Impacts of Market Liberalization on Regulatory Network: A Longitudinal Analysis of the Swiss Telecommunications Sector

Manuel Fischer, Karin Ingold, Pascal Sciarini, and Frédéric Varone

This article looks at the reconfiguration of the regulatory actors’ network, as induced by the liberalization and reregulation processes in utility sectors. It investigates the changes in governance structures and patterns of collaborative ties between actors resulting from these processes. Applying stochastic actor-oriented modeling (SAOM) to data on the liberalization of the Swiss telecommunications sector over two decades, we test whether and to what extent structural changes driven by liberalization and reregulation express themselves through network effects, that is, through changing patterns of interactions between political authorities, regulators, regulatees, and interest groups. Our empirical tests highlight a rearrangement of the regulatory network and a reorganization of relational patterns around new actors, such as the sector-specific regulatory agency, coregulators, and new operators.

KEY WORDS: social network analysis, stochastic actor-oriented modeling, liberalization, regulation, telecommunications

Introduction

During the last three decades, Western countries have undergone major reforms toward the liberalization (i.e., opening to market competition), privatization (i.e., private ownership of incumbent), and reregulation (i.e., creation of independent and sector-specific regulatory agencies) of what were formerly public monopolies in utility sectors such as telecommunications, postal services, electricity and gas, railways, and civil aviation (Henisz, Zelner, & Guillén, 2005; Jordana, Levi-Faur, & Fernandez i Marin, 2011; Simmons & Elkins, 2009). In the European context, these reforms resulted in a rearrangement of the regulatory framework; that is, a reshaping of collaborative ties between public and private actors and various levels of government (Coen & Thatcher, 2007; Majone, 1997; Thatcher & Coen, 2008).

According to the governance and regulation literature, liberalization and reregulation may lead to several structural changes. In this article, we focus on three structural changes. First, the liberalization and reregulation processes which result in a dispersion within the regulatory network. Second, the creation and empowerment of
new actors only involved after the sector’s liberalization (e.g., sector-specific regulatory agency, operators in competition with incumbent). These new actors, holding a strategic position in the regulatory network, strongly influence the collaboration structure as they tend to attract ties from others. Third, changes in competence allocation lead to more horizontal and nonhierarchical governance structures.

Against this background, the aim of our article is to look at the changes in governance structures and patterns of collaborative ties between actors, resulting from the liberalization and reregulation processes. As outlined in the introduction to this special issue (see Lubell, Scholz, Berardo, & Robins, 2012), we thus investigate the network as a meso-level concept and address the impact of macro-level political institutions and processes (liberalization and reregulation) on its configuration. Empirically, we apply tools from social network analysis (SNA) to a longitudinal study of the Swiss telecommunications sector, a sector that has been gradually liberalized since the early 1990s. We test whether and to what extent the three structural changes mentioned above express themselves through network effects, that is, through changing patterns of interactions between political authorities traditionally involved in decision making (e.g., government, parliamentary committees), implementers of the new regulatory framework (e.g., the newly created sector-specific agency, the competition agency, and the preexisting judicial courts), regulatees (e.g., incumbent operator and new competitors), and interest groups (e.g., business, trade unions, and consumers). To that end we particularly focus on these four actor categories, carrying out a longitudinal analysis of the collaboration data of the Swiss telecommunications sector gathered at three different points in time and covering 15 years (1995–2010). More specifically, we use a stochastic actor-oriented model (SAOM) to assess the impact of the three structural changes on the macro level described above on micro-level processes governing network formation (see Lubell et al., 2012). Our model includes various endogenous network effects, as well as exogenous node and dyadic covariate effects. Our results show that the global network density has decreased as a result of the liberalization and reregulation process. In comparison, collaboration has increased within and between specific groups of actors, toward new and powerful actors, and among actors with similar policy preferences.

This article is structured as follows. In the next section, we elaborate on the liberalization and regulation literature and discuss the impact of both the emergence of new actors and competence reconfiguration on the structural patterns of the reregulated sector. Based on concepts and measurements from SNA, we then hypothesize about the network effects that may result from the liberalization of a public utility sector. The next section introduces the reader to the evolution of the Swiss telecommunications policy over the last two decades, outlines our research design and longitudinal data gathering, and offers an introduction to SAOM for dynamic network studies. The following sections present and discuss the results in light of our hypotheses. In the conclusion we summarize our main results and emphasize the importance of a longitudinal and multi-level (actors, groups of actors, network) design to better grasp the transformation of a liberalized sector.
Theoretical Framework

The transformation of utility sectors from public monopolies to competitive markets may cause major structural changes in the configuration of actors. We discuss these likely changes in the next subsection. Based on SNA literature, we describe more specific relational effects that may arise over time from liberalization, privatization, and reregulation. From that we infer a series of hypotheses.

Structural Changes after Liberalization

Liberalization of utility sectors goes hand-in-hand with other processes such as privatization, reregulation, and a vertical and horizontal shift of competences (Thatcher & Coen, 2008). Each of these processes induces relational changes among actors involved in the regulatory framework.

Liberalization results in a sector previously dominated by a public monopoly opening up to market forces. The new competition rules bring in additional operators, including private actors and/or actors that are no longer restricted to the national boundaries. This leads to both a horizontal (multiplication of actors offering the same service, e.g., mobile phone, Internet connection) and a vertical (inclusion of actors belonging to different decisional levels, e.g., international private firms) dispersion within the group of regulatees (see also van Kersbergen & van Waarden, 2004, p. 155).

The privatization of the incumbent operator modifies the jurisdictional status of public enterprises: The former monopolist no longer (completely) belongs to the government. As a consequence, the role of the public authorities in the concerned sector is dramatically affected: the provision of the regulated services is now, at least partly, co-delivered by private actors (Finger & Varone, 2006; Genoud & Varone, 2002).

Finally, the liberalized sector is re-regulated. To prevent market failures, to foster market competition, and to guarantee the provision of public service obligations, new regulatory agencies acting independently from elected authorities are created: the so-called Independent Regulatory Agency (Gilardi, 2008; Jordana et al., 2011; Thatcher & Coen, 2008). They therefore act in a completely new regulatory framework in which competences and power are horizontally divided.

