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Design paths of federal intergovernmental cooperation

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Abstract

Actors rarely approach institutional design choices with a blank slate but are influenced by design choices made at earlier stages. How does institutional design evolve over time and are there specific paths to deepening cooperation? We investigate the institutional design paths of subnational cooperation that are chosen to address increasingly complex and interconnected policy problems. We theorize that besides the substantive problem, earlier choices matter to explain what institutional design mechanism is chosen; that is, the design of existing institutions between two subnational governance units, called substates, influences the design of subsequent institutions. Using a semi-parametric Cox proportional hazards model, we show that the design paths of subnational cooperation in the Swiss water governance sector correlate with earlier design choices. Our results indicate that not all cooperation is self-reinforcing and path-dependent, but they show which specific design choices are more likely to follow each other in repeated formal federal intergovernmental cooperation.

KEYWORDS

federalism, institutional design, intergovernmental cooperation, path-dependency, sequencing

INTRODUCTION

Existing explanations for the variation in the design of intergovernmental cooperation in federal systems focus on the problem characteristics that these institutions are established to address (Feiock, 2013; Schlager et al., 1994), the governance incentive structures (Bolleyer, 2006; Feiock, 2013), or the interdependencies among actors (Fischer & Jager, 2020; Herzog & Ingold, 2019; Hollway & Koskinen, 2016). However, many sectors become increasingly institutionalized, with new formal agreements being layered upon existing agreements (Béland & Hacker, 2004; Feiock, 2013; Hacker, 2002; Howlett & Rayner, 2006a; Mahoney & Thelen, 2010; North, 1990). Earlier institutional design choices by substates shape the subsequent development of institutionalized intergovernmental cooperation among those. As such, agreements now rarely address a problem that has not already seen some institutionalized response before. Beyond the potential influence of traditional variables such as problem characteristics and interdependencies, this paper seeks to understand how these earlier institutional design choices affect when and which institutional design mechanisms are adopted later.

Drawing on the literature on common pool resource governance (Heikkila et al., 2011; Ostrom, 1990, 1993), institutional collective action (Feiock, 2013; Feiock & Scholz, 2010), and international cooperation (Bernauer et al., 2013; Conca et al., 2006; Koremenos et al., 2001; Mitchell & Keilbach, 2001), we define institutional design mechanisms as the rules that treaty parties agree upon to organize and structure their interactions for the management of given issues. We consider three particular design mechanisms: provisions for monitoring, conflict resolution, and agreement commissions. For each of these mechanisms, we assess how previous dyadic institutional experience influences the rate of further cooperation through these design mechanisms, thereby identifying design paths through which substates structure their interactions (Milewicz et al., 2018). These "design paths" create co-existing and incrementally changing layers of institutions between the same government entities within federal systems.

We investigate design paths in federal water systems in Switzerland. With strong competencies on the substate level and high levels of institutionalized cooperation (Bolleyer, 2009), Switzerland serves as an ideal-typical case setting for insights into the dynamics of federal cooperation over time (George & Bennett, 2005). In the face of interlinked policy issues, Swiss substates—called cantons—have a wide range of cooperation options that manifest formally in numerous bi- or multilateral treaties called "concordats" (Benz, 2021; Bochsler, 2009; Bolleyer, 2009). Unlike the mandatory power-sharing obligations in some other federal systems, Swiss inter-cantonal cooperation usually occurs voluntarily. Our study focuses on the uptake and design mechanisms contained in concordats around water management issues within the last 40 years. Water is a particularly apt issue, as it illustrates various symmetric or asymmetric patterns of federal interdependency (Mitchell & Keilbach, 2001).

After qualitatively coding formal treaties between Swiss cantons to identify institutional design mechanisms, we analyze our dataset based on dyads of substates that could potentially share an agreement. We employ a semi-parametric Cox proportional hazards model to provide fine-grained insight into the temporal design paths, controlling for exogenous factors—most importantly, the substantive problem characteristics such as issue sector or symmetry—that would affect intergovernmental cooperation. This observational research design allows an investigation of the extent to which prior design choices correlate with later choices.

