vertical distribution of power (Knill and Tosun, 2012). In his seminal work, Lijphart (1999) establishes a typology of modern democracies according to the extent to which states formally and informally concentrate or diffuse political responsibility. Lijphart distinguishes consensus democracies, which diffuse and limit political responsibility in a variety of ways, from majoritarian democracies, which concentrate political responsibility in the hands of the majority (Lijphart, 2008). By applying Lijphart's typology, Kriesi et al. (2006) as well as Adam and Kriesi (2007) explore the impact of macro-political institutional contexts on the structure of decision-making networks. Consensus democracies are said to provide strong incentives for cooperation, while majoritarian democracies are known for their competitive style of policy-making (Kriesi et al., 2006). Hence, the authors expect network members' "interaction patterns to be more cooperative in consensus democracies and more competitive in majoritarian democracies" (Adam and Kriesi, 2007, 138).

However, a country's institutional architecture is not assumed to be reflected 1:1 in the network structure, because decision-making networks can develop a dynamic beyond formal institutions (Börzel, 1998). While institutional arrangements are stable, decision-making networks can be described as fluid. Hence, the assumption here is that given a stable institutional arrangement, not every type of network structure is possible, but the observable patterns in decision-making are expected to belong to a neighborhood of networks (Lubell et al., 2012). Analyzing these diverse network structures is a key to understanding policy-making across political systems. Towards this goal, the present article addresses the following research question from a comparative perspective: Which structural aspects do decision-making networks exhibit given their embeddedness into a political system?

To answer this question, we compare decision-making networks in the field of water protection in four countries, which display different degrees of variation with regards to their political architectures. While Switzerland and Germany are both examples of consensual-federal democracies, France is a classic majoritarian-unitary system, and the Netherlands a hybrid form of federal-unitary democracy. Our case selection enables us to understand (as thoroughly as possible with the limitations of only four cases) which network properties exist given their institutional frame. This way, we explore structural aspects, which characterize the neighborhoods of networks in various political systems.

In the first section of the article, we define network structures that are expected to be evident in consensus, majoritarian, or hybrid democracies according to the literature. With a comparative research design, we categorize the macro-political systems of Switzerland, Germany, France, and the Netherlands following Lijphart's typology. In the methods section, we explain the use of exponential random graph models (ERGM) to analyze the network data and compare decision-making networks. As comparisons between networks of different size represent an inherent difficulty in network research (see e.g., Friedkin, 1981), this paper makes use of micro-level interpretations of ERGMs (Desmarais and Cranmer, 2012) and compares predicted probabilities based on said models (Faust and Skvoretz, 2002). After presentation and discussion of our results, we reflect on the structural properties that characterize neighborhoods of networks across political systems and discuss broader simplications.

Macro-Political Structures and Decision-Making Networks

Lijphart (1984) modernized the comparative literature on political systems with his systematic-empirical approach to categorizing countries' political architecture (Mainwaring 2001, 57, after Vatter 2014).

While the classical distinction between parliamentary and presidential democracies relies on constitutional formal rules, Lijphart additionally takes informal characteristics of political systems into consideration. Accordingly, formal and informal rules structure power dependencies and interactions between policy actors, and also define how democracies operate. Lijphart's systematic-empirical approach focuses on the analysis of different modes of decision-making as well as the distribution of power. These elements connect particularly well to the study of political networks, which aggregate multi-actor interactions of decision-making processes and reflect power dependencies. Hence, Lijphart's typology of democracies concentrates on aspects that are constitutive of the policy network approach.

In Lijphart's (1999) distinction between the two extreme models of modern democracies, namely consensus and majoritarian democracies, a central distinctive element is the dispersion of power. Majoritarian democracies concentrate power in the hands of the majority government, while consensus democracies emphasize the diffusion of power (Lijphart, 2008).

More specifically, Lijphart bases his distinction on two dimensions: vertical division of power termed the *federal-unitary dimension*, and horizontal division of power, the *executive-party dimension* (Lijphart, 2012; Vatter and Stadelmann-Steffen, 2013). Ideal-typical majoritarian democracies are characterized by unitary and centralized governments (on the federal-unitary dimension), a competitive two-party system out of which one majority party controls the entire government and dominates the parliament, a first-past-the-post electoral system and competitive interest group pluralism (on the executive-party dimension). Hence, distinctive is the concentration of power in the hands of the majority, typically in the form of one-party cabinets (Lijphart, 1999, 91). While competition and majority rule guide decision-making processes in majoritarian democracies, compromise-seeking and consensual negotiations are emphasized in consensus democracies (Kriesi et al. 2006, Vatter 2014, 56). Consensus democracies are defined by federal and decentralized governments (on the federal-unitary dimension); multi-party systems, executive power sharing, balance of power between the executive and the legislative, proportional representation, and interest group corporatism (on the executive-party dimension). According to those characteristics, ideal-typical consensual democracies restrain power from governmental and parliamentary majorities; they strengthen participatory rights of political minorities, and aim at the diffusion of power (Schmidt, 2010). To overcome political conflicts, political elites are incentivized to work towards amicable agreements in both parliamentary and extra-parliamentary phases of decision-making processes. As a result, Lijphart's typology distinguishes between consensual-federal and majoritarian-unitary democracies at the extremes, and consensual-unitary as well as majoritarian-federal democracies as hybrid forms of democracies.

Distribution of power

Kriesi et al. (2006) make use of Lijphart's typology of democracies, and propose that different types of political systems provide opportunity structures for the emergence of certain network structures over others. In consensus democracies several organizations share power, and within those organizations, different political forces further split power. Ingold and Leifeld (2016) argue that the diffusion of power should also be reflected in the structure of decision-making networks. Kriesi et al. (2006) expect several central network actors to share power in consensus democracies. Majoritarian democracies, on the contrary, are said to concentrate power within a few political institutions and actors (Kriesi et al., 2006). Consequently, decision-making networks are expected to be largely centralized around a few powerful actors.

Consensus democracies are more likely to display decision-making networks with a fragmentation of power among policy actors. In majoritarian democracies, on the contrary, decision-making networks are more likely to be characterized by the concentration of power in the hands of a few actors (according to Kriesi et al., 2006; Fischer, 2012).

Based on these theoretical foundations, we formulate the following hypothesis:

Hypothesis 1 (Power) *Consensus democracies tend to be characterized by a fragmentation of power among network members, while majoritarian democracies tend to concentrate power in the hands of only a few actors.*

Types of interactions

Political systems do not only structure power dependencies but also define interaction patterns between policy actors. In consensus democracies, institutionalized consultative procedures incentivize the diverse types of policy actors to seek compromise, whereas majoritarian democracies induce competitive interaction patterns through unilateral styles of policy-making.

More specifically, institutionalized consultative procedures of consensus democracies can include participative committees or advisory bodies. Such formal consultative processes promote negotiations in cases of conflict, they induce cooperative styles of policy-making (Kriesi et al., 2006), and as such, increase the interconnectedness between policy actors (Bressers and O'Toole, 1998, 219). Bressers and O'Toole (1998) categorize decision-making networks by their level of interconnectedness, which stands for the number of contacts among actors. Interaction patterns can be labeled as cooperative or competitive, where cooperative stands for many interaction points and competitive stands for few opportunities for exchange.

The expectation for consensus democracies is that network structures reflect the cooperative style of policy-making by means of close-knit, interconnected patterns of ties among network members (Adam and Kriesi, 2007). In majoritarian democracies informal rules are thought to underline more competitive interaction patterns along with a unilateral style of policy-making. In comparison to consensus democracies, network interactions are less close-knit and rather competitive in nature (Adam and Kriesi, 2007).

While the previous authors' (Adam and Kriesi, 2007; Kriesi et al., 2006) typology of network structures focuses on interactions between policy actors, Fischer (2012) concentrates on a more aggregated level: on *coalition structures*. He argues that advocacy coalitions, as defined by Sabatier (1988) and Sabatier and Jenkins-Smith (1994), are the most crucial structural elements of decision-making networks because they represent belief-cohesive subgroups in which actors coordinate action and work towards a common political goal (Fischer 2012, 55, see also Ingold 2011, Kriesi and Jegen 2001). By focusing on interactions *between* coalitions rather than among single actors, we deduce that, in consensus democracies with consultation mechanism and a cooperative styles of policy-making, interactions between coalitions are necessary for building compromise. In majoritarian democracies, by contrast, conflictive types of interactions between coalitions are likely to be common as these systems typically lack consultation mechanisms and provide incentives for competition.

Combining insights of the above-presented authors, i.e., Lijphart with his typology of democracies, and Kriesi et al. (2006), Bressers and O'Toole (1998), and Fischer (2012) with their network typologies, suggests the following hypothesis regarding the intensity of network interactions.