Overall, the structural rearrangement taking place during the liberalization process can best be described as a shift from traditional public monopoly and hierarchy—through public ownership of the incumbent—to a more independent regulation that introduces competition between (new) operators (Börzel & Risse, 2010, p. 116). The newly liberalized sector is located between strict hierarchical regulation and an extreme open-market system, and can therefore be labeled as a governance network (Mayntz & Scharpf, 1995; van Kersbergen & van Waarden, 2004), a task-specific regulation (Hooghe & Marks, 2003), or a negotiation system (Börzel & Risse, 2010).

Going one step further than this rather metaphorical definition of governance networks (see Adam & Kriesi, 2007; Dowding, 1995), we conduct a formal SNA of policy networks. Several scholars have highlighted the usefulness of such a formal
network analysis in studying the structure of policy processes in general (Fischer, Fischer, & Sciarini, 2009; Ingold, 2008; Knoke, Pappi, Broadbent, & Tsujinaka, 1996; Kriesi, 1980), and liberalization processes in particular (Fischer, Sciarini, & Nicolet, 2003; Sciarini, 1994). SNA helps to model the overall decision making and implementation structures and assists with locating single actors or groups of actors in these structures. Nodes in a policy network are individual or collective actors involved in policymaking, and ties constitute channels for influence, information, and collaboration flow—these are all relevant elements for the production and implementation of policy outputs. In this research, we focus on the particular policy network built of actors involved in the design and implementation of the new regulatory framework after the specific sector’s liberalization. Network boundaries are thus drawn around actors that have the appropriate institutional position or that intervene in the policy process in order to access decision making about and implementation of the new regulatory framework. More concretely, we concentrate on four specific actors’ groups that are directly involved in the reconfiguration of the liberalized sector: first, the political authorities responsible for lawmaking, whose role is predominantly restricted to setting the legal framework and defining its content; second, the group of regulators (i.e., courts, competition agency, and price oversight agencies) including the sector-specific regulatory agency, these being actors responsible for implementing the sector-specific law and taking regulatory decisions on a case-by-case basis; third, regulatees that are targeted and affected by legal and procedural decisions within the regulatory decisions; and finally, interest groups, such as trade unions, business federations, and consumer associations, actors defending particular interests during the formulation and implementation of rules.1

After liberalization, regulatory networks include public and private actors that interact sporadically (see Ansell & Gash, 2007) and competences and jurisdictions are more dispersed (Hooghe & Marks, 2003). These have developed as an alternative to both former hierarchical systems, where competences were bundled, actors limited, and relations controlled and restricted, and pure market competition, where interest group pluralism and managerial rules dominated (Ansell & Gash, 2007).

Building on the arguments presented above, we expect three major structural changes to occur after liberalization and reregulation (Magetti & Gilardi, 2010). A dispersion of the network due to shifts in competencies and the opening-up to market forces; an increased relational activity around the new actors of the field; and a dominance of horizontal and nonhierarchical relations between actors (see Table 1, first column).

Network Effects Driven by Liberalization: Research Hypotheses

As argued above, the processes of liberalization and reregulation lead to a division of tasks, competences, and regulatory powers among a large set of actors belonging to different decisional levels. In such larger networks characterized by horizontal governance, relations among actors become dispersed and scarce as it is harder for actors to maintain or build up a fair number of collaboration ties. In social
<table>
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<th>Expected Structural Changes</th>
<th>Hypotheses (H)</th>
<th>Related Network Effect</th>
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<tr>
<td>Network dispersion</td>
<td>H1: Liberalization and reregulation lead to a decrease, over time, of the overall density within the collaboration network.</td>
<td>Decrease in overall density</td>
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<td>Relational reorganization</td>
<td>Individual actors level</td>
<td>New actors' increase of out-degrees centrality</td>
<td>Activity effect (exogenous node-covariate effect)</td>
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<td>around new actors and</td>
<td>H2a: As a result of liberalization and reregulation, new actors have a higher propensity to have outgoing ties than old actors.</td>
<td>New actors' increase of in-degrees centrality</td>
<td>Popularity effect (exogenous node-covariate effect)</td>
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<td>dominance of horizontal,</td>
<td>H2b: As a result of liberalization and reregulation, actors have a higher propensity to send ties to new actors than to old actors.</td>
<td>Increase of in-degree centrality</td>
<td>Popularity effect (exogenous node-covariate effect)</td>
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<td>local, nonhierarchical</td>
<td>H3: As a result of liberalization and reregulation, powerful actors have a higher propensity to receive ties.</td>
<td>Increase of in-degree centrality</td>
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<td>structures</td>
<td>H4a: As a result of liberalization and reregulation, actors belonging to the same category have a higher propensity to create and reciprocate ties among each other.</td>
<td>Higher tie exchange among actors of same category (political authorities, regulators, regulatees, interest groups)</td>
<td>Exogenous node-covariate effect (same covariate effect)</td>
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<td>Group effect</td>
<td>H4b: As a result of liberalization and reregulation, particularly regulators and regulatees have a higher propensity to create and reciprocate between-group ties.</td>
<td>Higher tie exchange within categories of regulators and regulatees, respectively</td>
<td>Exogenous dyadic-covariate effect</td>
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<td>H5: As a result of liberalization and reregulation, actors that hold converging policy views have a higher propensity to create ties among each other.</td>
<td>Higher tie exchange among specific actor categories</td>
<td>Interaction between exogenous dyadic-covariate effect and reciprocity effect</td>
</tr>
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<td></td>
<td></td>
<td>Higher tie exchange among actors sharing same preferences</td>
<td>Exogenous dyadic-covariate effect</td>
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network analytical terms, we should thus observe a decrease in the number of collaboration ties between actors, that is, a lowering density of the network. Density is an index of the degree of dyadic connection in a population (Wasserman & Faust, 1994). For binary data, density is the ratio of the number of present ties divided by the number of possible dyadic connections in that given network. Deduced from that, our first hypothesis thus reads as follows:

Hypothesis 1: Liberalization and reregulation lead to a decrease, over time, of the overall density within the collaboration network.

Besides the dispersion of relations within the network, the second expected major change in the liberalized and reregulated network stems from the inclusion of new actors. Apart from the creation of the sector-specific regulator and a general shift of competences from elected authorities toward a single- or multi-entity of regulators (Cole & Banerjee, 2010), the emergence of new regulatees has various consequences on the network (Hypotheses 2 to 5).