Overall, we find that institutional design mechanisms contribute to specific institutional design paths, facilitating the future inclusion of additional design mechanisms of the same type, but hampering the inclusion of design mechanisms of another type. For example, establishing a commission can lead to further agreements featuring commission-related provisions. However, once a commission is established, dyads are unlikely to add independent monitoring or conflict resolution mechanisms. There are few long "design paths" where cooperation has developed through multiple different types of mechanisms. Only on pollution and fishing do we sometimes see monitoring mechanisms being replaced or complemented by the establishment or update of the responsibilities of a commission.

This study contributes to the literature in three ways. First, we extend the literature on intergovernmental cooperation in federal systems (Bolleyer, 2006; Bowman, 2004; Garrick et al., 2014; Woods & Bowman, 2018) in two dimensions. We investigate our system over time, considering cooperation as a long-term, open-ended process where previous choices impact future cooperation activities. We also distinguish cooperation activities according to their institutional design mechanisms instead of simply assessing cooperation and non-cooperation (Fischer & Jager, 2020; Herzog & Ingold, 2019). In this way, we provide new insights for puzzling situations, for example, where governments employ different patterns of cooperation for similar underlying problem characteristics.

Second, we contribute to the literature on common pool resource governance (Heikkila et al., 2011; Ostrom, 1990, 1993) and related institutional collective action dilemmas (Feiock, 2013). This literature has mainly dealt with the incentives, risks, and costs of different design mechanisms to solve specific problems, but without an explicit focus on the development and layering of these institutional design mechanisms over time. By doing so, we can investigate potential interactions of different design mechanisms over time (Feiock, 2013).

Third, by employing advanced semiparametric Cox proportional hazards models, we estimate the rate at which different cooperative links between substates emerge. Although our observational research design does not necessarily enable us to estimate an unbiased causal effect of earlier design choices on choices in the path, these insights are valuable as they highlight various differentiated paths that cooperation may take rather than assuming uniform trends for more and deeper cooperation. It also recognizes how different design mechanisms can impel or impede further cooperation by instituting the same and other design mechanisms.

This article proceeds as follows. The next section describes in more detail our reasoning and conceptualization of cooperation as sequential and introduces some drivers of these dynamics we can consider here. The third section describes the research design. This section includes the coding scheme for agreement design mechanisms to operationalize different mechanisms of cooperation as our dependent variable and a presentation of the empirical model. The fourth section presents the results, including a summary of the robustness checks (more detail is provided in the appendices). The article then concludes in the fifth section and highlights several future research avenues.

PATHS OF INTERGOVERNMENTAL COOPERATION IN FEDERAL SYSTEMS

While gathering less scholarly attention than international cooperation, cooperation among substates is a central component of the governance of federal systems in general and environmental governance in particular (De Stefano & Garrick, 2018; Garrick et al., 2014; Moore, 2017, 2018; Schlager et al., 2012; Schlager & Heikkila, 2009). Substates often rely on different institutions to codify their cooperation, ranging from sporadic contacts to regular meetings or formal routines and statutes (Bolleyer, 2006). Intergovernmental agreements with legal statuses, such as interstate compacts in the United States, or concordats among substates in Switzerland, are among the institutions with the highest formalization. Prior research highlights that substates cooperate (i) to increase their problem-solving capacity in the face of common, increasingly large-scale challenges (Woods & Bowman, 2018), (ii) to pursue similar goals and preferences (Bolleyer, 2006; Bowman & Woods, 2007; Feiock, 2013), or (iii) to avoid renegotiation of authority between substates and the central state and to retain authority within the federal system (Moore, 2017). Choices for the specific design of intergovernmental cooperation have been explained by problem characteristics (Feiock, 2013; Schlager et al., 1994), incentive structures (Bolleyer, 2006; Feiock, 2013), or actor interdependencies (Fischer & Jager, 2020; Herzog & Ingold, 2019).