Hypothesis 2 (Interconnectedness) *Consensus democracies tend to display rather close-knit cooperative interactions, while majoritarian democracies tend to exhibit sparse and competitive interactions among policy actors and across coalitions.*

In their network typology, Bressers and O'Toole (1998) do not only characterize the quantity (i.e., interconnectedness) of interactions between policy actors, but also specify a more qualitative or normative aspect of it.

A central aspect of decision-making networks is the distribution of objectives among network members. Actors base their policy objectives on fundamental values or worldviews, also termed *beliefs* in the language of the Advocacy Coalition Framework (ACF) (Sabatier and Jenkins-Smith, 1994). Underlying beliefs guide policy actors objectives, instrument preferences, and actions. With shared beliefs, actors tend to self-identify as cohesive clusters or coalitions drawing a line between "us" and "them" (Bressers and O'Toole, 1998). Within cohesive coalitions of belief-similar actors, interactions are more likely to be consensual and mutually reinforcing. Across coalitions, however, belief-dissimilar actors are likely to clash. In fact, it is an inherent characteristic of political processes that actors with diverging beliefs clash as they advocate their preferred policy during negotiations. Despite this common feature, political systems diverge with regard to participation mechamisms, i.e. the degree to which they give access to a large diversity of actors (with diverging and potentially conflicting objectives) or rather restrain access to belief-similar actors. Furthermore, political systems are distinct in the degrees to which they provide for consensus-seeking mechanisms across belief-dissimilar actors or groups of actors, or whether they lack institutionlized conflict-settlement.

Ideal-typical consensus democracies, according to (Lijphart, 1999), provide strong incentives for compromise-seeking and negotiations across belief-dissimilarities. Where belief-dissimilar actors seek compromise or consensus, interactions can be labeled as consensual. Majoritarian democracies, by contrast, lack both formal and informal incentives for cooperative and consensual styles of policy-making, and therefore belief dissimilarities hamper actors' interactions in this type of macro-political system comparably more than in consensus democracies.

There are (counter-intuitive) side effects of the structurally given consensus-seeking mechanism in consensus democracies. By incentivizing belief-dissimilar actors to find compromises, consensus democracies potentially give more room for conflicts. While consensus democracies diffuse power among diverse, potentially belief-dissimilar actors (e.g. multi-party governments), majoritarian democracies concentrate power. Clear majorities are more likely to be composed of a group of belief-similar actors (e.g. one-party governments), which are less prone to conflictual interactions. The argument here is not that consensus democracies are more conflictual than their majoritarian counterparts, but their mechanisms to deal with fundamental conflicts of belief-dissimilarities are distinct. Consensus democracies integrate a larger variety of actors from the political spectrum into decision-making and include conflict-settlement mechanisms through consensus-seeking mechanisms. Majoritarian democracies, by contrast, tend to exclude parts of the political spectrum to the advantage of one clear majority, thereby preventing conflicts rather than settling them. If clear majorities fail to build, however, majoritarian democracies find themselves locked into particularly polarized conflicts that, additionally, lack conflict-settlement mechanisms.

From these theoretical foundations, we deduce the following hypotheses on the quality of network interactions:

Hypothesis 3 (Belief dissimilarities) *In consensus democracies actors tend to interact across belief-dissimilarities, while in majoritarian democracies belief-dissimilarities tend to hamper interactions among policy actors.*

Table 1: Typology of country-specific network structures after Adam and Kriesi (2007), Bressers and O'Toole (1998), and Fischer (2012)

	Consensus democracies		Majoritarian democracies	
	Consensual-federal	Consensual-unitary	Majoritarian-federal	Majoritarian-unitary
Distribution of power	Fragmentation of power		Concentration of power	
Type of interaction: interconnectedness	Cooperative interactions (across coalitions)		Competitive interactions (across coalitions)	
Type of interaction: belief cohesion	Interactions across belief-dissimilarities		Few interactions across belief-dissimilarities	

In summary, we propose a two-dimensional typology of network structures in Table 1, in which the distribution of power constitutes the first dimension and the types of interactions (quantity and quality) represents the second dimension. Together these two dimensions distinguish network structures in consensus and majoritarian democracies.

Data and Methods

Case

We categorize the Swiss, German, French, and Dutch macro-political systems according to Lijphart (1999) typology in order to illustrate what types of network structures are to be expected in these four cases. Section A in the Supplementary Information (SI) online contains additional information on the political systems of the four countries. Germany or Switzerland are both typical consensual-federal democracies, while France is a classic example of a majoritarian-unitary system. The Netherlands is a hybrid system with its federal-unitary democracy. In accordance with their macro-political systems, network structures of Switzerland and Germany are assumed to belong to the same neighborhood (Lubell et al., 2012). In these consensus democracies, networks are presumed to display a fragmented power structure, cooperative interaction patterns, and a low degree of conflict or belief dissimilarities. Due to their 'opposite' type of democratic system, French network structures are expected to concentrate power in the hands of a few actors, to display competitive interaction patterns, and a higher degree of conflict. The Dutch macro-political system is positioned between the two extremes of consensus and majoritarian democracies, so its network structures can be expected hybrid as well. Table 2 provides a summary of the link between macro-political and network structures, following the different typologies exposed in the previous section.

Table 2: Overview of expected network structures and interactions in the four cases.

	Consensus democracies		Majoritarian democracies	
	Consensual-federal	Consensual-unitary	Majoritarian-federal	Majoritarian-unitary
Expected network structure	Switzerland, Germany	Netherlands	—	France
Interconnectedness	Cooperative interactions		Competitive interactions	
Cohesion	Consensual interactions		Conflictive interactions	
Power	Power fragmentation		Power concentration	

Data

We contacted a total of 199 state and non-state actors in Switzerland, Germany, France, and the Netherlands through a mixed-mode survey[1] between 2011 and 2014. Network boundaries were delimited based on the concept of policy domain by Laumann and Knoke (1987). We selected all actors who were involved in formulating, advocating, and selecting policies on emerging pollution issues in water protection, including governmental bodies, science, political parties as well as water, environmental, and economic associations. Network members are all actors involved in the following decision-making processes during the following timeframes: the Swiss amendment of the Waters Protection Act and Ordinance between 2007 and 2013; the German adoption of the Surface Water Ordinance between 2008 and 2011; the adoption of the French Micropollutants Plan between 2009 and 2013; the Dutch policy-making process on pharmaceutical micropollutants between 2001 and 2013. We surveyed actors if they a) participated at least twice in the mentioned decision-making processes (decisional approach), or b) hold formal regulatory competences in the field of emerging water pollutants (positional approach), or c) were considered important by knowledgeable experts in the field (reputational

[1]From the 199 observations, a majority of actors (i.e., 158) were surveyed by paper-and-pencil mail questionnaire (Metz, 2017). Following respondents' preferences, 41 actors were surveyed through semi-structured personal interviews by using the same questionnaire.

approach) (see Knoke, 1994; Laumann et al., 1989). Response rates range from 89.2% for Switzerland, 68.4% for Germany, 45.5% for France, to 50.5% for the Netherlands (response rates calculated after AAPOR 2011).

We surveyed each actors' cooperative/competitive interaction patterns through their collaboration ties. Respondents received a complete list of country-specific actors and were asked to check all those with whom their organization had closely collaborated during the decision-making process on micropollutants in the respective timeframe. For each country we created a $n \times n$ adjacency matrix (N) of cooperation ties with n actors (values 0 indicating no cooperation ties and 1 indicating cooperation between two actors). Additionally, we surveyed actors' consensual/conflictive interaction patterns through their ally/opponents ties. Allies or opponents correspond to actors with whom they agree or disagree on policy content.

Figure 1 depicts the four collaboration networks. The Swiss network N_{CH} contains 47 unique nodes (i.e., actors) together with 253 directed edges (i.e., collaboration ties between actors), resulting in a network density of almost 12% ($253/(47 \cdot 46)$). The German decision-making network N_{DE} contains 29 actors and 121 edges (network density = 15%). The French network N_{FR} contains 18 actors and 96 edges (network density = 31%). And the Dutch decision-making network N_{NL} contains 16 actors and 108 edges (network density = 45%).

Statistical approach

Exponential random graph models. We examine structural differences in the four decision-making networks using Exponential Random Graph Models (ERGMs). The inherent dependencies among observations in network settings violate the core assumption of independence in conventional regression models. The violence of the independence assumption may result in biased estimates and optimistic p-values (Cranmer and Desmarais, 2011; Cranmer et al., 2017). To overcome these difficulties, we use a statistical model that can handle and model dependencies. ERGMs are developed to estimate effects of exogenous as well as endogenous covariates on network formation (Frank and Strauss 1986; Wasserman and Pattison 1996; Robins et al.

