Drivers for policy agreement in nascent subsystems: An Application of the Advocacy Coalition Framework to Fracking policy in Switzerland and the UK

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Abstract:

The study of public policy deals with subsystems in which actors cooperate or compete to turn their beliefs into policy solutions. Yet, most studies concern mature subsystems in which the main actors and their allies and enemies can easily be identified. This paper tackles the challenge of studying nascent subsystems, in which actors have begun to engage in politics but are uncertain about other actors' beliefs. Actors thus have difficulties to identify their allies and opponents. Focusing on the Advocacy Coalition Framework, we examine three main ways in which actors might agree to support the same policy design before they decide whether or not to form long term relationships within advocacy coalitions: they see the issue through the same lenses, they follow leaders, or they know each other from earlier cooperation. We use the case of fracking policy in consensual Switzerland and the majoritarian UK as a key example, in which actors have begun to agree with each other, but where final policy outputs were not yet defined, and long term relationships not yet observable. We find that, when dealing with new issues, actors strongly rely on former contacts rather than shared ideologies or leadership.

Keywords: Policy subsystem, nascent subsystem, policy agreement, advocacy coalition, hydraulic fracturing.

Introduction

At the heart of public policy theory is the idea that most of the action happens in well-established policy subsystems. Subsystems are the networks that actors form or operate within, to interact and coordinate actions with each other to influence the design of policy solutions. In most cases, influential policy theories have generated insights from *mature* subsystems, in which we can identify three crucial aspects relatively easily: the key participants, the territorial boundary (including the most relevant policymaking venues), and the substantive topic. For example, multiple streams analysis identifies the need for policy solutions to be deemed technically and politically feasible by a well-established policy community (Kingdon 1984), punctuated equilibrium theory establishes the role of shared beliefs in establishing (or challenging) policy monopolies in key policymaking venues (Baumgartner and Jones 1993), and the advocacy coalition framework identifies the role of 'shocks' to help explain the rise and fall of coalitions dominating a subsystem (Sabatier and Weible 2007b; Sabatier and Jenkins-Smith 1993).

However, by focusing only on mature subsystems, we miss an important piece of the puzzle: we do not know how and why particular subsystems form. Specifically, we do not know how actors begin to agree with each other to support the same policy design, before they decide to cooperate regularly to secure shared policy beliefs and preferences. This agreement upon policy design is an important pre-condition for successful policymaking and implementation (Ansell and Gash 2008).

Studies of mature subsystems show that actors tend to coordinate actions based on ideological positions or power structures, depending on the degree of conflict or the level of decision-making, respectively (Fischer and Sciarini 2015a; Calanni et al. 2014; Ingold and Fischer 2014; Schneider et al. 2003). The scarce literature on *nascent* subsystems does not describe with such certainty how actors organize, interact and agree, partly because actors' policy beliefs are not well established when dealing with new issues (Beverwijk et al. 2008;

Stritch 2015). In such situations, the identification of coalition partners is a challenging task to policy actors, and understanding actors' behavior in these situations is a challenge to researchers.

To help solve this puzzle, we explain the dynamics of nascent subsystems within the Advocacy Coalition Framework. More concretely, we identify ways to measure activity at the early stage of policy action, to track the development of policy agreement. We ask: which drivers shape actors' agreement in nascent policy subsystems? We examine three sets of hypotheses, testing their general application but also exploring differences across institutional and policy-related contexts. The first investigates whether actors agree on policy design when they see the world through similar lenses. The second examines the role of actors' reputations as leaders: some follow the lead of actors with decision-making or scientific authority (Fischer and Sciarini 2015a; Calanni et al. 2014; Ingold and Fischer 2014; Schneider et al. 2003). Our third set of hypotheses claims that initial agreement on policy design is built on *mutual knowledge*. We use this phrase as a shorthand, describing what happens when actors know each other, and have built up knowledge of each other's actions, which might prompt them to, for example, trust each other to act responsibly, predictably, or in accordance with shared aims. Empirically, we investigate policy agreement in three different nascent subsystems concerning the issue of hydraulic fracturing regulation in two different institutional contexts, that is, consensual Switzerland and the majoritarian United Kingdom (UK). The comparison allows us to examine the extent to which we can confirm or refute the outlined hypotheses generally, or if they apply more or less strongly in different institutional settings.

After hydraulic fracturing caused a gas boom in the United States, these new methods of unconventional gas development were discussed and tested in Europe. Hydraulic fracturing is a contested issue in societal, scientific and political debates in many European countries, but only very few projects of hydraulic fracturing are in an advanced state (Weible et al.

2016). Scientific research discusses the environmental risks of fracking and its impact on natural resources, ecosystems and human health, as well as the potential economical and geo-political risks and benefits for countries and regions (Wagner 2015; Stevens 2010). Policy actors are specialized in the specific issue of hydraulic fracturing to different degrees, and they defend diverging views with respect to the benefits and risks related to unconventional gas development (Lachapelle et al. 2014). Based on the potential but uncertain harms to humans and the environment, civil society and green NGOs are strongly opposed to fracking. Private sector representatives and some local governments point towards its potential economic benefits and therefore favor limited regulation of the issue, but specific drilling sites also tend to face high opposition from local populations. As a consequence, only few clear regulations exist, and policy outputs are not final in many cases. They might take a different shape than traditional state interventions regarding energy or natural resource policy, and it is still unclear on which level appropriate legislation should happen. Given the relatively few policy outputs and organized advocacy on one side, and the high potential of political conflict and new specialized policies on the other, we argue that hydraulic fracturing is an ideal case to study policy agreement at a nascent stage.

The remainder of our paper is organized as follows. First, we demonstrate the importance of nascent subsystems to theories of the policy process. Policy scholars provide only partial explanation if they focus solely on mature subsystems. Second, we provide three actor-centered hypotheses on potential drivers of policy agreement: shared beliefs, leadership, and mutual knowledge. Third, we provide new data, and innovative analysis – using the Exponential Random Graph Model – to explain developments in real time in the UK and two Cantons in Switzerland. We find clear evidence that, when dealing with new issues, actors rely far more on former contacts than shared ideologies or leadership.