Besides these well-researched exogenous drivers, cooperation also develops endogenously over time as an open-ended temporal process, creating incentives and constraints for further institutionalization (Mahoney & Thelen, 2010) through the sequential development of cooperation and the institutionalized responses of such cooperation. In this context, the concept of policy sequencing stresses "how outcomes […] are firmly based or rooted in previous events and thinking as related structural processes of [how] negative and positive feedback affect actor behaviour" (Howlett & Rayner, 2006b, p. 7). Adapted to the case of horizontal cooperation in federal systems, this means that existing cooperative structures and institutionalized instruments structure further cooperation. Existing institutions influence the transaction costs and incentives of establishing or updating further institutions of different types (Feiock, 2013).

Formal horizontal cooperation among substates in federal systems can rely on a variety of institutional structures and instruments. Design mechanisms, defined as the rules that substates give themselves for organizing their cooperation, vary in how they structure future interactions. The literatures on CPR governance (Heikkila et al., 2011; Ostrom, 1990, 1993; Schlager et al., 2012) and international cooperation (Abbott & Snidal, 2000; Bernauer et al., 2013; Conca et al., 2006; Mitchell & Keilbach, 2001) specify and investigate different institutional design mechanisms that agreements can include. We focus on three design mechanisms: conflict resolution, monitoring, and commission. We select these three different design mechanisms because they (i) are prominent in both large- and small-scale governance systems and related literature; (ii) offer substantively different institutional options to govern environmental issues within federal systems; and (iii) are independent of the substantive issue. None of the three mechanisms of conflict resolution, monitoring, or commission are—per se—applicable to a specific substantive issue such as fisheries, water pollution, or shipping transport only and thus to a specific problem only.[1]

First, *conflict resolution mechanisms* institutionalize the settlement of disputes and possible infractions. Shared common pool resources (CPRs) of any kind create incentives to engage in both conflictual and cooperative behavior (Bernauer et al., 2012; Bernauer & Böhmelt, 2020; Böhmelt et al., 2014; Hollway, 2020; Petersen-Perlman et al., 2017; Wolf, 1997). Mismatches between spatial scales of CPRs and governance structures are particularly conflict-prone. Conflict resolution mechanisms provide mutually agreed means to solve frictions before a potential escalation. CPR governance benefits from easily accessible conflict resolution mechanisms (Cox et al., 2010). While also involving liabilities for participants, conflict resolution mechanisms offer substates some security in situations of uncertainty or high stakes. As such, they foster trust and reduce transaction costs for further cooperation (Tir & Stinnett, 2011). Conflict resolution may take different forms and venues, ranging from bilateral resolution to impartial third-party intervention and sometimes courts. We hypothesize that conflict resolution mechanisms are a design element that induces further agreements, potentially including all three mechanisms of conflict resolution, monitoring, and commissions. Addressing the misalignment of interests by resolving disputes through conflict resolution mechanisms makes existing and continuing coordination problems more explicit and specific, while simultaneously creating trust and reducing transaction cost for cooperation (Wolf, 1997).

Second, agreements that include *monitoring* as an institutional design mechanism grant parties the right to assess or have assessed the state of natural resources and management practices (Beck et al., 2010) or implementation of and compliance with an agreement, even outside their territory (Koremenos et al., 2001). Monitoring provides additional information on the state of the natural resource and the functioning of the mutual agreement (Cox et al., 2010). For instance, monitoring provisions may formalize the mutual inspections of sewage treatment plants or joint water quality monitoring programs. Monitoring is, therefore, instrumental to reducing suspicion and fostering trust between cooperation partners. In this way, monitoring might lower incentives for defection by revealing non-compliance (Cox et al., 2010; Ostrom, 2009; Ostrom et al., 1999). However, as monitoring implies only very little transfer of authority and offers only limited opportunities for sanctioning defective behavior, more stringent mechanisms may be needed if problems increase (Feiock, 2013). Therefore, we hypothesize that monitoring design mechanisms included in treaties between substates will induce more agreements, including other design mechanisms.