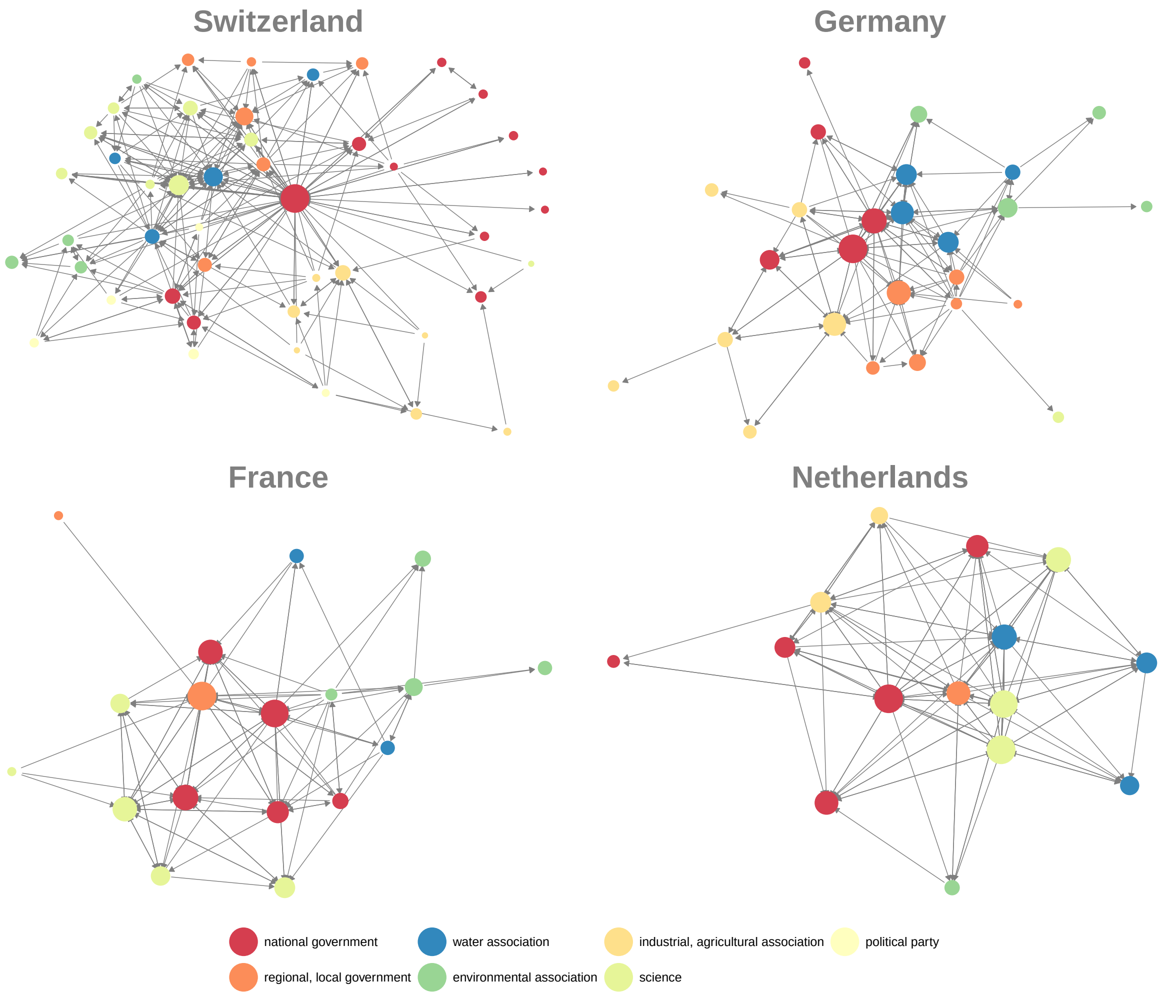

Figure 1: Decision-making networks from Switzerland, Germany, France and the Netherlands. Nodes colored by actor types, and sized by indegree centraly. Isolate nodes were removed from the graphs but not from the analysis.

2007; Robins et al. 2007). The model can be expressed as the probability of observing the given network N over all possible permutations $\mathcal{N}$ of the network:

$$P(N,\boldsymbol{\theta}) = \frac{\exp\{\boldsymbol{\theta}^T \boldsymbol{h}(N)\}}{\sum_{N^* \in \mathcal{N}} \exp\{\boldsymbol{\theta}^T \boldsymbol{h}(N^*)\}}, \tag{1}$$

where N is the observed network, $\boldsymbol{\theta}$ represent the estimated parameters and $\boldsymbol{h}(N)$ is a vector of statistics containing exogenous and endogenous covariates (Cranmer and Desmarais, 2011).

The ERGM can also be thought of as a logistic regression of tie formation, where the probability of observing a specific tie between two actors i and j is dependent on the specified changes in the $\boldsymbol{h}(N)$ statistics (Wasserman and Pattison, 1996; Desmarais and Cranmer, 2012).

$$P(N_{ij} = 1|N_{-ij},\boldsymbol{\theta}) = logit^{-1}\left(\boldsymbol{\theta} \cdot \boldsymbol{\delta}^{(ij)}(N)\right), \tag{2}$$

where N_{-ij} refers to the network excluding N_{ij}, logit^{-1} is the inverse logistic function and $\boldsymbol{\delta}^{(ij)}(N)$ are the vector of change statistics for the vector of endogenous and exogenous covariate statistics such that they measure the changes in the statistics as dyad {i,j} changes from zero to one (Desmarais and Cranmer, 2012, 404-5).

To allow the incorporation of endogenous network statistics into the model, the estimation of the ERGM is carried out with Markov Chain Monte Carlo Maximum Likelihood Estimation (MCMC MLE) (Wasserman and Pattison, 1996; Cranmer and Desmarais, 2011). We use the `ergm` package (Hunter et al., 2008) in the `statnet` suit of packages (Handcock et al., 2003) for the statistical computing environment `R` (R Core Team, 2016) to estimate the ERGMs.

The inclusion of endogenous network statistics are bound to the assumption that all necessary statistics are modeled to prevent omitted variable bias (Cranmer et al., 2017). To ensure the sufficient inclusion of endogenous network statistics we perform goodness-of-fit tests for each of the models using the `btergm` package (Leifeld et al., 2018).

Comparing results across networks. We run four separate ERGMs, one for each of the decision-making networks, and compare the effects of our independent variables across the models. To ensure comparability of the effects as well as their effect sizes, we use the micro-level interpretation of ERGM models that conceptualize ERGMs as a logistic regression of tie formation (Desmarais and Cranmer, 2012). We calculate predicted probabilities over all dyads in the networks, using change statistics for all endogenous and exogenous variables and the estimated coefficients from the ERGMs, as proposed by Faust and Skvoretz (2002).

Comparing structural properties across different networks is difficult, as the number of nodes and the number of ties differ between each of the networks. The estimated coefficients of the ERGMs allow for an interpretation of which structural patterns or data-generating processes are discernible within one network. However, they do not allow for a direct comparison of coefficient sizes across different networks. This is because the coefficients are reported as log-odds and show relative risks, i.e., they can be interpreted as the risk of having a cooperative tie between two actors compared to the risk of a non-cooperative tie. These risks are dependent on network size and density. In order to compare the effects between different ERGMs, predicted probabilities can be calculated for each dyad (i, j) in the network. These predicted probabilities can be used at the dyad-level to examine the probability that node i has a tie to node j conditional on the rest of the network (Faust and Skvoretz, 2002).

$$Pr(\{i, j\} = 1|N^{-ij}) = \frac{exp(\hat{\theta}_{edges} + \boldsymbol{h(N_{ij})} \cdot \boldsymbol{\hat{\theta}})}{(1 + exp(\hat{\theta}_{edges} + \boldsymbol{h(N_{ij})} \cdot \boldsymbol{\hat{\theta}}))} \tag{3}$$

First, the odds of a dyad between nodes i and j is calculated using the baseline probability of a tie (captured in the *edges*-term) plus the change statistic for each independent and control variable (here in the simplified notation $h(N_{ij})$) times the estimated coefficient of said variable (Faust and Skvoretz, 2002, 276-7). Then the odds are transformed into probabilities by dividing them by one plus the odds. The change statistic represents the difference in the value of the independent or control variable if the dyad (i, j) is toggled, i.e., if the dyad (i, j) is transformed into a edge if it was previously a non-edge; or if the dyad (i, j) is transformed into a non-edge, if it was previously an edge.

We use the `btergm` package (Leifeld et al., 2018) to calculate predicted probabilities that allow comparisons of effects between ERGMs.

Operationalization of variables

We use a number of endogenous and exogenous variables to test our main hypotheses whilst controlling for a number of possibly confounding effects.