Theory

We apply insights from the ACF, but note that the issues we raise apply more generally to policy theory. Most policy theories – such as multiple streams analysis (MSA), punctuated equilibrium theory (PET) and the advocacy coalition framework (ACF) – identify the logic of interactions in mature subsystems. MSA examines the dynamic between three separate 'streams': lurches of attention to policy problems; the development of feasible solutions, and the motivation and opportunity of policymakers to adopt a particular solution (Kingdon 1984; Cairney and Jones 2015; Zahariadis 2014; Jones et al. 2015). Although many people act independently to secure government attention to a problem, the processing of feasible solutions is more limited to the experienced and well-connected policy entrepreneurs that look for the right time to propose them, such as when they detect a *high level of agreement* about how to frame and solve a problem, and the well-established policy community which helps 'soften' or modify a proposal, to increase its technical and political feasibility and chances of success.

An important initial emphasis of PET was on the role of agreement in the establishment of policy monopolies in key venues (Baumgartner and Jones 1993; Baumgartner et al. 2009; Baumgartner et al. 2014). A 'monopoly of understandings' referred to *high levels of agreement* among a select group of policymakers, regulators, congressional, and private actors, about the nature of the policy problem and the best solution. Actors in *disagreement* with this policy settlement often needed to cooperate to generate external attention and shift policymaking responsibility to an alternative venue.

At the heart of ACF explanation of minor policy change is the role of policy learning within an advocacy coalition which tends to dominate debate and have the most influence on policy. Major policy change is rare, and linked to the role of 'shocks' to help explain the rise and fall of dominant coalitions (Sabatier and Jenkins-Smith 1993; Sabatier and Weible 2007a). It is possible to trace back these events to the ways in which actors form coalitions with others sharing similar beliefs, worldviews and ideas on how to best solve a problem.

Coalition allies then coordinate action and engage in strategies such as venue shopping or the activation of veto points (Fischer 2014; Tsebelis 1995; Nohrstedt and Olofsson 2016), and *agreement upon beliefs and policy preferences within coalitions* is reinforced when they see opponents as more powerful and evil than they really are (Fischer et al. 2016; Sabatier et al. 1987).

With each theory, we can conclude that the appearance of advocacy coalitions, issue framing, successful venue exploitation, or entrepreneurship is the result of long-term developments and established patterns of agreement and disagreement in policy subsystems. It is possible to trace back these developments, but most studies tend not to do so; or, in Baumgartner and Jones' (1993) original case studies, they rely on documentary and data analysis of events and agreements formed decades before.

In each case, most studies miss the chance to (1) assess early stages of actors' coordination, such as the agreement on policy design; and (2) track the levels of such agreement in real time: before actors engage systematically, subsystems mature, and action is influenced heavily by path dependence and former interactions on the same issue. When studying nascent subsystems as they develop, we have the chance to investigate the pre-conditions for more established relationships among actors formulating and implementing policies. To do so, our study relies on concepts and elements of the Advocacy Coalition Framework. More concretely, the dependent variable is agreement upon policy design. Following the ACF's belief hierarchy (Sabatier and Jenkins-Smith 1993), this corresponds to agreement on the level of secondary aspects, that is, on the question on how an issue is to be regulated, and what instruments are needed to tackle a given problem.

Actors dealing with new issues

New issues arise on the policy agenda following, for example, the development of new technology. New issues on the political agenda are characterized by what Sabatier and

Jenkins-Smith (1999) call "little history of policy solutions or outputs, little advocacy activity, and little public and decision-making attention." New issues on the agenda potentially prompt a series of steps: first, actors consider their position on a given issue and identify the actors which might agree with them about the best way to respond. At this stage, beliefs of actors are only vaguely formulated (Sabatier and Jenkins-Smith 1999) or fragmented (Beverwijk et al. 2008), even though actors might have already formulated their policy positions on similar or related issues earlier. Further, when a subsystem transcends from a nascent to a mature stage, actors start to have some degree of specialization in the specific policy area (see Henry et al. 2014). Second, some actors discuss how to cooperate to influence policy. Third, some engage together to try to influence policy in at least one significant venue. These actions produce reactions. Actors who do not share the same beliefs engage in the same venues to counter their influence. They begin to form alliances with other actors which seem to share their aims or beliefs. In turn, there is a reinforcing effect: when each set of actors witnesses the other engaging in coordinated action, it prompts them to mobilise and cooperate with each other. As this activity increases so too does contact with policymakers: subsystems develop when early ad hoc activity becomes more systematic engagement with policymakers in dedicated venues or meetings. This corresponds to a move from so-called advocacy communities with some ideological and coordinative congruence (see Stritch 2015), to "real" advocacy coalitions sharing beliefs and coordination patterns (Sabatier and Jenkins-Smith 1999). In such a context of a nascent subsystem, achieving agreement on policy design might be conceived as one first step towards coalition formation. Below, we formulate three sets of hypotheses on potential drivers of actors' policy agreement in such nascent subsystems.

Drivers for agreement in policy networks

The fact that an actor perceives agreement with another actor can be defined as a directed relation between two actors integrated in a larger policy network. Network interactions are

driven by actors' individual attributes and behavior, but are also embedded within a larger, exogenous institutional framework (Fischer et al. 2012; Ingold and Leifeld 2014; Gerber et al. 2013; Lubell et al. 2012). To understand policy agreement between actors in a nascent subsystem, we focus mainly on micro-level drivers, including variables at the actors' level and at the level of actors' ties.

We identify, from the literature on mature subsystems, the factors most likely to impact policy agreement (see below). Most often, the aim of studies focusing on belief homophily, leadership, or mutual knowledge was to understand an advanced form of within-coalition coordination such as collaboration among political actors. Still, homophily, leadership, or mutual knowledge should also matter when actors engage in early coordination in a nascent situation, that is when establishing policy agreement. We thus test if these drivers are also present at a nascent stage of policy development.

Belief and level homophily: seeing the world through similar lenses

First, policy network studies point strongly to phenomena of homophily (Gerber et al. 2013). Homophily refers to the fact that two actors which are similar with respect to some attribute create a relationship (Mcpherson et al. 2001; Calanni et al. 2014). With respect to policy agreement, actors are often similarly affected by a political problem and they see the policy problem through the same lenses. They tend to develop a common understanding of the problem, and might even engage in joint learning processes (Berardo and Scholz 2010; Feiock 2009; Lubell et al. 2009). We thus expect homophily to foster policy agreement, and we take into account two types: ideological and level homophily.