First of all, we may expect that new actors tend to shape collaborative ties more than established actors. In the regulatory framework, new actors have to build up collaborative ties to execute new tasks attributed to them (as regulators typically do) or to respond to and fulfill regulatory standards (e.g., regulatees), whereas established actors can rely on already created relations, but have the tendency to also relate to new actors (Genoud & Varone, 2002; Obermann, 1999). This would be seen both through a tendency of new actors to send collaboration ties to other actors, and a tendency of new actors to receive incoming ties. Our expectations regarding the in- and out-degree centrality (Freeman, 1979) thus lead to the following hypotheses:

Hypothesis 2a: As a result of liberalization and reregulation, new actors have a higher propensity to have outgoing ties than old actors.

Hypothesis 2b: As a result of liberalization and reregulation, actors have a higher propensity to send ties to new actors than to old actors.

Further, the structural changes arising from the liberalization and reregulation processes may not only result in the emergence of new actors, but may also cause a shift in the balance of power in the regulatory framework. On the one hand, actors suffering from a loss of competences as a consequence of liberalization may (potentially) experience a related decrease in power and influence. As a consequence, these actors become less attractive as potential collaboration partners. On the other hand, actors empowered by the regulatory changes are likely to become increasingly attractive as potential collaboration partners to other actors (power-dependency theory, see Henry, 2011; Stokman & Zeggelink, 1996; Weible, 2005; Weible & Sabatier, 2005). As a consequence of the reorganized sector and the dispersion of power and competences in a horizontal governance structure, new as well as established actors seek collaboration with the newly empowered actors in order to gain influence themselves. We thus expect powerful actors to occupy more central positions in the network. More specifically, powerful actors are expected have a tendency to receive more collaborative ties. Our third hypothesis thus reads as follows:
Hypothesis 3: As a result of liberalization and reregulation, powerful actors have a higher propensity to receive ties.

One of the most prominent concepts in SNA, and particularly interesting when studying a network over time, is reciprocity (Wasserman & Faust, 1994). More concretely, and even though we assume that the overall density of the liberalized network decreases over time (see Hypothesis 1), the decrease presumably does not hold for all actors, and we can observe accentuated tie creation and reciprocity on a local level. This can be explained as being related to the situation of liberalized utility sectors: In the former monopolistic situation, regulatory competences and the provision of services were integrated in one public entity (Finger & Varone, 2006). This situation did not involve a large range of actors, and there was only a small need for coordination of actors playing the same role within the concerned regulatory process. After the liberalization, this situation changed considerably, and we encountered a competitive fragmented network where actors belonging to the same category tended to organize themselves. The rationale for this is twofold. First, it intuitively makes sense to assume that actors playing the same role within a regulatory framework tend to exchange information, to share their experiences, and to coordinate their decisions. The opening of the sector to competition creates uncertainty about market actors’ behavior and the impact upon the market of regulatory decisions. For example, coregulators need to coordinate among themselves to reduce such uncertainties and to ensure the predictability and credibility of public regulation. Long-term commitments are absolutely essential for operators, who need to invest their resources in the liberalized sector (e.g., in expanding the telecommunication network) and to calculate their return on investment (Gilardi, 2008; Majone, 1997, pp. 139–40). Second, and more substantively, utility sectors are highly technical and raise a number of technological issues (e.g., innovations, technical rules, interoperability, and security), economic issues (e.g., regulation of access pricing and service tariffing), and judicial issues (e.g., fair competition, consumer protection, and public service obligations). They thus require a great deal of expertise and shared information among actors facing similar challenges.

Specifically, we expect a strong tendency toward the creation and reciprocation of collaboration ties for specific groups of actors, and this to be foremost among actors belonging to the same type or category of organizations (homophily, see, e.g., Goodreau, Kitts, & Morris, 2009). First, this holds for the category of regulators that also include the sector-specific regulatory agency: collaboration among these actors is imposed by the law, as for some decisions and procedures they hold joint regulatory competences. Furthermore, it may constitute an advantage for these actors to share knowledge and competences as it may reduce information asymmetry (typically about the real costs of service provision by operators) that could favor regulatees (Coen & Thatcher, 2005). Second, an increased collaboration might also be expected among the incumbent and newly arrived operators. Although they are in a competitive situation, when it comes to addressing regulatory standards, they may benefit from an increased collaboration to enhance harmonization, to discuss technical norms, and to coordinate market developments (Curien & Gensollen, 1990).
Hypothesis 4a: As a result of liberalization and reregulation, actors belonging to the same category have a higher propensity to create and reciprocate ties with each other. This should be particularly true for the categories of regulators and regulatees.

Aside from an increase in collaboration among functionally similar actors, we also expect more specific changes between the newly installed groups of regulatees and regulators. More specifically, we assume that these actors have a strong tendency to send collaborative ties, both within their category and toward actors of the other category. Again, there are several reasons for this expectation. First, the main sector-specific regulatory agency and the coregulators are supposed to be in close contact with each other for the implementation of the regulatory act, participatory rule-making, and reporting issues. Second, regulators tend to compensate for the information asymmetry they suffer vis-à-vis operators by developing close contacts with them. Operators, on their part, also tend to develop their relations with regulators as part of their capturing strategy (according to the seminal hypothesis of Stigler, 1971).

Hypothesis 4b: As a result of liberalization and reregulation, regulators and regulatees in particular have a higher propensity to create and reciprocate between-group ties.

Note that we do not expect a similar and symmetrical tendency for the other actors’ categories of the regulatory network, namely political authorities and interest groups. The argument supporting this choice is that the liberalization and reregulation process within utility sectors is not a vital issue for politicians and associative actors, who are also involved in other public policies. This is in sharp contrast with the situation of competing service providers and of the sector-specific regulatory agency: their respective existence or survival as organizations depending directly upon the evolution of the liberalized market.

Finally, we may also expect a very different network effect if we focus on the collaboration ties among actors holding similar policy preferences, even if these actors do not belong to the same actors’ group (as defined above). As outlined in the introduction to this special issue (Lubell et al., 2012), the advocacy coalition framework (ACF; Weible & Sabatier, 2005; Zafonte & Sabatier, 2004) is a particularly appropriate framework for the application of statistical models of networks. It assumes that actors sharing similar values and converging views with respect to policy proposals are likely to form advocacy coalitions and influence lawmaking and regulatory processes. The ACF sees a policy process as competition of coalitions holding divergent beliefs. Shared beliefs among members make coalitions hold together, and can be seen as a precondition for actors with shared policy preferences to coordinate their actions and build common strategies (Ingold, 2011). As a result of the tendency of actors to develop collaborations with other actors that agree on the policy design, one may witness the formation of coalitions composed of various types of actors jointly supporting a given form of liberalization or reregulation. For example, one could expect the formation of a proliberalization coalition composed notably by the sector-specific regulatory agency, new operators entering the market,
and the eligible consumers. On the opposite side, an antiliberalization coalition could potentially be composed of the incumbent operator, trade union representatives, and some left party authorities.