Power concentration. Hypothesis 1 relates to power concentration and network centralization. We examine to which extent the four networks show centralized or decentralized tendencies by examining the indegree distribution of the network nodes. In centralized networks, coordination is dominated by few central actors and power is inherently concentrated, resulting in a distinct network structure of few high-indegree nodes and many low-indegree nodes. However, in networks where power is more broadly distributed and shared, there are fewer high-indegree nodes and more nodes with similar numbers of incoming ties. We use a geometrically weighted indegree distribution term, presented by Hunter (2007) to model power concentration. The term captures tendencies of popular nodes (i.e., nodes with high indegree centrality) to disproportionally attract other nodes and become even more popular. More formally, the term creates a count of nodes with indegrees ranging from its minimum to its maximum:

$$h_{\text{gwindegree}} = e^{\alpha} \sum_{m=1}^{n-1} \{1 - (1 - e^{-\alpha})^m\} IDeg_m(N), \tag{4}$$

where N refers to the Network, m are indegree specifications ranging from 1 to the maximum indegree (in a network with n nodes, $max(IDeg) = n - 1$) and α is a decay parameter used to scale down low indegree counts of high indegree nodes (Hunter, 2007, 221). The higher the α-parameter, the more weight is given to changes to high-indegree nodes. To adequately model high-indegree nodes, we set a high α-parameter of 1.4 and compare model fit (using BIC scores) with other models with slightly higher or lower α-parameters. A negative coefficient for the geometrically-weighted indegree distribution term indicates that the network is more centralized due to its large variance in the indegree distribution among the nodes (Levy, 2016). The term can be interpreted as a popularity statistic that captures whether indegree is distributed equally among the nodes or not. In networks, where the distribution is skewed, some nodes have high indegrees, i.e., are popular nodes in the network.

We expect popularity—or network centralization—to play a role in all four decision-making networks. However, we expect the effect to be stronger in both the French and the Dutch decision-making network due to the nature of their unitary political system that favors centralization and gives a few actors the opportunity to hold strong positions to exercise power and marginalize opponents.

To compare the effects of popularity on the probability of forming ties, we calculate predicted probabilities for a random selection of nodes and with specific indegree levels. We use these predicted probabilities to assess the increase in the probability of forming a new tie, if the node has a high or low indegree centrality (following the framework of interpreting ERGMs at the dyad level, presented by Desmarais and Cranmer, 2012).

Network interconnectedness. To capture network interconnectedness (Hypothesis 2) we use a variable on cooperation among actors of opposing coalitions. We also measure the overall level of interconnectedness through triadic closure in the network.

The first variable is an edge covariate that measures whether actors reach out towards opponents, i.e. actors with whom they have a conflictive relationship.

$$h_{\text{edgeCovariate}} = \sum_{i,j} N_{ij} x_{ij}, \tag{5}$$

where N refers to the all edges in the focal network and x refers to the edge attribute pertaining to nodes i and j. A positive coefficient indicates that actors have a tendency to collaborate with other actors despite their opposition. We expect to find a positive relationship in consensus democracies due to their inherent necessity to collaborate and overcome adversities and seek compromises across coalitions.

We further test interconnectedness in the decision-making networks by including a triadic closure effect that examines to what extent two nodes i and j become tied due to the number of additional partners k they share. We use a geometrically weighted term, presented by Hunter (2007, 224), to capture effects of triadic closure:

$$h_{gwesp} = e^{\alpha} \sum_{k=1}^{n-2} \{1 - (1 - e^{-\alpha})^{k}\} EP_{k}(N), \tag{6}$$

where N represents the network and EP refers to the number of shared partners k that edges i, j have in common. The counts of shared partners for all edges in the network are summed up. The α-parameter is used to weight the counts, with a α-value near 0 giving more weight to lower counts (i.e., number of edges with only one or two shared partners, for instance). We chose an α-parameter of 0.25 as it produced the best fit for the four network models based on the Bayesian Information Criterion (BIC). The effect yields a positive coefficient if nodes have a tendency to close open triads and therefore form denser collaboration patterns. We expect to find a positive effect of triadic closure in consensus democracies, because consensus democracies foster close-knit collaboration patterns. We also expect a smaller or nonexistent effect of triadic closure in majoritarian democracies, which institutionalize competitive relations.

Belief dissimilarities. For Hypothesis 3 we examine belief dissimilarities among collaboration partners in all four networks. We operationalize belief dissimilarities using an absolute difference effect for weighted policy beliefs.

We surveyed beliefs on environmental concern and risk averseness by asking respondents to rate their level of agreement on a four-point Likert scale with five different statements. We asked whether water protection measures should 1) address the sources of pollution, or 2) the end-of-pipe; 3) follow the precautionary principle or 4) the risk-based principle; and 5) aim at completely eliminating micropollutants in waters. We coded answers between 1 (strongly disagree) and 4 (strongly agree) (see Section B in the SI online for additional information and phrasing of the variables). The absolute differences effects was calculated by comparing the differences in answers for each of the five questions k:

$$h_{absdiff} = \frac{\sum_{k}^{l} |x(k)_i - x(k)_j|}{l}, \tag{7}$$

where k refers to the l belief questions and $x(k)$ represents the value of question k for each respondent i and j.

In the resulting dissimilarity matrices, higher values stand for actors' belief dissimilarities. Smaller values express belief cohesion and point to situations where pairs of nodes display similar levels of environmental concern and risk averseness in the field of water protection.

A negative coefficient in the ERGM indicates that strong belief dissimilarities among two nodes has a negative effect on their likelihood of forming a collaboration tie. In other words, the smaller the differences in beliefs between two actors, the more likely are they to work together. Based on insights from the multiple studies on advocacy coalitions and their applications in various political systems, we expect to find a negative effect of belief dissimilarities on collaboration in all four networks (Henry et al., 2011; Ingold and Varone, 2012; Henry, 2011; Ingold, 2011; Weible and Sabatier, 2005). However, we expect the effect to be stronger in majoritarian democracies, where cooperation and consensus-seeking among dissimilar actors is not instiutionally encouraged as is the case for consensus democracies (Adam and Kriesi, 2007; Kriesi et al., 2006; Lijphart, 1999).

Control variables. We control for a number of endogenous and exogenous variables. Apart from the most basic control variable—the network density—we control for instrument preference dissimilarity, reciprocity, popularity and activity effects of governmental actors, activity effects of important actors (i.e., actors with high reputation power) and differences in reputation power between two nodes. Section C in the SI online holds additional details as well as specifications of control variables.

Results

Table 3 reports the results of the four ERGMs on tie formation. Model 1 corresponds to the results of the Swiss case, Model 2 corresponds to the German case and Models 3 and 4 correspond to the results of the French and Dutch decision-making networks, respectively. Coefficients are reported as log odds. Figures 2-5 show goodness-of-fit assessment of the models. We simulated 500 networks using the estimated parameters and compared their network properties to the original network (boxplots represent the values from simulated networks and black lines represent values from the original networks). We compare degree distributions, dyad-wise shared partners, incoming k-stars, geodesic distance and triadic closure for the observed and simulated networks. All networks show an acceptable fit with the small exception of incoming k-stars for the Swiss network.[2] We further check whether tie prediction in the simulated networks is accurate using receiver-operating curves (see far right panels in Figures 2-5). All curves are well above the curves including exogenous variables only, which indicates good fit and predictive power and allows for a substantive interpretation of the coefficients of the models.

We test our first hypothesis on power-sharing by examining the degree of centralization of the four decision-making networks. As expected, all networks exhibit negative and significant popularity effects, demonstrating skewed indegree distributions. To examine the effect in more detail, we calculate the (relative) probability of adding an additional tie for a randomly selected node to a node with a specified indegree. Figure 6 shows the increase in the probability of a tie when an additional incoming tie is added to a node. Both the Swiss and German networks show slowly increasing probabilities, with an additional incoming tie increasing a node's attractiveness by only a few percentage points. In the unitary French and Dutch systems, networks show much steeper increases in popularity effects (as well as overall higher probabilities, controlled for overall network density) that tailor off only after six existing incoming ties. Results indicate higher levels of power concentration in the French and Dutch cases than in the Swiss and German federal systems that prioritize power fragmentation.

In our second hypothesis, we assumed that actors in consensus democracies are more likely to exhibit close-knit collaborative interaction patterns (across coalitions) than in majoritarian democracies. The term for collaboration across coalitions is highly significant and positive in the Swiss and German networks, non-significant in the French network and weakly significant

[2]Adjusting the indegree distribution decay parameter lead to degeneracy in the German, French and Dutch network. We report an additional ERGM for the Swiss case controlling for incoming 2-stars in Section D in the SI Online. Results do not change by exchanging indegree distribution term with incoming 2-stars term. However, the fit improves.