Ideological homophily refers to the fact that actors with similar policy core beliefs, or actors being similarly affected by potential policy change, tend to prefer the same policy design and instruments for the regulation of a given issue. The ACF (Sabatier 1987; Jenkins-Smith et al. 2014) focuses on shared beliefs and argues that actors in a policy process form

coalitions based on similar beliefs that can range from fundamental values to favoring the same policy instruments. The causal mechanism we are investigating implies that core beliefs influence the preferences for measures and instruments to tackle a specific problem. Whereas coalition formation based on shared beliefs is a well-studied phenomenon in mature subsystems, we expect beliefs to matter also in nascent subsystems, and for an early stage of coordinated action such as policy agreement. We thus assume that in nascent subsystems actors tend to agree upon policy design with actors who share a similar ideology. For example, organizations that are similarly affected or threatened by potential policy change tend to agree on policies (Ingold and Metz 2015; Heikkila and Weible 2016).

Further, issues of environmental and energy policy, such as hydraulic fracturing, mostly pitch actors with right-wing and economy-friendly core beliefs against left-wing and environmental actors (Ingold 2011; Kriesi and Jegen 2001; Montpetit et al. 2016; Ingold and Fischer 2014)[1]. Whereas the first favor values of economic efficiency and free market, the latter support state intervention to defend the environment. Based on this, we formulate the following hypothesis:

> ***Hypothesis 1a:*** *Actors with similar core beliefs tend to agree on policy design in a given policy process.*

Level homophily concerns the level of decision-making in a multi-level political system. In most political systems, competences are shared between central and regional or subnational levels. For example, in hydraulic fracturing in the UK, the central level is responsible for the general regulation of the issue, but whether hydraulic fracturing actually happens depends strongly on the devolved (Scotland, Wales, Northern) levels, responsible for land planning, and local levels, where concrete drilling projects have to be implemented and might confront local resistance. In Switzerland, the regional level is responsible for drilling permits, whereas the central level regulates the environmental standards which need to be

respected. Given these different aspects of the policy treated at each level, we expect homophily effects to take place. In multi-level political systems, belonging to the same level of decision-making fosters a common understanding of the problem, collective action and joint learning processes (Berardo and Scholz 2010; Feiock 2009; Lubell et al. 2009). This joint understanding of the problem through a level-specific lens may contribute to policy agreement:

> ***Hypothesis 1b:*** *Actors belonging to the same level of decision-making tend to agree on policy design in a given policy process.*

Authority and knowledge: follow the leader

In situations when a new issue enters the agenda or a subsystem is in its nascent stage, actors seek information (Klein et al. 1999; Leach et al. 2014). They refer to other actors who they deem knowledgeable, and tend to adopt their policy positions. We distinguish two types of actors which should most often act as "opinion leaders" or "reference actors", that is, actors generally perceived as scientific experts or powerful actors.

In a policy sector where empirical or academic evidence of human effects on the environment are still lacking, scientific knowledge is an important resource in policymaking. Actors need information about the problem and the likely effects of different policy designs on target groups. This allows them to justify their own beliefs and to know why one policy design might be most suitable to solve a problem. Scientific actors and think tanks are generally the main providers of "objective" or technical knowledge (Leifeld and Schneider 2012). Actors are thus expected to agree with the policy positions of scientific actors.

> ***Hypothesis 2a:*** *Actors tend to agree with scientific actors on policy design in a given policy process.*

Calanni et al. (2014) show that power is an important factor shaping relations among actors in collaborative subsystems. Actors with a high reputation for policy influence are role models to others: powerful actors, whether formal decision-makers or structurally well embedded actors (Ingold and Leifeld 2014; Fischer and Sciarini 2015a), have an important impact on policy outputs (Choi and Robertson 2014; Henry 2011). Given their influential position, they are also credible knowledge providers regarding policy design and which levels of policy-making should tackle an issue. Thus, political actors are expected to agree with powerful actors

> ***Hypothesis 2b:*** *Actors tend to agree with influential actors on policy design in a given policy process.*

Former collaboration and joint venues: The role of mutual knowledge

Political actors may rely on actors they know from former policy processes. Policy network scholars emphasize the role of trust and mutual knowledge (Berardo 2009; Cook et al. 2005; Leach and Sabatier 2005; Lubell 2007) as well as venues and institutional opportunity structures (Leifeld and Schneider 2012; Fischer and Sciarini 2015a) for policymaking. We take into account two factors which contribute to mutual knowledge between actors, and provide them with opportunities to find an agreement on their policy positions: actors can develop mutual knowledge and a joint understanding of how to best solve a problem from former collaboration in other policy processes (Ingold and Metz 2015); and, venues of the policy process create institutional opportunity structures for actors to develop contacts (Leifeld and Schneider 2012; Williamson 1991; Sabatier and Weible 2007a). Joint

participation in venues, such as consultation procedures or working groups, facilitate communication and allows actors find agreement on their policy positions.

Hypothesis 3a: *Two actors who have collaborated before tend to agree on policy design in a given policy process.*

Hypothesis 3b: *Two actors participating in the same venues tend to agree on policy design in a given policy process.*

Cases

We focus on a new issue on the political agenda: the exploitation of unconventional gas resources using the technology of hydraulic fracturing ('fracking'). Some might consider the whole issue as 'semi-new' since energy companies have engaged in unconventional means to access minerals for decades. Further, there are policy subsystems very closely related to unconventional gas exploitation where actors already have well-established beliefs and shared action among each other. Such related areas might include energy production, fossil fuels, and climate change. Yet, fracking should be considered as an own, nascent subsystem, for the following reasons: first, there are almost no final policy outputs. For instance in the Swiss case, forms of state intervention are discussed (such as introducing fracking moratoriums or bans), but there is no final decision, or the final decision was implicitly postponed (moratorium). Furthermore, and in both countries, the appropriate levels of decision-making are still under discussion: while in the UK, decision-making concerning unconventional gas exploitation took place mostly at the national level, some regional policymaking might still happen. The opposite is the case in Switzerland (see also below). Second, and related to the potential new policy outputs, beliefs (secondary aspects and policy core beliefs) are highly diverse and include, for instance, considerations about energy self-sufficiency or land use change, but also water or air quality issues (related to the fracking liquids and horizontal

drilling techniques; very specific to unconventional gas development using hydraulic fracturing methods). The third evidence for a nascent subsystem is provided by the presence of some actors that started to specialize in this policy area. In the UK, green NGOs or neighborhood associations (FrackOff, No Hot Air) as well as administrative entities (OUGO) were created. In Switzerland, mostly neighborhood associations are specialized on the issue (Collectif Val-de-Travers; see section below and Appendix I for the actors' lists).and are specialized in this issue.