Third, substates may rely on *commissions* to institutionalize the governance of shared resources. Commissions can adopt different structures and functions, ranging from expert advisory councils to complex organizations with their own decision-making power (Dombrowsky, 2007; Feiock, 2013). Commissions build a common framework and ensure some degree of supra-governmental autonomy compared to direct intergovernmental interaction. Such formal institutions established through water agreements foster stability and persistence (Biermann & Bauer, 2004; Duffield, 2007). Depending on their set-up, commissions can also internalize the design mechanisms discussed before; they may play an instrumental role in monitoring or providing third-party conflict resolution venues if disputes arise. The fundamental difference to conflict resolution or monitoring is the competencies that substates necessarily cede to commissions, similar to independent regulatory commissions (see e.g., Bertelli & Whitford, 2009). Permanent structures, such as secretariats, may manage joint meetings and information exchange and thus create infrastructure to act with a certain degree of independence, covering various issues (Koremenos, 2008; Koremenos et al., 2001). Commission bureaucrats and representatives may further seek to maintain or enlarge their influence by ensuring that the commission keeps or increases its influence on substate cooperation in a logic consistent with the principal-agent relation (Waterman & Meier, 1998). For these reasons—the breadth and depth of cooperation within commissions and the potential development of their agency—we hypothesize that commissions slow down other forms of formalized cooperation but accelerate the emergence of additional agreements that update and enlarge the competencies of commissions.

RESEARCH DESIGN AND DATA

To evaluate these hypotheses, we focus on intercantonal cooperation in the Swiss water sector. Cooperation among substates has a long tradition as an element of horizontal, cooperative federalism in Switzerland. Swiss federalism is built on strong competencies of substates (called "cantons") which have pronounced incentives to enter into cooperation (Bolleyer, 2006, 2009). Substate cooperation through these agreements is voluntary, but the national Constitution has recently set incentives for substates to cooperate (Cappelletti et al., 2014; Fischer et al., 2010). To address cross-border issues, substates have been cooperating bilaterally or multilaterally in a self-organized manner on a large diversity of issues, including water resources. The number of substate agreements (called "concordats") operating among Swiss substates has increased over time (Bochsler, 2009), even if the number of new concordats has been declining recently (see Figure 1).[2]

Data

Data are based on an inventory of Swiss national and cantonal law in an official database called lexfind.ch. The database is a publicly funded project run by the Intercantonal Conference of Cantonal State Chancellors, includes all information published on the substate's websites (including legal documents), and is updated daily. Substate agreements were identified by restricting the search to inter-cantonal law. Water-relevant pieces were identified based on searching in all official languages for "wasser," "aqua" (both without quotation marks), and "eau" (with quotation marks to restrict the inclusion of irrelevant agreements, given the other meanings of the French "-eau" as a suffix). On 30 April 2020, we obtained 343, 60, and 9 search results in German, French, and Italian, respectively. These are not unique agreements, as many are listed by the respective agreement members several times. We excluded duplicates and obtained 161 unique water agreements with a total number of 414 members. This means that a substate was, on average, a member of 16 bi- or multilateral water agreements.