Table 3: Results on network structure using exponential random graph models for each of the four policy networks

	CH	DE	FR	NL
Hypotheses				
H1: Popularity distribution (gwidegree)	-1.11^{***}	-1.11^{*}	-2.34^{**}	-3.16^{***}
	(0.34)	(0.52)	(0.71)	(0.87)
H2: Collaboration across coalitions	1.60^{***}	1.62^{***}	1.16	0.92^{*}
	(0.33)	(0.30)	(0.60)	(0.45)
H2: Triadic closure (gwesp)	1.15^{***}	1.11^{***}	1.03^{*}	1.81
	(0.19)	(0.27)	(0.46)	(1.03)
H3: Belief dissimilarity	-0.06	-0.63^{**}	-0.79^{*}	0.17
	(0.14)	(0.24)	(0.32)	(0.23)
Controls				
Instrument preference dissimilarity	-0.88^{***}	-0.46	-1.10^{*}	0.12
	(0.19)	(0.34)	(0.43)	(0.51)
Reciprocity	1.21^{***}	1.25^{***}	1.13^{**}	1.51^{***}
	(0.26)	(0.35)	(0.42)	(0.44)
Outdegree: Governmental actors	-0.12	0.13	0.39	-0.60
	(0.16)	(0.28)	(0.40)	(0.37)
Indegree: Governmental actors	0.08	0.32	0.62^{*}	0.37
	(0.13)	(0.23)	(0.28)	(0.28)
Outdegree: high reputation	0.01	0.05^{**}	0.07^{*}	0.34^{***}
	(0.01)	(0.02)	(0.03)	(0.07)
Difference in reputation	0.03^{***}	-0.00	0.00	0.05
	(0.01)	(0.02)	(0.03)	(0.05)
Edges	-3.21^{***}	-2.80^{***}	-1.36	-6.20^{***}
	(0.31)	(0.53)	(0.87)	(1.58)
AIC	1149.83	497.73	300.86	243.98
BIC	1212.30	549.42	341.82	282.27
Log Likelihood	-563.92	-237.86	-139.43	-110.99

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

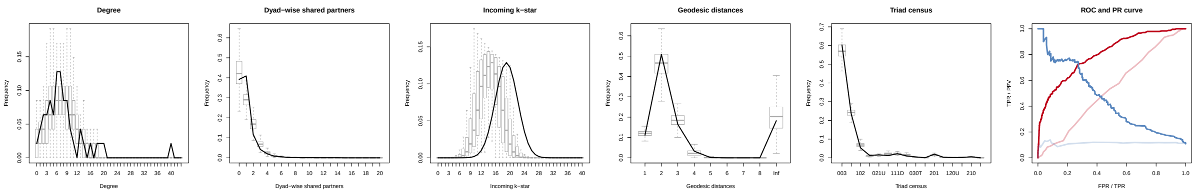

Figure 2: Goodness-of-fit assessment of the ERGM on the Swiss decision-making network

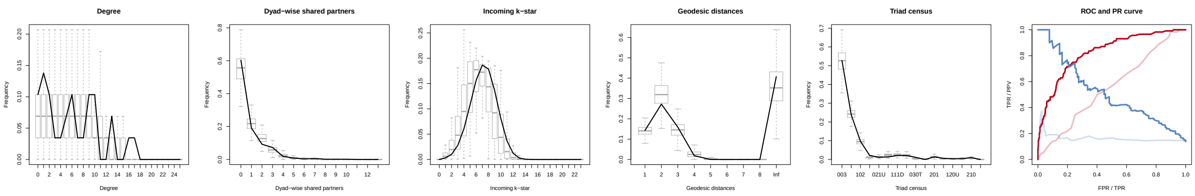

Figure 3: Goodness-of-fit assessment of the ERGM on the German decision-making network

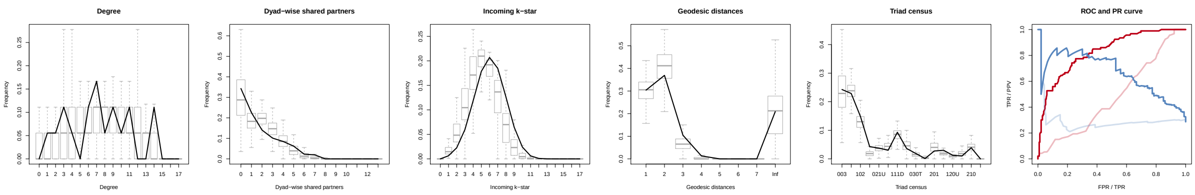

Figure 4: Goodness-of-fit assessment of the ERGM on the French decision-making network

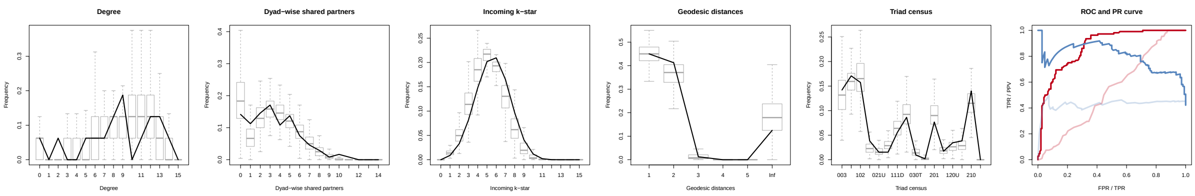

Figure 5: Goodness-of-fit assessment of the ERGM on the Dutch decision-making network

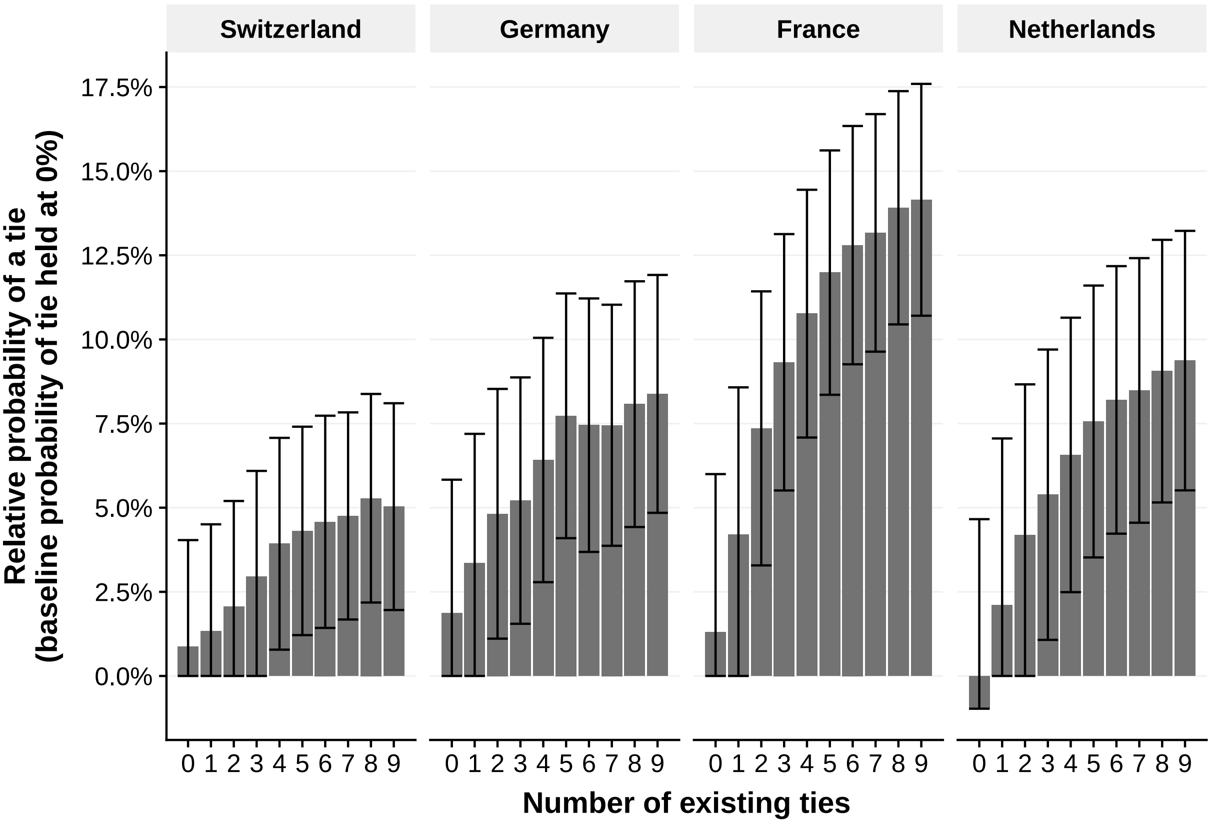

Figure 6: Popularity effect over the four different decision-making networks. x-axis represents the number of edges to a target, y-axis represents the relative probability of forming an additional tie (controlled for the baseline probability of forming a tie in each network). Error bars represent 95% confidence intervals.

and positive in the Dutch case. Decision-makers in Switzerland and Germany have a strong tendency to collaborate with actors with whom they disagree. The term has to be interpreted as a correlation between naming someone as a collaboration partner and naming someone as an opponent.

Figure 7 shows edge probabilities for actors creating ties with opponents. In the German (and to lesser extent in the Swiss) case, actors have a strong tendency to collaborate with actors with whom they also disagree. The same is true for the Dutch case but not in the French case, where the bootstrapped confidence intervals are too large to draw a meaningful conclusion. Interestingly, the probability of collaborating with an opponent is driven in the Swiss and German case by collaborations with governmental actors. This is not true for the Dutch case. Section D in the SI online shows the results of a detailed analysis on cooperating with governmental and non-governmental opponents.