Our empirical analysis compares two sub-national entities in Switzerland (CH) and national policy-making in the UK. This case selection covers different institutional contexts and policy-making situations (see Table 1). First, in comparative politics, the UK most often represents the classic 'Westminster model', stressing the 'majoritarian' nature of policymaking; whereas Switzerland is an ideal-typical consensus democracy (Lijphart 1999). Second, the British government structure can be classified as unitary, whereas Switzerland is a federalist country where responsibilities are organized according to the subsidiarity principle in most policy sectors. Yet, in both countries, hydraulic fracturing regulations are produced in a multi-level setting including the national as well as regional and local entities. In Swiss federalism, sub-national authorities hold mineral rights and decisional power about gas resources. Cantons have the competence to distribute exploration, site development and exploitation concessions to third parties. The protection of drinking water and ecosystems is regulated by national law. Constructions potentially harming natural resources, ecosystems and the environment have to be evaluated by an Environmental Impact Assessment. This assessment is also one of the basic principles sub-national authorities use in their evaluation of a concession request. In the UK, central government shares responsibility for environmental policy with the EU, and delegates planning decisions to devolved and local governments (Cairney 2015; Cairney et al. 2016). Still, the central state decides on the major elements of unconventional gas exploitation policies such as energy policy/security,

taxation/mineral rights, and the license for private companies to drill. We thus cover countries where the main competence for regulation lies at the central level (UK) and at the regional level (CH).

Third, there is a difference in the degree to which unconventional gas development is regulated in both countries, and between the two Swiss cases. Both Swiss cases represent very restrictive policy outputs (moratorium and ban). In the canton of *Neuchâtel*, a gas company had preliminary negotiations with the canton about a potential exploration concession. The planned drilling site in Val-de-Travers induced public opposition in the form of protestation rallies, public campaigns and parliamentary initiatives. As a consequence, a moratorium for ten years was installed in 2014 on all gas exploration and exploitation. In the canton of *Bern*, no concrete project of hydraulic fracturing is planned. Still, a parliamentary initiative asked for the opinion of the cantonal government on hydraulic fracturing. Further, the cantonal Green party and environmental organizations started a popular initiative to legally ban hydraulic fracturing in Bern. The initiative was successfully submitted in 2014. At the same time, a parliamentary motion asked the government to act, and the latter plans to introduce a ban in the next revision of the respective law.[2]

The UK government has produced a series of decisions which can be interpreted as a tentative pro-fracking position (Decc 2012; Cairney et al. 2016). It provides the conditions for private companies to decide how viable their projects are, when subject to government taxation, and planning and environmental regulations (White et al. 2014). Further, the central UK government promises tax breaks on capital investment and government compensation to local areas. Before being able to start a project, companies need to have licenses from DECC and multiple public bodies (such as the Environmental Agency) and planning consent from devolved and local areas. Several protest events at the local level complicate the implementation of planned projects. Overall, still, policy outputs rather point towards a more permissive and liberal solution in the UK, and more restrictive policies in Switzerland.

Table 1 summarizes the differences between the cases under study. Our case selection allows us to investigate whether the specific dynamics of nascent subsystems are valid in different institutional and policy contexts. If results from our analysis hold in all cases, we can be confident that the observed effects are at work independently of the specific institutional or policy-making context. If results differ between cases, this will be discussed in the light of the differences presented above. However, given that we are unable to control for all potential context differences, we refrain from formulating explicit hypotheses on the influence of these context conditions.

Additionally, the last rows of Table 1 present the number of actors in the respective policy networks, and the average value of the dependent variable, i.e. policy agreement. It shows that on average, across all actor-actor dyads, policy agreement is highest in Neuchâtel and lowest in the UK (last line).

--- Table 1 about here ---

Data and methods

For all three cases, data on dependent and independent variables stem from surveys sent electronically in summer (UK) and winter (Switzerland) 2014. Response rates were satisfactory, reaching 53% in the UK, 65% in Neuchâtel, and 48% in Bern. To identify survey partners, we first identified all relevant actors participating in the respective policy process. Instead of individuals, modern policymaking and policy design is shaped by collective actors and organizations (Knoke 1993; Laumann and Knoke 1987). Collective actors dispose of resources such as knowledge, money, personnel or information which allows them to impact decision-making (Henning 2009; Stokman and Zeggelink 1996). Based on the traditional combination of decisional, positional and reputational approaches (Knoke 1993), we created an actors' list for each case. More specifically, we first identified actors holding formal

competences in decision-making on fracking regulation (positional), based on our knowledge of the respective political systems, and document analysis. Second, we identified the venues of the three decision-making processes[3] and retained those actors who participated in these venues (decisional). Survey respondents were then asked to add additional relevant actors (reputational). Overall, 34 actors in the UK, 30 in Neuchâtel, and 23 in Bern were retained for analysis, representing private and public entities such as municipal representatives, administrative agencies, green NGOs, universities, or industry associations (for a full list of actors and actor types, please consult Supplementary Online Material, Appendix I).

The dependent variable of our analysis consists of actors' agreement on policy design regarding unconventional gas extraction through hydraulic fracturing. In the survey, we asked actors to indicate which other actors (from the list mentioned above) they agree or disagree with about policy measures to be taken for the regulation of unconventional gas development.[4] In case actors did not know whether they agree or disagree with another actor, they indicated nothing. We used this data to create a network of policy agreement with values of 1 for the presence and of 0 for the absence of policy agreement (i.e. neutral relation o disagreement) between two actors[5].