_Hypothesis 5: As a result of liberalization and reregulation, actors that hold converging policy views have a higher propensity to create ties with each other._

**Case, Data, and Method**

The reconfiguration of the network structures after the liberalization and within the reregulation process is illustrated here by the case of Swiss telecommunications policy. In Switzerland, the telecoms liberalization process follows the logic of “autonomous adaptation” to the regulations of the European Union (EU): a situation in which the country voluntarily adapts to the EU legislation without being formally required to do so (Sciarini, Fischer, & Nicolet, 2004).

Our analysis will be based on three of the most important periods of this process, from its beginnings in the 1990s up to the present day. First, in 1997, a major reform led to a full liberalization of the sector and to a partial privatization of the incumbent monopolist. This provided the legal basis for the interconnection between different suppliers of telecommunication services, and established the Communication Commission (ComCom) as the new independent regulatory agency of the policy domain (e.g., Fischer et al., 2003). Second, in 2006, a minor reform liberalized the last mile, for example, the connection between the local center and the homes. While less far-reaching than the 1997 reform, the development of the last mile is nevertheless relevant as it took place shortly after legal disputes had demonstrated the need for clarification regarding the legal basis of the competences of the regulator (i.e., the ComCom), and forced the incumbent monopolist to share access to the last mile with its competitors (e.g., Fischer et al., 2003).

As is often the case with policies of autonomous adaptation and/or in policy domains with rapid technical changes, the 1997 law and its subsequent revision defined the formal setting of implementation—and of the related rights and duties of the independent regulatory agency. Therefore, to gain detailed insights into the implementation phase and to take a closer look at the effects of the new competence distribution, one also needs to study the structure of the policy network after the legislative decision-making processes, that is, in the implementation phase (Fischer, 2005, p. 93). For this reason, besides the policy networks of the 1997 and the 2006 reforms, our longitudinal study includes a third set of network data covering the implementation phase after 2007.

_Longitudinal Data on Swiss Telecommunications Policy_

Comparable data sets on policy networks are rare, not least because gathering data at various points in time is highly demanding and resource consuming. In that sense the data set at our disposal is exceptional. It is composed of comparable network data of a policy domain collected in three different periods. The first and
second data sets cover the major Swiss telecoms reform in 1997 and the minor reform of 2006. They were both gathered through face-to-face interviews in 2001/2002 (see Fischer, 2005; Fischer, Nicolet, & Sciarini, 2002; Fischer et al., 2003; Sciarini, Nicolet, & Fischer, 2002; Sciarini et al., 2004) and 2008 (see, e.g., Fischer, Sciarini, & Traber, 2010), respectively. The third data set on the implementation phase after 2007 stems from a written survey sent out by post in 2010, as well as some interviews with the sector-specific regulatory agency and new operators.

For the definition of the key actors involved in the decision-making and implementation processes, we relied on the classical combination of positional, decisional, and reputational approaches. Like others (e.g., Knoke et al., 1996, p. 7), we believe that collective actors, rather than individuals, stand in the foreground of today’s politics. Therefore, actors in this article are defined as organizations participating in the policymaking and implementation processes. Following the decisional approach, we first identified actors that took part in the telecoms decision-making and implementation processes. We then complemented this first list with actors holding an overall strategic position in the Swiss political system in general or in the telecommunications sector in particular. Finally, we also added the actors that did not belong to our original list, but were mentioned as very powerful during our initial expert interviews. This left us with a set of 63 actors for the 1997 reform and 45 actors for the 2006 reform. From these lists we interviewed the actors who were identified by at least two approaches (among the three positional, decisional, and reputational approaches): that is, 31 actors (50 percent) for the 1997 reform and 21 (47 percent) for the 2006 reform. For the implementation phase after 2007, the list was composed of 38 actors, and the questionnaire was sent out to the 31 actors identified by at least two approaches. The response rate was considerable and reached 82 percent.

For the construction of our dependent variable, and thus the reconstruction of the collaboration network among all actors and periods, we proceeded as follows: Based on the complete list of all actors participating in the respective decision-making or implementation process (and not only the list of survey participants), interviewees were asked to identify those actors with whom they collaborated intensely. Furthermore, survey participants were asked to add further actors if they thought that someone was missing. This would have allowed us to also interview/send the questionnaire to actors not yet included in the survey, if they were mentioned by at least two survey partners. However, new actors were only sporadically added to the list, and ever only by one interviewed actor.

Other relevant variables deduced from our survey data are outlined hereafter. The first concerns the scores of actors’ reputational power. Again, from the complete list of actors, our interview partners were asked to mention which actors were, in their view, very influential. Based on these answers, we calculated the reputational power score of each actor, which corresponds to the mean of the total judgments from all survey participants. Second, we introduced a measure of conflict among actors. Based again on the same list of actors participating in the respective process, interviewees were asked to mention the actors with whom they agreed or disagreed about the telecoms policy. Finally, actors were categorized according to their type. Considering our hypotheses, actors belonging to the four following categories were
relevant for this research: regulators (sector- and non-sector-specific regulators), regulatees (incumbent and new operators), political authorities, and interest groups. We thus integrated in our analysis all actors belonging to one of these four categories. Additionally, they are all involved in the design and the implementation of Swiss telecommunications regulation. At the end, we were able to study the regulatory network of 23 collective actors.

Finally, and as we were interested in the difference between actors established before and actors established after the liberalization process, we created an actors’ attribute, labeling as “new” all stakeholders that were installed just after the liberalization in 1997 (see Appendix 1). More specifically, the most important actors labeled as “new” were the sector-specific administrative unit (OFCOM, created in 1991) and regulatory agency (ComCom, created in 1997); the newly involved operators Sunrise, Orange, Cablecom, Swisscable, and IG Telekom; and the two coregulators ComCo (i.e., competition agency) and Price Surveillance (i.e., price oversight agency).