We further excluded agreements that contain the term "water" but consider it only as a peripheral issue (instead focusing, e.g., on fire protection, public procurement, waste incineration, or border demarcation with neighboring countries) and thus are not of interest to our research on shared waters between cantons. After excluding these, 122 unique agreements remained. Of those, we further excluded 39 multilateral agreements to limit higher-order interdependencies in our statistical model. Additionally, we restricted our main analysis to agreements between 1980-01-01 and 2020-01-01 to improve

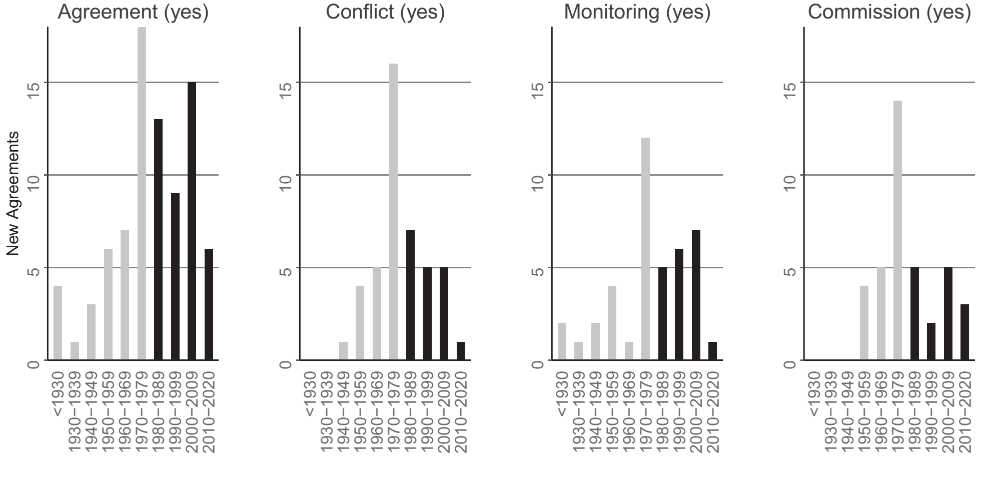

FIGURE 1 New agreements and their design per decade: The time period after 1980 (black bars) is included in the models.

consistency and comparability, as the canton of Jura was only founded in 1979. The final count of bilateral intercantonal water agreements analyzed was 42. Robustness checks using all bilateral agreements are presented in the Table 7 in Appendix II.

The agreements used for the analysis deal with freshwater and surface as well as groundwater and include, for instance, the following issues: construction agreements regulate joint water works; agreements on pollution typically set up water treatment plants; shipping agreements, for instance, involve port regulations; fishing agreements often prescribe how much fish may be withdrawn in which places. These primary topics can easily be identified from agreement titles.

Dependent variable: Agreement design mechanisms

To assess the different types and qualities of cooperation, we develop a scheme for the qualitative categorization of agreement texts which captures the presence or absence of different design mechanisms. The first design mechanism, conflict resolution, is coded as being present whenever a procedure is specified that regulates how potential tensions and conflicts between both substates should be settled. This design mechanism includes three sub-forms. First, peer resolution, in which the concerned substates use internal procedures (no other substate or national agency involved who acts as a mediator) to resolve tensions. For example, in their cooperation agreement on shared measures of nature protection (783.32), the cantons of Basel Stadt and Basel-Landschaft agree to settle all disputes through the jurisdiction of one canton, Basel-Stadt. Second, dedicated conflict resolution bodies are established in the agreement. For instance, the cantons of Nidwalden and Obwalden included in their concordat covering the construction of a commonly used water treatment plant (783.3) for cases of conflict-specific provisions for setting up an arbitration panel including members from both cantons. Third, conflict resolution through super-ordinate federal agencies or jurisdictions. For example, the cantons of Basel-Stadt and Basel-Landschaft, in their agreement on the construction and use of a hydroelectric power plant, name the Swiss Federal Supreme Court as the locus for conflict resolution (493.21).

The second design mechanism, monitoring, describes institutionalized actions to track compliance of contracting substates and elicit information about the ecological state of rivers and lakes. This mechanism appears in two ways, with either substates or a commission monitoring agreement compliance. Due to efficiency considerations, substates may decide to allow police forces of one substate to enforce provisions within the jurisdiction of other substates. For example, the fishery agreement on a shared river between the cantons Zurich and Zug allows inspectors from both cantons to monitor rule compliance on each other's territory (923.74). Commission monitoring is present when a commission formally established or updated through this agreement, or a commission of an agreement in the same lineage has the right to monitor (see below, e.g., for commissions).