In summary, the results show that, for the consensus democracies of Switzerland and Germany (and to a lesser degree the Netherlands) there is a high probability of establishing a tie with opponents across coalitions. In other words, activities in political decision-making processes are largely about finding common ground with opponents across coalitions.

Results for the French case seem atheoretical at first sight. At closer look, the network contains few mentions of opponents (see Figure 1 in the SI online) resulting in large confidence intervals for predicted probabilities. Results indicate that there are less opponents in the French case. Rather than exhibiting several opposing coalitions, the French network structure resembles one large majority coalition within which intensive collaboration takes place.

We further examine network interconnectedness by studying triadic closure. While the Swiss and German networks exhibit a strong tendency toward triadic closure and, hence, close-knit colllaboration patterns, the French and Dutch networks exhibit less or no tendencies towards triadic closure respectively.

Considering results for both operationlizations of Hypothesis 2 together provides a more detailed picture of actors' interaction patterns across political systems. Our findings confirm that interactions tend to be more cooperative in the consensual systems of Switzerland and Ger-

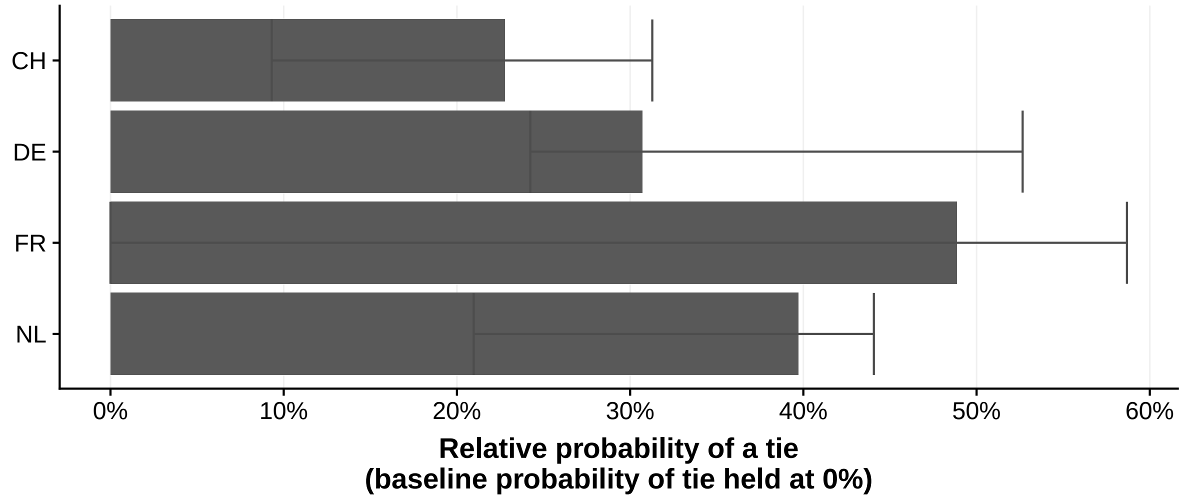

Figure 7: Median relative probability of establishing a tie with an opponent. Error bars refer to bootstrapped bias-corrected 95%-confidence intervals based on 10,000 draws.

many than in the French-style majoritarian democracies. At first sight, collaborative patterns look not so different for the French network than for the Swiss and German ones. However, our analysis showed that these results originate from different network structures. Reflecting the more competitive nature of the French political system, its network exhibits only few mentions of opponents. In the French majoritarian system opponents are more marginalized and less integrated into the policy-making process than is the case for the Swiss and German networks. Hence, dense collaborative patterns (triadic closure) take place among actors who generally agree on policy content rather than as a result of consensus finding mechanism across coalitions of opposing actors. Our results show that there are less opponents in the French case and, thus, point to a decision-making process that is less open for diverse types of interests.

Results for the Dutch case reflect the demand of its political system for compromise seeking. The Dutch network shows strong tendencies (see Figure 7) to collaborate with named opponents (i.e., or being on bad terms with collaboration partners). The data mirrors the fact that the Dutch decision-making process lasted for more than 15 years. Despite this long period of time, actors could not yet agree on a policy for the reduction of micropollutants in water. One reason for the difficulties in reaching agreement was that the Dutch pharmaceutical industry doubted the robustness of scientific results on micropollutants (i.e., those indicating negative effects on the environment) and called for further research before adopting any policy measures. To overcome these difficulties and reach agreement, a number of working groups have been set up, which integrate diverse interests regarding the use and the protection of the resource water, thereby providing multiple opportunities for exchange among opponents.

Our third hypothesis builds on Lijphart's typology according to which majoritarian democracies lack consensus-finding mechanisms. Belief-dissimilar actors are therefore less likely to collaborate. Accordingly, we assumed a negative effect of belief dissimilarities on interactions in the French-style majoritarian democracy. In the consensus oriented Swiss and German cases, by contrast, we assumed belief dissimilarities to play out less importantly (Hypothesis 3).

Figure 8 (left panel) shows the dissimilarities regarding policy beliefs among two collaborating actors. In fact, French members have a significantly lower mean compared to the other three cases (Two-sample t-test, mean CH, DE and NL = .83, mean FR = .68, t = 3.06, p-value = .003), indicating stronger belief similarities among collaboration partners in the French case compared to Swiss, German or Dutch ones. This result also indicates that actors with diverging policy beliefs take part and collaborate in the Swiss, German, and Dutch policy-making processes. In the French process, by contrast, actors with diverging policy beliefs have been marginalized, which reduces the necessity to encounter opponents. In line with the comparably higher belief similarities in the French case, are results in Table 3 reporting the coefficients of the absolute difference effects as well as the marginal effects of belief differences on collaboration.

Results in Table 3 show that only the German and French coefficients are significant and negative for belief dissimilarities. As belief dissimilarities between pairs of actors increase, their odds of forming a collaboration tie decrease when holding all other independent and control variables constant. In the Swiss and Dutch cases, by contrast, belief dissimilarities do not impact collaboration patterns. Swiss and Dutch actors collaborate with belief-similar and dissimilar others, which is in accordance with what we can expect from consensus democracies. In line with theory is also the French case, where diverging beliefs hamper collaboration. In sum, our results follow theoretical expectation in the Swiss, French, and Dutch cases, but are incongruent with theory in the German case. Belief dissimilarities seem to hamper collaboration more than we would expect from the German consensual type of democracy.

To understand this result in the German case, we re-ran the models including a interaction effect for the collaboration with oppenents variable and belief dissimilarities. The results are reported and interpreted in detail in Section D in the SI online. Even though the interaction effect does not show any significant results, its control reduces the belief dissimilarity term to a non-significant parameter estimate ($\theta = -0.23$, p-value = 0.786284), while increasing the size of the collaboration across coalition parameter estimate ($\theta = 1.98$, p-value = 0.622067). The results for the other models do not change (see Table 4 in the SI online).

All in all, results follow theory for Swiss, German and Dutch consensus democracies where belief dissimilarities have no significant effect on collaboration (see Table 3 as well as Table 4 in the SI online). Results also support our expectations for the French majoritarian democracy where actors who display dissimilar beliefs are less likely to collaborate. A more fine-grained analysis of interactions across belief dissimilarities shows that effects are more complicated than expected. Even if consensus democracies provide for mechanisms of compromise-seeking, they also allow more for the integration of heterogeneous actors which, in turn, creates opportunities for belief dissimilarities and conflictive interactions.

Figure 8 on the right depicts a more fine-grained interpretation of the belief differences and their correlation with cooperative ties. All four curves show large confidence intervals that almost all spread across the zero-line (which reflects the baseline probability of a tie for each network). In the case of the significant and negative effect for the French network, the marginal effect shows a slightly curved relationship, where the probability of a tie decreases as differences in policy beliefs increase and then trais off.