Stochastic Actor-Oriented Modeling (SAOM)

As demonstrated by several studies, SNA offers an extensive and extremely useful toolbox for the study of decision-making structures (Knoke, 1990; Knoke et al., 1996; Krackhardt, 1990; Kriesi, 1980). Unlike mainstream statistics that focus on entities and their attributes, SNA is interested in entities and their relations. In the context of this article, the nodes of the network are collective political organizations, such as political parties, interest groups, or agencies of state administration. These actors are linked by ties of collaboration. Networks are dynamic phenomena per se because the behavior of the actors in the network results in constantly changing network configurations (Snijders, 2005). SAOMs (see Snijders, van den Bunt, & Steglich, 2010, as well as Desmarais & Cranmer, 2012; Lubell et al., 2012; Robins, Lewis, & Wang, 2012) for network dynamics, like the one used in this analysis, model network changes in part endogenously, as a function of the current network structure (network effects), and in part exogenously, both as a function of the actors’ characteristics (actors’ covariates) and as characteristics of pairs of actors (dyadic covariates). Statistical analysis of network data and its dynamics are complicated by the fact that the network ties cannot be assumed to be independent from each other (see Cranmer et al., 2012; Lubell et al., 2012; Robins et al., 2012). The SAOM takes this specific data structure into account and combines continuous time Markov analysis and random utility models (van den Bunt & Groenewegen, 2007). This model describes the development of a social network over time as a result of the rational actions of individual actors in the network (van den Bunt, van Duijn, & Snijders, 1999, p. 171). In other words, these models analyze which individual choices lead to which network structures, and how these structures change over time. The first observation serves as a baseline and captures the influence of ongoing exogenous factors that structure the network. SAOMs do not assume the observed networks to be in a stable equilibrium, but model the changes between periods (Lubell et al., 2012). The model deconstructs network change into its smallest
constituents and assumes that between the observations, the network is modified by a certain number of sequential steps, in each of which an actor creates one new tie, terminates one existing tie, or does nothing at all. The probability of such a change depends on the function of actors’ preferences. It is assumed that actors try to maximize their expected utility by initiating or dissolving a tie. Actors’ preferences are represented by the objective function. This function is the core of the SAOM and determines the change according to the actors’ preferences, constraints, and perceptions of their network environment. The objective function thus measures how attractive various different tie changes are for an actor, given the structure of the network and specific attributes of actors in the network (Snijders et al., 2010, p. 52). Like in generalized linear statistical models, the objective function is assumed to be a linear combination of a set of components, called effects (Snijders et al., 2010, p. 47). Computer simulations have shown that the estimates of the parameters in the objective function are quite normally distributed. They can therefore be tested by referring to the t-ratio (Snijders et al., 2010, p. 50).

On the one hand, structural effects like tendencies toward reciprocity or transitivity are unknown parameters that have to be estimated from the observed data and are expressed by parameters for local network structures. They constitute processes endogenous to the network and must be controlled for in order to correctly estimate the effects of the other parameters. The selection of the most appropriate specification of the endogenous network effects may require a data-driven procedure. On the other hand, exogenous effects are modeled with parameters expressed by covariates at the node or the dyadic level, and can be constant or changing between the time periods.

Since SOAMs are too complex for the application of classical maximum likelihood estimation procedures and testing methods, one has to rely on the method of moments and Monte Carlo computer simulation to approximate the expected values of the statistics (van den Bunt et al., 1999).

Analysis

Table 2 presents the changes of the collaboration networks between the three time periods: 1997 (t1), 2006 (t2), and 2010 (t3). As can be seen in the table, both from t1 to t2 and from t2 to t3, the majority of the possible ties start by being absent and end up so (0 → 0). About 10 percent of the possible ties do exist and continue to do so (1 → 1). From t1 to t2, roughly the same amount (12 percent resp. 14 percent) of ties are deleted and created, while from t2 to t3, the number of newly created ties is

<table>
<thead>
<tr>
<th>Period</th>
<th>Total</th>
<th>0 → 0</th>
<th>0 → 1</th>
<th>1 → 0</th>
<th>1 → 1</th>
<th>Jaccard</th>
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<tbody>
<tr>
<td>t1-t2</td>
<td>529</td>
<td>337</td>
<td>62</td>
<td>74</td>
<td>56</td>
<td>0.292</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>64%</td>
<td>12%</td>
<td>14%</td>
<td>11%</td>
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</tr>
<tr>
<td>t2-t3</td>
<td>529</td>
<td>377</td>
<td>34</td>
<td>64</td>
<td>54</td>
<td>0.355</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>71%</td>
<td>6%</td>
<td>12%</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Tie Changes between the Three Networks
clearly inferior (6 percent resp. 12 percent) to the number of deleted ties. The fact that from t1 to t2, but particularly from t2 to t3, the percentage of deleted ties is superior to the percentage of created ties means that the density of the network is constantly decreasing from the first reform in 1997 to the implementation phase of the second reform in 2010. This confirms our first hypothesis.

The Jaccard index in the last column expresses the amount of change between two waves (Batagelj & Bren, 1995; Jaccard, 1900, both cited in Snijders et al., 2010, p. 49). The method requires that there is not too much change between the time periods and not too little change between the first and the last time period. Experience has shown that Jaccard values between consecutive waves should preferably be higher than 0.3, and that values less than 0.2 would lead to doubts about the assumption that the change process is gradual, compared to the observation frequency (Snijders et al., 2010, p. 49). The following sections present the results of the different models including network and covariate effects. Models were estimated with the SIENA 4.0 package in R (Ripley & Boitmanis, 2010; Ripley & Snijders, 2011).

Network Effects

A first model includes basic endogenous network parameters such as the out-degree, reciprocity, and two triadic closure effects (transitive triplets, number of actors at distance two) to address changes in the telecoms collaboration network as a function of the current network structure (not yet accounting for actors’ characteristics or relations among pairs of actors—see therefore the next section). The first two parameters are important as controls for the density in the network (i.e., the number of observed ties compared to the number of all possible ties in a network) and for the actors’ propensity to reciprocate an existing tie (see also Lee, Lee & Feiock, 2012). The following two parameters are addressing triadic network closure, that is, the tendency of actors to become interconnected with each other (see Burt, 2001; Coleman, 1990; Robins et al., 2012). Transitive triplets indicate the actors’ tendency to create collaborative ties to “collaborators of collaborators,” that is, the tendency to create a tie to actors with whom they are already indirectly linked. The number of actors at distance two takes into account indirect connections between actors. The fewer the indirect connections between actors, the stronger the tendency toward network closure.