The third design mechanism involves the establishment or update of an agreement commission for the management of treaty provisions. This design mechanism may also be present in three different forms. First, permanent commissions are bodies of the agreement by themselves. These include joint management bodies with allocated tasks, for instance, policing fisheries or shipping. One example is the intercantonal commission for the fishery on Lake Murten, which goes back a concordat between the cantons Vaud and Fribourg (923.61). With oscillating chairmanship, substate representatives participate in the commission's decision-making bodies and, for example, decide on licenses for professional fishers. A second type comprises public special-purpose associations typically for maintaining shared infrastructure and services, such as water treatment and quality management, where a spatial misfit between hydrological flow patterns and governance structures exists. Substates initiate these associations, but operation and oversight are delegated to lower administrative levels, such as municipalities, usually tasked with this kind of public service provision. For instance, by means of a concordat, the cantons of Thurgau and St. Gallen established a regional water supply association initially comprising eight municipalities plus two water corporations from both sides (751.51) that is then charged to organize regional water supply largely autonomously. Third, commissions may be created in the form of a public-private enterprise. This form of cooperation is often found for shared electricity generation facility management, such as in the agreement mentioned above between Basel-Stadt and Basel-Landschaft on the construction and use of a hydroelectric power plant.

TABLE 1 Chi-squared correlation between design mechanisms.

	Conflict	Monitoring	Commission
Conflict	–	0.05 (0.823)	7.019 (0.008)
Monitoring	–	–	0.034 (0.853)
Commission	–	–	–

Note: *p*-values are shown in parentheses.

Substates usually retain significant influence and veto powers in these, for example, by occupying large shares of seats in governing boards, allowing them to influence organizational conduct.

All agreements have been assessed and coded for whether they specify or establish or update these three institutional design mechanisms. Appendix I presents anchor examples using text excerpts that illustrate the three mechanisms' manual annotation of text passages. Several mechanisms can be present in one agreement, meaning that the mechanisms are not mutually exclusive (see also Table 1). Whenever a design mechanism was identified in an agreement, the first author coded a 1 for the respective variable and 0 otherwise. To increase this procedure's robustness and assess its reliability, the second author coded a random sample of 15% of agreements. Average scores of inter-coder reliability tests (Cohen's Kappa) lay at 0.77 (for a more detailed assessment, see Table 3 in Appendix I).

Figure 1 shows the number of new agreements and the number of design mechanisms per decade. As concordats are rarely terminated or dismantled, the cumulative number of agreements rose over time, illustrating the increasing importance of sub-national cooperation in federalist Switzerland. The number of new agreements was especially high between 1970 and 1979, reflecting a raised awareness of environmental issues and legislation at the national and cantonal levels in Switzerland and beyond (Mauch & Reynard, 2004). Monitoring and Commission mechanisms are both present 73 times in the data. Conflict resolution is present in 61 agreements. Table 1 presents χ^2 between the three design mechanisms we use to assess the correlation between binary variables. It shows that although monitoring does not tend to co-appear with the other design mechanisms, conflict resolution, and commission are strongly correlated, meaning they often co-occur in the same agreement.

As some of our examples on agreement design mechanisms have shown, similar mechanisms have been chosen for different problems and different mechanisms have addressed similar problems. Table 2 in Appendix I shows that all mechanisms are roughly equally distributed over all problem areas. We conduct pairwise *t*-tests (see Appendix I) to show that the symmetry of water interdependence does not vary across design mechanisms. Both types of evidence suggest that the same design mechanisms are often applied to different problem structures in terms of issue and symmetry (Feiock, 2013; Mitchell & Keilbach, 2001; Schlager et al., 1994). This supports our central argument that problem structure may not be the only driver of variation in institutional design but that past institutional choices might also matter.