We controlled for a number of effects to ensure the models have a good fit and the independent variables are not confounded. When it comes to instrument preference dissimilarity, the Swiss and French case show negative effects, indicating that actors with the same instrument preferences are more likely to work together. Unsurprisingly, reciprocity has a strong

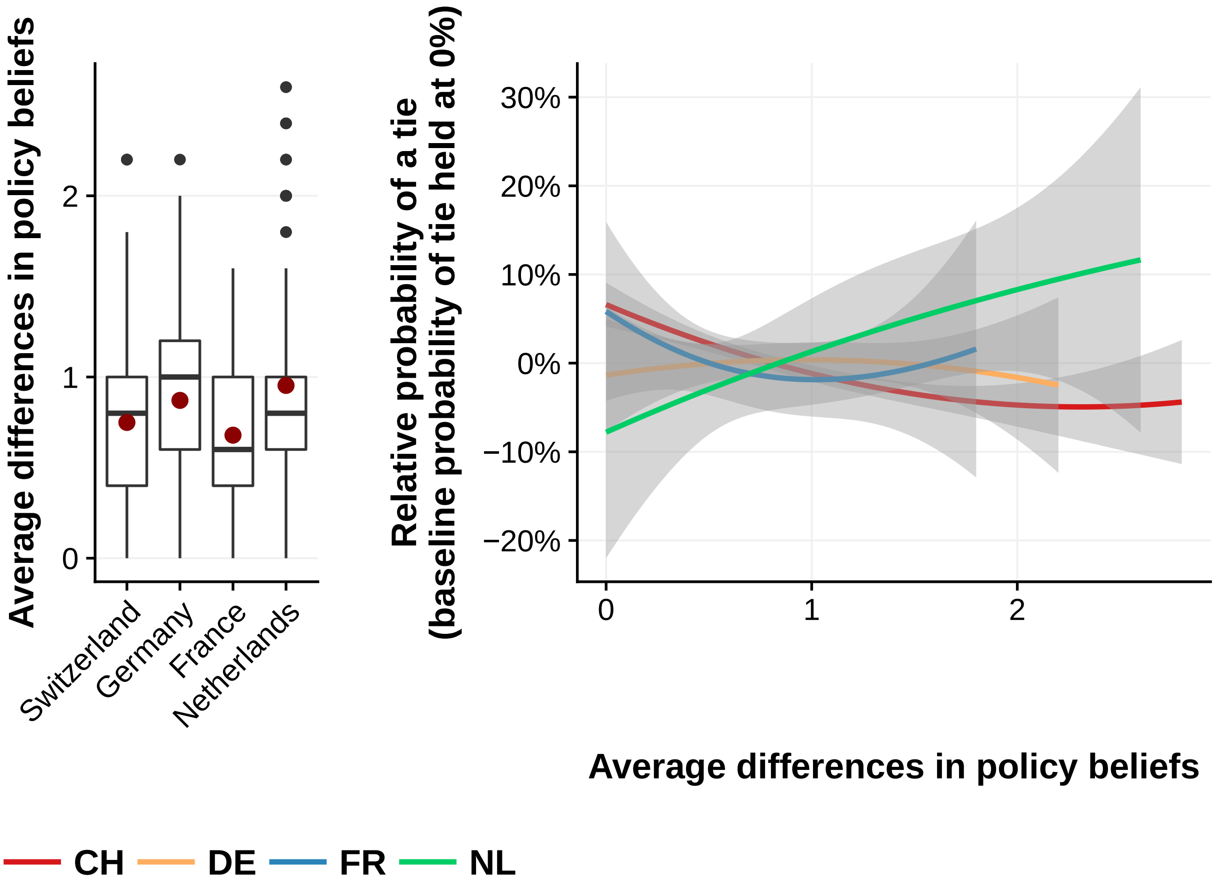

Figure 8: Absolute differences in policy beliefs. Boxplot (left panel) reports absolute differences in policy beliefs for each edge in the four collaboration networks. Red dot represent mean policy belief differences. Marginal plot (right panel) of the effect of differences in policy beliefs on tie probability. Shaded area represent 95%-confidence intervals.

positive effect in all four networks. The positive effect indicates that reciprocity is stronger for the observed networks than the random networks with all other variables held constant. Actors who nominate other actors as collaboration partners are often named as partners themselves. Governmental actors are slightly more popular in France reflecting French etatism, and actors which are regarded as important by network members have higher outdegree centrality. Please refer to Section D in the SI online for more detailed interpretation of control variables.

Conclusion

The paper assesses whether different types of democratic systems shape interactions between actors participating in political decision-making processes as we would expect from institutional theory. According to Lijpharts typology of democracies, one would expect a fragmentation of power across diverse actors with cooperative, consensus-oriented interactions in consensus democracies. Majoritarian democracies, by contrast, are said to concentrate power in the hands of a few actors, lack consensus-building mechanisms, and are therefore characterized by competitive interactions where belief-dissimilar actors do not interact. In our analysis, we tested these expectations against empirical observation of actors' interaction patterns in decision-making processes on water protection. We compared the consensual-federal democracies of Switzerland and Germany, with the French majoritarian-unitary case; and the Dutch hybrid system of consensual-unitary democracy. Our findings generally support theoretical expectations and additionally provide a detailed picture of how macro-political systems shape actors' interaction patterns in policy-making processes.

Results that test our Hypothesis 1 show that power generally matters in political networks. In a political context, it is not a surprising finding that actors tend to collaborate with others that they consider powerful. Our data additionally indicates that the popularity effect is stronger in the French and Dutch unitarian systems where higher levels of power concentration occur than in the Swiss and German federal systems that diffuse power.

Additionally, our findings highlight that policy-making processes are all about finding common ground with opponents in consensus democracies. In line with Hypothesis 2, our results show that there is a tendency to collaborate with opponents across coalitions in the Swiss, German, and Dutch cases more so than in the French network. As expected for Swiss and German consensus democracies (and to a lesser extent for the hybrid Dutch consensual-unitary democracy), networks exhibit close-knit collaborative interaction patterns across coalitions.

Moreover, results indicate that governmental actors are driving consensus-seeking interactions in Switzerland and Germany. We also find a higher tendency towards cooperative interactions (assessed through triadic closure) in the Swiss and German consensus-oriented democracies than in the French and Dutch cases.

Overall, results for the intensity of interactions follow the pattern of Lijpharts typology of democracies according to which German and Swiss consensual-federal systems are diametrically opposed to the French majoritarian-unity democracy, while the Dutch consensual-unitary democracy represents a hybrid case in between.

Finally, our results allow us to better understand how political systems shape the quality of actors' interactions. In Hypothesis 3 we assumed interactions to be inhibited by belief-dissimilarities in majoritarian-unitary systems more so than in consensual-federal ones. As expected for the Swiss, German and Dutch consensus democracies, actors collaborate independently of belief-dissimilarities, while belief dissimilarities hamper interactions in the French majoritarian system. We also find that the relationship between beliefs and collaboration depends on the openness (or closedness) of political processes to include heterogeneous actors with diverse beliefs (or only homogeneous ones). Political processes that welcome heterogenous actors are also more prone to conflictual interactions. We interpret our results according to which French actors named less opponents and diverged less on policy beliefs as a consequence of the majoritarian system, where opponents are marginalized. Instead of forming opposing coalitions, our French case of a majoritarian system builds one dominant coalition where actors tend to converge on policy beliefs. Such structures are designed to avoid conflictual interactions instead of encouraging interactions among oppontents.

Another added value of our paper is that our models accurately capture the mechanisms behind tie-creation despite the differences in network size and institutional structures. Thereby, we are able to compare results across cases and better understand the ways in which formal institutions frame actors' interactions in decision-making processes.

One drawback of our study is that we possess of snapshot data only. Future research could assess the linkages between political systems and network structures more thoroughly by using longitudinal data, which capture how decision-making processes evolve over time. Such research would be valuable in order to understand the importance of consensus-building mechanisms in processes, that welcome diverse interests to partake, and therefore are more prone to conflictive interactions than closed settings that marginalize opponents. Additionally, it would be valuable to better understand which dimensions of belief cohesion improves over time where consensus-building mechanisms are in place. The latter may not necessarily lead to a situation where all actors agree on policy orientation and content; but to one where actors understand each others positions and motivations better, trust each other, and therefore are more willing to engage in compromise. Finally, longitudinal data would be necessary to capture whether network structures change in policy-making processes between low, medium, and high levels of interactions depending on the stage of the policy process. Different quantities and types of actors may intervene and interact depending on whether the policy-process is, for example, in the stage of agenda-setting or policy-formulation.

We have argued that analyzing interaction patterns within network structures contributes to better understanding the social context within which policy content is agreed upon. To ultimately better understand why certain political systems perform better in terms of producing policy outputs and policy change, future research is needed that links network structures to policy outputs (as attempted in Metz 2017). Such a research agenda would have to consider the interdependencies between political systems on the macro-level, decision-making networks on the meso-level, and actors beliefs and preferences on the micro-level in order to understand these variables' impact on policy outputs. Beyond that, a complete model of policy outputs would have to consider further contextual variables that impact why (or why not) policy outputs are produced. Such a complete model would serve to estimate the explanatory value of the network variable compared to other explanations for policy outputs, which is an insight lacking from the literature so far. To date, it remains a challenge to include the network variable together with other explanations in one coherent policy-making model: Network data is particularly resource intensive to gather and its analysis demands specific, "relational" approaches. To circumvent such challenges, macro-political structures may serve as a proxy capturing "neighborhoods of network structures". Our paper indicates that stable institutional environment limit observable network structures to neighborhoods of networks, but more empirical evidence is necessary to identify the structures that can typically be found in such neighborhoods beyond power dependencies and interaction patterns. For example, an important feature of decision-making processes is the role of non-governmental actors, representing different societal interests, and the degree to which democratic systems give or restrain access of interest group to policy-making processes. Finally, not only macro-political systems, but also policy domains establish institutional structures (Hacker and Pierson, 2014; Fischer, 2015). Accordingly, neighborhoods of networks may look different, for example, in environmental, economic, or social policy. While we kept the policy domain constant in our study, future research is necessary that compares network structures across domains.