For each model, the rate parameter \( r \) represents the expected average number of opportunities for relational changes per actor from \( t_x \) to \( t_{x+1} \). The density (out-degree) parameter is significant, but is negative for all four models (see Table 3). This parameter is difficult to interpret by itself, but its negativity is an indicator that over the three observed periods, actors had a low propensity to send (random) ties to other actors. In the basic model 1, the reciprocity and the transitivity effect are also significant and positive, meaning that there is a tendency for actors to reciprocate ties and to create transitive triplets (and thus to “close” their local network structure). There is also a significant negative effect of the “number of actors at distance two” effect, which further confirms the tendency toward network closure.
Dyadic and Actors’ Covariate Effects

Model two includes actor covariates and thus accounts for actors’ characteristics, this being important for the test of our Hypotheses 2 to 5. Two types of actors’ attributes were included here.

Table 3. SIENA-Models

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate parameter $p_{t_1-t_2}$</td>
<td>41.85*</td>
<td>56.24**</td>
<td>59.83**</td>
<td>56.10**</td>
</tr>
<tr>
<td></td>
<td>(22.73)</td>
<td>(23.32)</td>
<td>(23.02)</td>
<td>(23.11)</td>
</tr>
<tr>
<td>Rate parameter $p_{t_2-t_3}$</td>
<td>13.08***</td>
<td>14.94***</td>
<td>18.61***</td>
<td>19.65***</td>
</tr>
<tr>
<td></td>
<td>(2.60)</td>
<td>(3.39)</td>
<td>(3.04)</td>
<td>(3.35)</td>
</tr>
<tr>
<td>Network structure effects:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>-1.35***</td>
<td>-1.26***</td>
<td>-1.27***</td>
<td>-1.31***</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.16)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>1.10***</td>
<td>1.00***</td>
<td>0.91***</td>
<td>0.96***</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.18)</td>
<td>(0.19)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Transitive triplets</td>
<td>0.08***</td>
<td>0.06***</td>
<td>0.06*</td>
<td>0.06**</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Number of actors at dist. two</td>
<td>-0.26***</td>
<td>-0.29***</td>
<td>-0.29***</td>
<td>-0.28***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.08)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>Exogenous effects:</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>New ego</td>
<td>0.07</td>
<td>0.05</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.12)</td>
<td>(0.13)</td>
<td></td>
</tr>
<tr>
<td>New alter</td>
<td>0.46***</td>
<td>0.30**</td>
<td>0.30*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.15)</td>
<td>(0.15)</td>
<td></td>
</tr>
<tr>
<td>Reput alter</td>
<td>1.16***</td>
<td>1.13***</td>
<td>1.15***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.33)</td>
<td>(0.28)</td>
<td></td>
</tr>
<tr>
<td>Same actortype</td>
<td>-0.02</td>
<td>-0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators</td>
<td>0.16</td>
<td>-0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators × reciprocity</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatees</td>
<td>0.55</td>
<td>1.29**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.34)</td>
<td>(0.53)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatees × reciprocity</td>
<td>-1.48**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.72)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators—coregulators</td>
<td>0.89*</td>
<td>1.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.54)</td>
<td>(0.97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators—coregulators × reciprocity</td>
<td>-1.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators—regulatees</td>
<td>0.97**</td>
<td>3.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
<td>(3.09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulators—regulatees × reciprocity</td>
<td>-3.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.19)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coregulators—regulatees</td>
<td>0.07</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.23)</td>
<td>(0.36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coregulators—regulatees × reciprocity</td>
<td>-0.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.65)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convergence/divergence</td>
<td>0.37***</td>
<td>0.32***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.13)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Levels of statistical significance: * = 0.1, ** = 0.05, *** = 0.01.
t-statistics are below 0.1 for all models, indicating good model convergence.

*Dyadic and Actors’ Covariate Effects*

*Model two* includes actor covariates and thus accounts for actors’ characteristics, this being important for the test of our Hypotheses 2 to 5. Two types of actors’ attributes were included here.
First, the variable “new” assesses whether an actor is new in the sense that it was only created after liberalization in 1997 (see Appendix 1). An activity effect for these actors indicates whether the new actors were particularly active in creating ties, and thus attempting to integrate into the network, while a popularity effect measures whether other actors attempted to create ties with the new actors.

Second, we test whether there is a popularity effect interacting with the actor’s reputation, for example, whether actors with higher reputation are more often approached by other actors. Results appear in Table 3 (model 2). The “new ego” effect is not significant, but the “new alter” effect is. This means that new actors have a tendency to attract collaboration ties over time. Further, the higher an actor’s reputation, the more often it is the target of another actor’s collaboration contact.

Model 3 includes further actor and dyadic covariates. First, the variable “actor-type” assigns a specific value to the different actor types previously described (political authorities, regulators, regulatees, and interest groups; see Appendix 1). By adding a “same covariate” effect to the model, we capture the degree to which actors of the same type have a tendency to collaborate with each other. According to the results of model 3, actors belonging to the same actor type do not collaborate more strongly than actors belonging to different categories of actors. Second, and being more specific concerning actor types, the model includes exogenous dyadic-covariate effects that allow testing whether either regulators or regulatees collaborate more strongly with their peers than with other types of actors. In model 3, none of these effects is significant, which means that there is no specific tendency to create within-group ties. Third, the model tests—again through exogenous dyadic-covariate effects—the occurrence of intensified tie exchange between different categories of actors, that is, the sector-specific regulator and coregulators; the sector-specific regulator and regulatees; and coregulators and regulatees. There is a significant and positive effect for the relations between the main regulator and regulatees, as well as between the main regulator and the coregulators. This means that actors from the respective categories have a higher propensity to create ties between each other.

Fourth, we include a variable measuring whether two actors agree or disagree about telecoms policy. It measures whether actors with convergent positions tend to collaborate more often than actors with neutral or divergent positions. Results show that if actors agree on their preferences for the policy, they collaborate more strongly than actors who do not agree.