Independent variables for testing hypotheses 1a and 1b are simple categorical variables for actors. We coded each actor according to different types. First, we attributed a level (national or regional) to each actor. Second, we coded left political parties and environmental groups as having left-green ideologies, whereas right-wing parties as well as business and industry representatives were coded as having right-economic beliefs. Third, for the test of hypothesis 2a, we coded actors as being scientific actors or not.

The other independent variables stem from data gathered through our survey. First, to assess the power of actors (hypothesis 2b), we rely on the measure of reputational power (Knoke 1996; Fischer and Sciarini 2015b). Based on the same list of actors as the dependent variable, we asked survey participants to indicate whether they consider the other actors on

the list as being very important in decision-making on unconventional gas development (in which case we attributed a value of 1 to the respective actors). The power of an actor corresponds to the number of times an actor was mentioned as being powerful, over all answers. Given that reputational power is based on the average perception of all other actors in the respective decision-making process, it is supposed to encompass many different aspects and sources of power. Finally, drawing on the same list of actors, we asked survey partners to indicate with whom they strongly collaborated in other, former policy processes. This results in a network of actors where a tie (1) represents past collaboration, whereas the absence of a tie (0) represents no former collaboration.

Second, we identified all venues and phases of the respective policy process under investigation. We asked survey participants to indicate which process venues their organization participated in. Based on this information, we created a 2-mode actor-venue matrix that was subsequently transformed in a valued one-mode actor-actor matrix, where the strength of a tie between two actors indicates in how many venues two actors jointly participated. We use these variables to test hypotheses 3a and 3b.

Exponential random graph models (ERGM)

We estimate Exponential Random Graph Models (ERGM, Robins et al. 2007) to evaluate the factors that account for policy agreement between two actors. With network data, such as our data on actors' policy agreement, the usual assumption of statistical models on the independence of observations is inappropriate. The assumption that agreement between actors *i* and *j* is totally independent on other agreement ties that actors *i* or *j* have with other actors in the network is unrealistic. The probability that two actors agree rather depends, at least partly, upon the structural properties of the agreement network in which the two actors are embedded. Contrary to usual statistical models, ERGMs allow for statistical inference on network data (for applications in political science, see, e.g., Cranmer and Desmarais 2011;

Leifeld and Schneider 2012; Gerber et al. 2013). Because error terms would be correlated across observations, standard regression models would erroneously attribute explanatory power to other independent variables, instead of attributing them to endogenous network structures (Cranmer and Desmarais 2011; Leifeld and Schneider 2012).

The dependent variable of an ERGM is the whole network as a one observation (Cranmer and Desmarais 2011). The whole dependent network is then modeled as a function of actor-level variables (node covariates), dyadic variables (edge covariates), and endogenous network structures. The latter refer to effects of network structures on the network itself. These effects are important to control for in any type of network model, as observations in a network are – per definition – non-independent from each other (see above). It is thus possible that a tie in a network is formed simply because of the existence of other adjacent ties. An example is actors' tendency to reciprocate ties or to collaborate with actors to which they are already indirectly connected. Not taking endogenous network structures into account would lead to an overestimation of the weight of exogenous parameters, that is, node or edge covariates.

An ERGM then calculates the probability of observing the network defined as dependent variable, over all the configurations that could exist in the network in question. Yet, given the very high number of possible network configurations, computing the exact maximum likelihood is impossible (Cranmer and Desmarais 2011). ERGMs are therefore estimated based on Markov Chain Monte Carlo Maximum Likelihood (MCMC-MLE). MCMC-MLE approximates the exact likelihood as it relies on a sample of possible networks to estimate the parameters (Cranmer and Desmarais 2011).[6] This iterative optimization proceeds until differences between the coefficients from the observed network and the average coefficients from the sample of simulated networks are no longer significant (p greater than 0.05) (Cranmer and Desmarais 2011).

Results

Results from the Exponential Random Graph Models are presented in Table 2. Models for the three cases are the same, with two exceptions: given actors all belong to the central level in the UK case, we are unable to test hypothesis 1b on level homophily for the UK. As there is only one scientific actor in Bern and Neuchâtel, respectively, we refrain from including the respective variable and testing this hypothesis for the Swiss cases.[7]

--- Table 2 about here ---

To control for endogenous network structures, we include a reciprocity parameter as well as two indicators (GWESP and GWDSP) which account for transitive triangular structures among actors. Reciprocity represents the situation when actor *a* indicates agreement with actor *b*, and actor *b* confirms agreement with actor *a*, independently of any exogenous node or edge covariates. In many types of networks, but more so in networks of policy agreement, one would expect to observe such effects of reciprocity. There is however no reciprocity present in the network of actors' agreement on policy, which lends support to our basic claim that this is a new issue dealt with in a nascent subsystem, and that actors are uncertain with respect to the policy preferences of other actors. The interpretation of the transitive triangular structures further supports this view. The GWDSP (geometrically weighted dyadwise shared partner) captures the tendency of a pair of actors (collaborating or not) to have a shared collaboration partner (corresponding to either open or closed triangles), whereas the GWESP (geometrically weighted edgewise shared partner) measures whether two actors that collaborate do have shared partners (corresponding to closed triangles).[8] Both effects are only based on the network itself, that is, exogenous node or edge covariates do not play a role in these mechanisms.

Joint assessment of the GWDSP (negative, i.e. negative tendency for any two actors to both agree with any third actor) and GWESP (positive, i.e. positive tendency for two actors who agree with a given third actor to also agree among themselves) parameters indicate the presence of transitivity in the network. As with the absence of reciprocity, this result suggests that the network of actors agreement on policies to deal with the new issue of hydraulic fracturing has a hierarchical structure, that is, network ties of policy agreement tend to point in one direction only. Actors appear to have a hard time recognizing the many different potential policy solutions, the respective preferences of their fellow actors, as well as their potential allies (Fink and Harms 2012; Krishnan et al. 2006; Beverwijk et al. 2008).