Funding This work was supported by the Swiss National Science Foundation (105217_140395, 149410).

Acknowledgements The authors would like to thank Philip Leifeld for helpful discussions on comparing network model effects. We are grateful for insightful comments by Karin Ingold and Robert Keohane. Previous versions of this paper were presented at MPSA Annual Conference, April 6-9 2017, Chicago, USA, and at SPSA Annual Conference, February 5-6 2018, Geneva, Switzerland. Conference discussants and panel members gave insightful feedback that helped improve our paper.

References

AAPOR (2011). *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. The American Association for Public Opinion Research.

Adam, S. and H. Kriesi (2007). The network approach. In P. A. Sabatier (Ed.), *Theories of the policy process*, pp. 189–220. Cambridge MA: Westview Press.

Aoki, M. (2011). Institutions as cognitive media between strategic interactions and individual beliefs. *Journal of Economic Behavior & Organization 79*(1), 20–34.

Börzel, T. A. (1998). Organizing babylon-on the different conceptions of policy networks. *Public administration 76*(2), 253–273.

Bressers, H. T. A. and L. J. O'Toole (1998). The selection of policy instruments: A network-based perspective. *Journal of Public Policy 18*(03), 213–239.

Cranmer, S. J. and B. A. Desmarais (2011). Inferential network analysis with exponential random graph models. *Political Analysis 19*(1), 66–86.

Cranmer, S. J., P. Leifeld, S. D. McClurg, and M. Rolfe (2017). Navigating the range of statistical tools for inferential network analysis. *American Journal of Political Science 61*(1), 237–251.

Desmarais, B. A. and S. J. Cranmer (2012). Micro-level interpretation of exponential random graph models with application to estuary networks. *Policy Studies Journal 40*(3), 402–434.

Dowding, K. (1995). Model or metaphor? a critical review of the policy network approach. *Political Studies 43*(1), 136–158.

Easton, D. (1965). *A Framework for Political Analysis*. Englewood Cliffs, NJ: Prentice-Hall.

Faust, K. and J. Skvoretz (2002). 8. comparing networks across space and time, size and species. *Sociological methodology 32*(1), 267–299.

Fischer, M. (2012). *Entscheidungsstrukturen in der Schweizer Politik zu Beginn des 21. Jahrhunderts*. Glarus: Ruegger.

Fischer, M. (2015). Institutions and coalitions in policy processes: a cross-sectoral comparison. *Journal of Public Policy 35*(2), 245–268.

Frank, O. and D. Strauss (1986). Markov graphs. *Journal of the American Statistical Association 81*(395), 832–42.

Friedkin, N. E. (1981). The development of structure in random networks: an analysis of the effects of increasing network density on five measures of structure. *Social Networks 3*(1), 41–52.

Hacker, J. S. and P. Pierson (2014). After the "master theory": Downs, schattschneider, and the rebirth of policy-focused analysis. *Perspectives on Politics 12*(3), 643–662.

Handcock, M. S., D. R. Hunter, C. T. Butts, S. M. Goodreau, and M. Morris (2003). *statnet: Software Tools for the Statistical Modeling of Network Data*. Seattle, WA. http://statnetproject.org (last access: May 8, 2018).

Henry, A. D. (2011). Ideology, power, and the structure of policy networks. *Policy Studies Journal 39*(3), 361–383.

Henry, A. D., M. Lubell, and M. McCoy (2011). Belief systems and social capital as drivers of policy network structure: The case of california regional planning. *Journal of Public Administration Research and Theory 21*(3), 419–444.

Hunter, D. R. (2007). Curved exponential family models for social networks. *Social networks 29*(2), 216–230.

Hunter, D. R., M. S. Handcock, C. T. Butts, S. M. Goodreau, and M. Morris (2008). ergm: A package to fit, simulate and diagnose exponential-family models for networks. *Journal of Statistical Software 24*(3), nihpa54860.

Immergut, E. (1992). *Health Politics: Interests and Institutions in Western Europe*. Cambridge: Cambridge University Press.

Immergut, E. M. (1998). The theoretical core of the new institutionalism. *Politics & Society 26*(1), 5–34.

Ingold, K. (2011). Network structures within policy processes: Coalitions, power, and brokerage in swiss climate policy. *Policy studies journal 39*(3), 435–459.

Ingold, K. and P. Leifeld (2016). Structural and institutional determinants of influence reputation: A comparison of collaborative and adversarial policy networks in decision making and implementation. *Journal of Public Administration Research and Theory 26*(1), 1–18.

Ingold, K. and F. Varone (2012). Treating policy brokers seriously: Evidence from the climate policy. *Journal of Public Administration Research and Theory 22*(2), 319–46.

Knill, C. and J. Tosun (2012). *Public policy: a new introduction*. London: Palgrave Macmillan.

Knoke, D. (1994). Networks of elite structure and decision making. In W. Stanley and J. Galaskiewicz (Eds.), *Advances in social network analysis: Research in the social and behavioral sciences*, pp. 274–294. Thousand Oaks: Sage.

Kriesi, H., S. Adam, and M. Jochum (2006). Comparative analysis of policy networks in western europe. *Journal of European public policy 13*(3), 341–361.

Kriesi, H. and M. Jegen (2001). The swiss energy policy elite: The actor constellation of a policy domain in transition. *European Journal of Political Research 39*(2), 251–287.

Laumann, E. O. and D. Knoke (1987). *The organizational state: Social choice in national policy domains*. Madison: Univ of Wisconsin Press.

Laumann, E. O., P. V. Marsden, and D. Prensky (1989). The boundary specification problem in network analysis. In L. C. Freeman, D. R. White, and A. K. Romney (Eds.), *Research methods in social network analysis*, pp. 61–88. New Jersey: Transaction Publishers, Rutgers.

Leifeld, P., S. J. Cranmer, and B. A. Desmarais (2018). Temporal exponential random graph models with btergm: Estimation and bootstrap confidence intervals. *Journal of Statistical Software 83*(6), 1–36.

Levy, M. A. (2016). gwdegree: Improving interpretation of geometrically-weighted degree estimates in exponential random graph models. *The Journal of Open Source Software 1*(3), 36.

Lijphart, A. (1984). *Democracies. Patterns of Majoritarian and Consensus Government in Twenty-One Countries*. New Haven: Yale University Press.

Lijphart, A. (1999). *Patterns of Democracy: Government Forms and Performance in Thirty-Six Countries*. New Haven: Yale University Press.

Lijphart, A. (2008). *Thinking About Democracy: Power Sharing and Majority Rule in Theory and Practice*. New York: Routledge.

Lijphart, A. (2012). *Patterns of Democracy. Government Forms and Performance in Thirty-Six Countries.* (2 ed.). New Haven: Yale University Press.

Lubell, M., J. Scholz, R. Berardo, and G. Robins (2012). Testing policy theory with statistical models of networks. *Policy Studies Journal 40*(3), 351–374.

Mainwaring, S. (2001). Two models of democracy. *Journal of Democracy 12*(3), 170–175.

Metz, F. (2017). *From Network Structure to Policy Design in Water Protection. A Comparative Perspective on Micropollutants in the Rhine River Riparian Countries*. Cham: Springer International Publishing.

North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge, New York: Cambridge University Press.

R Core Team (2016). *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/ (last access: May 8, 2018).

Robins, G., P. Pattison, Y. Kalish, and D. Lusher (2007). An introduction to exponential random graph (p*) models for social networks. *Social Networks 29*(2), 173–191.

Robins, G., T. A. Snijders, P. Wang, M. Handcock, and P. Pattison (2007). Recent developments in exponential random graph (p*) models for social networks. *Social Networks 29*(2), 192–215.

Sabatier, P. A. (1988). An advocacy coalition framework of policy change and the role of policy-oriented learning therein. *Policy sciences 21*(2-3), 129–168.

Sabatier, P. A. and H. Jenkins-Smith (1994). Policy change and learning: An advocacy coalition framework. *Policy Studies Journal 22*(1), 176.

Schmidt, M. (2010). *Demokratietheorien: Eine Einführung* (5 ed.). Wiesbaden: VS Verlag für Sozialwissenschaften.

Vatter, A. (2014). *Das politische System der Schweiz.* Baden-Baden: Nomos.

Vatter, A. and I. Stadelmann-Steffen (2013). Subnational patterns of democracy in austria, germany and switzerland. *West European Politics 36*(1), 71–96.

Wasserman, S. and P. Pattison (1996). Logit models and logistic regressions for social networks: I. an introduction to markov graphs andp. *Psychometrika 61*(3), 401–425.

Weible, C. M. and P. A. Sabatier (2005). Comparing policy networks: Marine protected areas in california. *Policy Studies Journal 33*(2), 181–201.