Finally, model 4 includes several interaction effects. On the one hand, there is an interaction between the within-group effect (within the same category of actors) and reciprocity. On the other hand, we include an interaction between the between-group effects (between specific categories of actors) and reciprocity. These interaction effects account for local nonhierarchical structures. More concretely, we expect that particularly among and between (co)regulators and regulatees, ties are reciprocated. First, the results in Table 3 show that there is a significant within-group effect for the category of regulatees. At the same time, the interaction effect with reciprocity is significantly negative. Compared to the rest of the actors, regulatees therefore have a higher propensity for creating within-group ties, but at the same time a lower propensity to reciprocate these ties. Second, the between-group effects between the
main regulator and the coregulators and between the main regulator and the regulatees disappear. This means that the high propensity for creating these between-group ties (as observed from model 3) is due to reciprocity effects, but these are not significant as they are not stronger than elsewhere in the network.14

Discussion

Overall, we can corroborate our first hypothesis. We observe that the density within the Swiss telecommunications network has been decreasing since the liberalization of the sector in 1997, as more ties are deleted than created. This tendency can be explained by different phenomena that impacted upon this process: Passing from regulatory hierarchy toward an open market system meant that the number of actors increased, but that the coordination among these actors changed from a dense vertical structure, to a more loose and competitive horizontal structure. Furthermore, the regulation and provision of the sectoral telecoms service was no longer provided by the same actor (i.e., the incumbent state-owned enterprise), but rather was fragmented among different entities, which resulted in a less dense regulatory structure. Finally, the first two periods under study correspond to decision-making processes regarding legislative acts, whereas the last period corresponds to the implementation phase of those acts. In the sector-specific implementation phase, fewer actors were active than in decision-making processes, and the translation of legal regulation is characterized by more task-oriented relations among actors. These three factors account for the decreasing number of relations within the Swiss telecoms regulatory network among the three observed periods.

Further, we can also test the remaining hypotheses regarding the emergence and integration of new actors within the Swiss telecoms regulatory framework. Here we are mainly interested in the new categories that emerged after the liberalization of 1997, namely the one of regulatees (operators), the newly installed sector-specific regulator, and the non-sector-specific coregulators.

We cannot confirm Hypothesis 2a that new actors (see Appendix 1 for actors' categories) are more active within the regulatory framework than preexisting ones (nonsignificant activity effect). This might be explained by the fact that preexisting actors also became more active once new conditions (in)directly affecting them and related to the opening of the sector were negotiated. Hypothesis 2b and the expectation of a popularity effect of new actors is, however, supported. It appears from our analysis that new actors are more frequently approached as collaboration partners than established actors. The established actors (as well as the other new actors) thus have a tendency to actively integrate the new actors in the collaboration network of telecommunication policy.

Additionally, we can observe that the power structure dramatically changed over time (see reputational scores in Appendix 1). Elected authorities, the former monopolist Swisscom, and the Federal administration lost power, whereas coregulators and—particularly—the sector-specific regulator ComCom enjoyed an increase in power. This is due both to the shift in competences from elected authorities toward (co)regulators, and also to the fact that our third data set applies to the
implementation phase, in which regulators intervene more than public authorities. Furthermore, our results support Hypothesis 3 that more powerful actors have a tendency to attract incoming ties from other actors in the network. Like many other real-world networks, the collaboration network in the liberalized telecommunication sector seems to be governed at least partly by a mechanism of “preferential attachment” (e.g., Barabasi & Albert, 1999) where actors seek to create ties to powerful collaboration partners.

Finally, our hypotheses on the “within-group” and the “between-group” effects can be partly accepted. There is a “within-group” effect only for the category of regulatees. According to our results, regulatees have a stronger propensity to create ties with their peers than with other actors. This effect is, however, partly equaled out by their negative tendency for reciprocity: Regulatees tend not to reciprocate the collaboration ties they receive from other regulatees. Contrary to what was expected, the other actor groups, and mainly regulators, did not create or reciprocate a significant amount of within-group ties.

A “between-group” effect is observable between the main regulator and the coregulators: the sector-specific regulatory agency ComCom and other coregulators, such as the Competition Commission and the Price Oversight, have indeed a tendency to collaborate. In the Swiss telecommunications sector, we thus observe what Cole and Banerjee (2010) call a multi-entity regulatory framework, where not only the sector-specific regulator, but a whole group of coregulators implement the regulatory rules and regulations. Furthermore, and again as expected, closer ties can be observed between the main regulator ComCom and the group of regulatees. This presumably results from the liberalization and the reregulation processes: by opening up the sector to market forces and by redefining competences, these processes enabled the groups of coregulators and operators to emerge, and then to coordinate. However, both of these between-group effects are the result of actions of reciprocity—actors confirm existing ties, but they do not create new ones.

Finally, in line with Hypothesis 5, actors holding converging views and sharing the same policy preferences about the new telecoms regulatory framework tended to create more ties between themselves than with other actors with divergent policy preferences.

**Conclusion**

This article looked at structural reconfigurations in the regulatory framework of a utility sector after the process of liberalization and reregulation. It explored the structural changes in the Swiss telecoms regulation over two decades and at three different levels: the overall network, actor groups, and individual actors themselves. It thereby analyzed the impact of macrolevel political institutions and processes (liberalization and reregulation), conceptualizing the network and its configuration on the meso level (see Lubell et al., 2012).

Regarding the overall network and the general rearrangement of actors, our analysis confirms a trend toward the dispersion of ties within the regulatory network: From the start of the liberalization process in the mid 1990s up to the
ongoing implementation process, the number of relations between actors has
decreased. On a local level, however, closure effects could be observed, meaning that
over time, actors became more interconnected and confirmed ties. More concretely,
actors sharing similar policy preferences and actors performing similar functions
had a strong tendency to collaborate: This was particularly true for the group of
regulatees and the between-group relations of the sector-specific regulator with
coregulators and operators (regulatees). Similarly, new and powerful actors tended
to attract ties. Such fine-grained results would remain unnoticed in a study that
would focus on either level of analysis—the network level, the actors’ group level, or
the individual actors’ level. In other words, our case study suggests that the identi-
fication of the structural changes brought about by liberalization and reregulation
requires a research design—and related analytical tools—that allow for the study of
the three network levels (overall network, groups of actors, individual actors) simulta-
neously. The application of an SAOM appears to be a particularly appropriate tool
in that respect. It enabled us to study network effects and reconfigurations over time
and on different levels. More specifically, the combination of endogenous and exog-
enous effects, that is, the inclusion of network effects, as well as actor and dyadic
covariates, allowed for a complex investigation of a network configuration over time.
The latter point proved especially crucial: Liberalization is a dynamic process and
understanding the related changes is only possible when accounting for various
structural patterns and observing the evolution of the network over time. It is true
that while gathering longitudinal data is resource-consuming, we were satisfied that
we could rely on good data in this regard.