Ideological homophily matters in two out of three cases, and for left-green actors only. In the UK and Neuchâtel, actors with left-green beliefs agree on policies to address hydraulic fracturing. This is not the case in Bern. There is also no specific agreement between actors with right-economic ideologies. Actors with a right-conservative background and economic interests do not agree on policy measures to address hydraulic fracturing in any of the cases. There is also no tendency of actors to agree with others on their same level of decision-making. This hypothesis was tested for the cases in federalist Switzerland only, but the multi-level structure of the policy does not seem to play a role with respect to policy agreement among actors. Furthermore, we observe no specific effect with respect to scientific actors, but others tend to agree with powerful actors in the UK and Bern cases, but not in Neuchâtel. If actors collaborated in former policy processes on similar issues, they tend to agree on measures to address hydraulic fracturing. This effect appears in all three cases. Joint venue participation, however, leads to policy agreement only in the UK and in the canton of Neuchâtel, but not in the case of Bern.

Discussion

Different types of homophily, leadership, and mutual knowledge have been shown to matter in mature subsystems, but is this is true in nascent subsystems? Our empirical analysis allows us to understand which factors could explain whether or not actors agree with respect to policy design in nascent subsystems. If results are not consistent across the three different institutional and policy contexts, this means that dynamics of actors' agreement in nascent policy subsystems are not independent of the specific context. In this case, we aim to account for these differences by pointing to institutional and/or case-related differences.

First, we hypothesized that actors with the same ideological core beliefs (left-green, right-economic) or from the same decision-making level (regional or national) agree on policies to address hydraulic fracturing. First, there is only weak support for our hypothesis 1a on belief homophily. Only actors with the same left-green beliefs tend to agree on policy design, and this is true in two cases only. On closer inspection, it appears that the left-green actors mostly agree on their opposition to specific drilling projects. Left-green actors agree in the cases of the UK and the Swiss canton of Neuchâtel, but not in Bern. The lack of a concrete fracking project in the canton of Bern, as opposed to the other cases, could explain a lack of agreement on the left-green side of the political spectrum. Opposing a specific policy project is a rather simple type of agreement. Opposition to specific projects represents a one-dimensional preference. On the contrary, agreeing on more complex types of policy designs in a policy debate unrelated to a concrete project, as is the case of Bern, seems more complicated.

Also, actors from the right realm and economic interests defend more fragmented and nuanced positions. First, while some of them want to allow or even promote projects of hydraulic fracturing, others are more skeptical. They are not explicitly in favor of hydraulic fracturing, recognize the potential risks for the environment and public health, and want to introduce legislation which takes these risks into account, but are against a ban or moratorium on the technology. Second, some firms dealing with conventional gas extraction are skeptical

because they are afraid of getting affected by the negative image of hydraulic fracturing.[9] Third, actors tentatively in favor of hydraulic fracturing potentially benefit from the former status quo, which in all three cases does not explicitly ban the technology. Contrary to left-ecological interests, to actively fight for a moratorium or ban, the status quo policy (i.e. no ban, no moratorium) is closer to right-economic ideologies on this issue. The lack of right-economic ideological homophily is thus also due to the uncertainty of the respective actors on whether active engagement in a policy process was necessary to defend their preferences. Overall, although given the weak support, we tend to reject hypothesis 1b.

Hypothesis 1b on level homophily could only be tested in the federalist setting of Switzerland, and has to be rejected. There is no homophily with respect to decision-making level, which means that the question of hydraulic fracturing does not give place to a conflict between decision-making levels in Switzerland.

Second, we expected actors to agree with scientific actors, as well as actors with a high influence reputation. Hypothesis 2a on scientific actors has to be rejected, as there is no specific effect for scientific actors in the case of the UK. Indeed, also scientific research is affected by the fact that hydraulic fracturing is a relatively new issue, and scientists disagree among them on several issues (Wagner 2015; Stevens 2010). It seems that in nascent subsystems, scientific actors also suffer from uncertainties, and are thus not the opinion leaders one would expect based on their in-depth knowledge of a given issue. By contrast, we have evidence in support of hypothesis 2b in two out of three cases. Powerful actors seem to act as opinion leaders in Bern as well as in the UK, but not in Neuchâtel. In this specific case, two of the most powerful actors were the cantonal government and the Department of Spatial Development and the Environment, which before the moratorium were negotiating with potentially interested firms. This hybrid position has probably led to a lack of confidence of other actors in these leading actors, and thus to disagreement with these powerful actors in the case of Neuchâtel.

Third, model results support our hypotheses 3a and 3b based on arguments about actors' mutual knowledge. If actors previously collaborated with each other in another policy process on similar issues, or if they participated in the same venues of the policy process, they agree on policies to regulate hydraulic fracturing.[10] Both factors allow actors to know about their mutual positions, and thus to enhance knowledge with respect to the preferences of other actors. With the exception of the Bern case (where participating in the same venue has no significant effect), former collaboration and joint venue participation enhances policy agreement in all cases. Again, a specificity of the Bern case could account for the fact that joint venue participation does not matter in this process: contrary to the UK and the canton of Neuchâtel, there was no concrete project of gas extraction (using hydraulic fracturing) planned in Bern. Venues dealt mainly with political aspects, but no specific aspect of a concrete project were discussed. In such a situation it seems to be more complicated for actors to develop a policy agreement, especially in a nascent situation.

Conclusion

This paper investigated the drivers of actors' agreement in nascent subsystems with respect to policy design related to the new issue of hydraulic fracturing. Whereas the literature outlines different drivers for actors' interaction in well-developed policy subsystems, we know much less about factors influencing policy agreement in nascent situations. We argue that, especially in nascent subsystems, actors have a hard time to know who to agree with, given the fragmented or fluid nature of beliefs at this stage (Stritch 2015; Sabatier and Jenkins-Smith 1999). Based on the literature on mature policy networks and subsystems, we analyzed whether homophily, leadership, and/or mutual knowledge were relevant drivers for actors' policy agreement in nascent subsystems, too. To test these arguments, we investigated three cases, which differ according to the specific institutional and policy-related context: two sub-national units in consensual Switzerland and one national political decision-making process

about hydraulic fracturing policies in the majoritarian UK. We examined our hypotheses based on results of Exponential Random Graph Models (ERGM). Our approach is novel as we do not study mature and consolidated, but nascent coordination among actors by assessing policy agreement.

First, and independently of the hypotheses, the endogenous structure of the network of policy agreement supports the basic assumption that actors have difficulties to identify ideological peers when dealing with new policy issues in nascent subsystems. They are unaware of other actors' preferences on hydraulic fracturing politics. Ties of agreement point thus mainly in one direction, and are not reciprocated among actors.

As hypothesized, actors' agreement on policy design in nascent subsystems has unusual elements. While we tested factors which usually also matter in mature subsystems, results point towards specific effects in nascent situations. Whereas ideological homophily or power constellations shape actors' interactions in mature subsystems (Fischer and Sciarini 2015a; Calanni et al. 2014; Ingold and Fischer 2014), trust and former contacts are most important in shaping the network of policy agreement in a nascent subsystem (see also Berardo 2009). The three cases confirm that in nascent subsystems, and when dealing with an issue which only recently entered the political agenda, actors' policy preferences and beliefs are not yet well defined. Actors in all three cases, and mainly pro-economy representatives, were unsure about which other actors to agree with, with the exception of those actors they know from previous processes or venue co-participation. Instead of mature advocacy coalitions including like-minded members engaging in a non-trivial degree of within and across-coalition coordination (Henry 2011; Sabatier and Weible 2005), nascent subsystems are influenced by "coalitions of convenience" (Cairney et al. 2016) or "advocacy communities" (Stritch 2015). In such situations, actors show some policy agreement with others, but do not yet form stable coalitions with ideologically similar others.

Differences between the three cases could mostly be attributed to the status of concrete drilling projects of hydraulic fracturing. On the contrary, we have no indication that the larger institutional context, such as the type of democracy or the level of decision-making, have an influence on the variables which explain policy agreement on the micro-level between two actors.

What does this mean for the design of policy processes in nascent subsystems? First, focusing on earlier processes, and adopting a long-term perspective on policy-making in a given subsystem or issue area, seems important. Second, providing political actors with opportunities to exchange ideas and get to know each other in venues such as roundtables or policy committees seems to be beneficial to policy agreement and the formation of stable coalitions. Future research should thus shed further light on the causal mechanisms between such opportunities of actors to exchange and increase mutual knowledge, policy agreement (on the process level), and the timeline, efficiency and effectiveness of policy introduction (output level). This study consists of a first step in doing so, by focusing on early stage of actors' coordination, assessing policy agreement in a nascent context.

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Table 1: Institutional setting and policy outputs in Switzerland and the UK

	UK	**Switzerland**	
		Neuchâtel	**Bern**
Type of democracy	Majoritarian	Consensus	
Government structure	Unitary	Federalist	
Jurisdictional level dealing with hydraulic fracturing	Central state, some competences at subnational levels	Sub-national, some competences at central level	
Policy design regulation hydraulic fracturing	No clear policy output, regional moratoriums	Moratorium on conventional and unconventional gas extraction	Ban on hydraulic fracturing
Actual gas extraction project	Yes	Yes	No
Number of actors included	34	30	23
Average agreement	0.13	0.19	0.14

Table 2: ERGM results

	UK	**Neuchâtel**	**Bern**
Edges	**-3.04**	**-3.60**	**-3.84**
	(0.31)	**(0.42)**	**(0.63)**
Reciprocity	-0.48	0.03	0.88
	(0.54)	(0.36)	(0.45)
GWDSP	**-0.61**	**-0.37**	**-0.46**
	(0.07)	**(0.05)**	**(0.10)**
GWESP	**2.08**	**1.67**	**1.29**
	(0.22)	**(0.26)**	**(0.33)**
Left-Green match	**0.42**	**0.48**	0.02
	(0.15)	**(0.18)**	(0.29)
Right-Economic match	0.04	0.36	-0.90
	(0.18)	(0.20)	(0.28)
Level match	-	0.19	0.87
	-	(0.19)	(0.45)
Science incoming	0.07	-	-
	(0.12)	-	-
Power incoming	**0.88**	0.45	**2.60**
	(0.35)	(0.46)	**(0.90)**
Former collaboration	**0.44**	**1.14**	**1.16**
	(0.15)	**(0.20)**	**(0.30)**
Joint venue participation	**0.11**	**0.42**	0.00
	(0.03)	**(0.07)**	(0.08)
AIC	584.4	554	253.3
BIC	634.6	601.7	295.6

Figures in bold indicate statistical significance at a level of $p \leq 0.05$

Supplementary Material: Actors' List UK

Actors in bold answered the survey.

Actor Acronym	Full actor name	Category 1= Political; 2= Industry; 3= NGO; 4= Research
BGS	**British Geological Survey**	4
CABINET	Cabinet	1
CAMPAIGNRE	**Campaign to protect Rural England**	3
CENTRICA	Centrica	2
CHATHAM	Chatham House	4
CIA	Chemical Industries Association (CIA)	2
CNG	**CNG Services Ltd.**	4
CONSERV	**Conservative party**	1
CUADRILLA	**Cuadrilla Resources Holding Ltd**	2
DECC	**Department of Energy and Climate Change (DECC)**	1
ECCCOMMITTEE	**Energy and Climate Change Committee of HoC**	1
ENVAGENCY	Environment Agency	1
FRACKOFF	Frack off	3
FRIENDS	**Friends of the Earth**	3
GEOLSOCIETY	Geological Society	4
GFRAC	Gfrac technologies	4
GREEN	Green party	1
HSE	Health and Safety Executive	1
IGAS	**IGas Energy**	2
LABOUR	Labour party	1
LIBERAL	Liberal Democrats	1
NATIONAL	**National Grid**	2
NO HOT AIR	**No Hot Air**	3
OUGO	**Office of Unconventional Gas and Oil (OUGO)**	1
OILGASUK	Oil & Gas UK	2
POLICY	**Policy Exchange**	4
SHELL	**Shell international Ltd.**	2
ROYALACADEMY	The Royal Academy of Engineering	4
ROYAL SOCIETY	The Royal Society	4
TOTAL	TOTAL	2
TYNDALL	**Tyndall Centre Manchester**	4
UKERC	**UK Energy Research Centre (UKERC)**	4
UKOOG	United Kingdom Onshore Operators Group (UKOOG)	2
WWF	**WWF UK**	3