The hypotheses formulated in this article were deduced from the general gov-
ernance and liberalization literature. As shown in the analysis, the expected network
effects were not all observed in the data. Given that this study is limited to a very
specific case, we have refrained from generalizing our results regarding network
reconfigurations after liberalization and reregulation. Wider implications can only be
drawn after applying our research design to cases from other sectors and countries.

This being said, our study of the Swiss telecoms context confirms a shift from
regulatory hierarchy toward so-called task-specific regulation (Hooghe & Marks,
2003). It also highlights the crucial role granted to new regulatory agencies, as well
as to coregulators. By contrast, our findings suggest that elected authorities and the
former monopolist are forced to share power and competencies with new actors.
Unlike most previous studies focusing exclusively on sector-specific regulators and
aiming at measuring their degree of independence, our study makes a strong case
for an alternative, more encompassing research design that includes all major actors
or, as a second best, for a research design that looks at the independence of regulators
vis-à-vis elected authorities, coregulators, and operators. In that sense, SNA appears
to be the most appropriate method to empirically assess the rise and the form of the
regulatory state (Majone, 1997).

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Pascal Sciarini is a full professor of Swiss politics and European integration at the Department of Political Science and International Relations, University of Geneva, Switzerland. His research and teaching focus on the Swiss political system, political institutions, Europeanization, and European integration. Pascal Sciarini is an expert in the analysis of direct democratic instruments, survey design, and public opinion building. He was Director of the Department until 2011.

Frédéric Varone is full professor in the Department of Political Science and International Relations at the University of Geneva. As an economist and a political expert, Varone has taught in the Universities of Berne, Lausanne, Louvain-la-Neuve (Belgium), Lille (France), and Geneva, as well as in several continued trainings for functionaries: in Brussels, Paris, and Munich in particular. He is presently heading the Master in Public Management (MAP) of the University of Geneva, as well as the European Network of Universities offering master’s programs in Comparative Public Administration (EMPA). He is a member of various commissions of experts focusing in particular on the evaluation of public policies.

Notes

1. The ties relevant to grasp the horizontal and vertical rearrangement of these actors in policy design and implementation are collaboration relations. Different from cooperation, collaboration does not grasp the dimension that actors organize to defend similar interests or preferences. Rather than addressing an ideological or strategic element, collaboration is defined here as an identified contact among actors during the policy process to jointly produce policy outputs and fulfill regulatory standards.

2. In both cases, the “higher propensity” reflects equally the creation of new ties and the maintenance of existing ties.

3. See the literature on “preferential attachment” (e.g., Barabasi & Albert, 1999) for a similar argument on network growth.

4. Only European actors and one federal agency failed to reply mentioning that they were not enough involved in the concerned process.

5. A general introduction to the method is to be found in Wasserman and Faust (1994). The importance of the method for the study of the structure of political systems and/or policy domains was demonstrated by, among others, the classic works of Laumann and Pappi (1976), Laumann and Knoke (1987), or Knoke et al. (1996).

6. The first, at the very least, is a common assumption on which statistical models for non-network data are usually based (see Lubell et al., 2012; Robins et al., 2012).

7. Continuous time means that network changes are assumed to be continuous and proceed in small, individual steps, even though network changes are observed at discrete moments in time (Snijders et al., 2010, p. 45). The Markov assumption states that for any point in time, the probability distribution of the future network given current and past states of the network is a function only of the current
network. This means that all relevant information is assumed to be included in the current state of the network (Snijders et al., 2010, p. 46).

8. The SIENA-model requires observations at at least two points in time, and networks ideally have at least 20 nodes. The time spans between the observations do not have to be of the same length.

9. The index is given by the formula $N_{11}/(N_{11} + N_{01} + N_{10})$ where $N_{11}$ is the number of ties present at both waves, $N_{01}$ is the number of ties newly created, and $N_{10}$ is the number of ties terminated.

10. Results can be accepted if the $t$-ratios for model convergence are less than 0.1.

11. This is because the density parameter is normally correlated with all other statistics in the model.

12. To capture a tendency toward network closure, one or two out of four possible statistics may be included in the model (see Snijders et al., 2010, p. 47). Alternative models including other effects that have been shown to be important in determining how networks evolve, such as balance (structural equivalence) or betweenness, did not perform better than the models presented here.

13. The within-group effect for regulatees did not appear in model 3 because this model does not control for within-group reciprocity. As the model does not distinguish between reciprocating and non-reciprocating ties, the positive effect for creating within-group ties and the negative effect for reciprocating these ties seem to equal each other out.

14. Additionally, a test for the heterogeneity of these effects over time (Lospinoso, forthcoming) shows that the effect of the parameters on the evolution of the policy network in telecommunications policy is constant between the two time spans.

References


Appendix 1—Actors List Swiss Telecommunications Policy over Two Decades

Reputational power scores are displayed for each actor and each survey period this actor was included in.

Reputational score: 1.0 corresponds to 100%
Actors with reputational power in bold participated in the respective period’s survey.

<table>
<thead>
<tr>
<th>Actors</th>
<th>Abbreviations</th>
<th>1997</th>
<th>2006</th>
<th>2010</th>
<th>Actortype</th>
<th>New actors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same actors in all three networks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Federal Council—Swiss government</td>
<td>CF</td>
<td>0.62</td>
<td>0.71</td>
<td>0.64</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2 Fed. Department for Environment, Transport, Energy and Communications</td>
<td>DETEC</td>
<td>0.79</td>
<td>0.74</td>
<td>0.76</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3 Federal Office of Communications</td>
<td>OFCOM</td>
<td>0.92</td>
<td>0.93</td>
<td>0.88</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4 Federal Communications Commission (RA)</td>
<td>ComCom</td>
<td>—</td>
<td>0.76</td>
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Actor types (1 = political authorities, 2 = regulators, 3 = regulatees, 4 = interest groups)
New actors = actors installed or involved only after the sector’s liberalization in 1997