Supplementary Material: Actors' List Neuchâtel

Actor Acronym	Full actor name	Category 1= Political; 2= Industry; 3= NGO; 4= Research
AAFR	**Friends of Farm Roberts Association**	3
ARE	**Federal Office for Spatial Development**	1
BAFU	Federal Office for the Environment	1
CC CdF	**City Council of Chaux-de-Fonds**	1
CC VdT	**City Council Val-de-Travers**	1
CC VNE	City Council of Neuchâtel	1
CE	**Celtique Energie Ltd.**	2
CONE	Cantonal Government Neuchâtel	1
CVdT	**Collectif Val-de-Travers**	3
DDTE	**Department of spatial development and the environment**	1
DEAS	Department of economy and social activity	1
ECOFORUM	**Umbrella organization for the Protection of the Natural Heritage of Neuchâtel**	3
GC	Cantonal Parliament Neuchâtel	1
GREP	**Greenpeace Neuchâtel**	3
PDC	**Christian Democratic People's Party**	1
PLR	**FDP. The Liberals**	1
PS	**Social Democratic Party**	1
POP	**Swiss Party of Labour**	1
PRNA	**Pro Natura Neuchâtel**	3
SCAV	**Cantonal office of consumption and veterinary**	1
SENE	Cantonal office of energy and environment	1
SPBA	Fishers Society of Basse-Areuse	3
SS	**Solidarity**	1
SWTP	**Federal Office of Topography Swisstopo**	1
UDC	**Swiss People's Party**	1
UNINE	Neuchâtel University	4
VERT	**Green Party**	1
VL	**Green Liberal Party**	1
WWF	**WWF Neuchâtel**	1

Actors in bold answered the survey.

Supplementary Material: Actors' List Bern

Actor Acronym	Full actor name	Category 1= Political; 2= Industry; 3= NGO; 4= Research
AWA	**Cantonal Water and Waste Authority**	1
ARE	**Federal Office for Spatial Development**	1
BAFU	Federal Office for the Environment	1
BDP	**Bourgeois Democratic Party**	1
BVE	Department of Construction, Transport and Energy of the Canton of Berne	1
CVP	**Christian Democratic People's Party**	1
EVP	**Evangelical People's Party**	1
EWB	**Utility company Energy Water Berne**	1
FDP	**FDP. The Liberals**	1
GEOEN	**Geo Energy Switzerland**	4
GEOEX	Geo Explorers Ltd	2
GLP	**Green Liberal Party**	1
GP	**Green Party**	1
GREP	**Greenpeace regional group Berne**	3
PRNA	**Pro Natura Bern**	3
RAPP	**Municipality Rapperswil BE**	1
SEAG	**SEAG. Company for Swiss oil and gas**	2
SP	**Social Democratic Party**	1
STML	**Stadtholder Agency Mittelland**	2
SVP	**Swiss People's Party SVP**	1
SWTP	**Federal Office of Topography swisstopo**	1
THUN	**City Thun**	1
WWF	**WWF Bern**	3

Actors in bold answered the survey.

Endnotes

[1] One exception may be trades unions, which are often left wing on social and economic policies but might support economic activities that benefit their members. In fracking, we generally find that trades unions prioritize health and safety and local environmental concerns over economic potential.

[2] From the 26 Swiss cantons, there is a potential for unconventional gas extraction in only 6, and only in three, Neuchâtel, Bern and Vaud, regulatory action and related policy processes were taking place. We excluded the canton of Vaud from this analysis, given that a) we did not want to include two cases (besides Neuchâtel) from the French speaking part of Switzerland, which represents only about a fourth of the Swiss population, and b) the policy process was still ongoing when data was gathered and the policy output still under debate, resulting in a low response rate (below 50%) for this canton. We still ran the same model with the Vaud data, and results are the same as in Neuchâtel, without the Left-Green match.

[3] For example, in the case of Neuchâtel, venues consisted of a formal request for an exploration concession by a private oil and gas company to the cantonal administration; or a parliamentary interpellation by a cantonal MP; or a public mobilization against fracking organized by some parties and green NGOs.

[4] The introduction of the survey included a statement about the nature of the policymaking process, the respective time period, the topics that were negotiated and the measures of fracking regulation that were discussed. Furthermore, the current status quo was also outlined, and c exploitation concessions, concessions for site development, exploration concessions, moratoriums, or bans were presented to actors as possible measures. All these elements should make sure that actors had the same decision-making process and the same possible measures about how to regulate fracking or not in their region in mind when answering the questions.

[5] The exact survey question is illustrated here with the example of Neuchâtel: "Please check all actors (*see list in Appendix I)* with whom your organization mainly agreed upon policy measures to be taken to regulate hydraulic fracturing in the canton of Neuchâtel (second column). In a next step, please indicate all actors with whom your organization mainly disagreed about policy measures to be taken to regulate hydraulic fracturing in the canton of Neuchâtel (third column). If there are actors missing, please add them to the bottom of the list and indicate if your organization agreed / disagreed with them."

[6] The MCMC algorithm proceeds as follows: in a given optimization iteration, the sum in the denominator of the likelihood function is approximated using a series of networks sampled from the distribution parameterized with those parameters that maximized the likelihood using the previous sample of networks.

[7] Note that a model with additional model terms (cyclical triplets, powerful actors outgoing ties, scientific actors outgoing ties) yields the substantively same results. Results are also robust to the inclusion of variables measuring information exchange between actors. Information exchange and policy agreement between two actors correlate (whereas the direction of causality is open to discussion), but the other effects in the models are not affected. Taking out the endogenous parameters and / or the former collaboration parameter out yields the substantially same results in the UK and the Bern case, but affects the other parameters in the Neuchâtel case (i.e. power and level homophily matter instead of ideological homophily).

[8] A low geometrical weighting parameter of 0.1 for both parameters means that two actors are unlikely to have a lot of shared partners and avoids model degeneracy (Leifeld and Schneider 2012; Goodreau et al. 2008; Morris et al. 2008).

[9] This reason was mentioned by several economic actors, and some of them even refused to fill in the survey due to this very reason.

[10] If we use a more restrictive criteria for assessing former collaboration, that is, only *reciprocated* former collaboration, the respective parameter is no longer significant in the case of the UK.