Independent variables and controls

While earlier agreements provide the independent variables of interest to test our hypotheses, we include a set of control variables representing the most important alternative explanations for agreement design. These capture the exogenous factors that influence treaty formation. Most importantly, water resource interdependencies between substates may pose different externalities to cooperation partners, affecting their interests and preferences in formalizing cooperation (Feiock, 2013; Fischer & Jager, 2020). Asymmetric externalities, which occur typically along rivers with clear upstream-downstream relations, induce costs upon other actors for which they are not compensated. By contrast, symmetric externalities induce similar or the same costs for all actors, including the perpetrator. Stationary CPRs, such as lakes, generate predominantly symmetric externalities, whereas non-stationary CPRs, such as rivers, also result in asymmetric externalities (Dombrowsky, 2007; Mitchell & Keilbach, 2001; Schlager et al., 1994). To capture the symmetry of hydrological interdependence and thus substates' interests in cooperation, we measure if externalities are shared equally between substates or if this relationship is uneven, meaning that water predominantly flows from one to another. To operationalize symmetry, we calculate the area in a watershed that drains to every other substate. Ranging from 0 to 1, higher values indicate more symmetric hydrological interdependence (see descriptions for Figures 2 and 3 in Appendix I for more detailed explanations).

Other control variables included in our models are dummy variables for four issue areas: pollution (e.g., sewage treatment, water maintenance), shipping (e.g., navigation, harbors, water police), fishing (usually around private or commercial fishing rights in individual water bodies), and construction (of e.g., bridges, weirs, or flood protection infrastructure).[3] These might provide different basic incentives for cooperation (Feiock, 2013). The distribution of new agreements across issue areas and time is shown in Figure 1 of Appendix I. We include a variable that captures whether one of two substates in a dyad is bilingual to control for the expectation that cultural similarity fosters cooperation (Bochsler, 2009; Fischer & Jager, 2020). These three control variables are constant over time (symmetry, bilingual) or specific to a treaty (issue area). They capture the most important exogenous factors at the dyadic level (i.e., the level of a (potential) treaty across two substates) affecting substate cooperation in federal systems (Fischer & Jager, 2020).

Table 2 presents summary statistics for all dependent and independent variables included in our models. The second column represents the 63 observations. These contain 42 dyads that signed one or more agreements plus 21 dyads that could have signed agreements but never did. Eighteen agreements contain conflict resolution mechanisms, 19 contain monitoring provisions, and 15 formalize updates or create commissions. Design mechanism variables are all binary. Variables that operationalize the number of prior agreements, commissions, monitoring mechanisms, or conflict resolution mechanisms are integer numbers. These distributions are all skewed to the right. In our robustness checks, we transform the variables counting the number of prior agreements to binary variables (1 meaning two cantons share at least one prior agreement, 0 otherwise). We start our analysis in 1980 (with earlier agreements being counted as prior agreements), given that the youngest Swiss canton (Jura) was founded in 1979. We also present one additional model in Appendix II (Table 6) with longer time ranges.

Model

We employ a Cox proportional hazards model with the time-stamped treaty as the unit of analysis. Using the treaty as the unit of analysis for bilateral agreements allows modeling the rate at which dyads of two cantons sign agreements. The Cox model is a semi-parametric survival model that models the time until an event occurs

TABLE 2 Descriptive statistics.

Row	Observations	Mean	Std. Dev	Min	Median	Max	Time varying
Agreement (yes)	63	0.67	0.48	0	1.00	1.00	No
Conflict resolution (yes)	63	0.29	0.46	0	0.00	1.00	No
Monitoring (yes)	63	0.30	0.46	0	0.00	1.00	No
Commission (yes)	63	0.24	0.43	0	0.00	1.00	No
Prior agreements	63	1.56	2.43	0	0.00	9.00	Yes
Prior conflict resolution	63	0.84	1.93	0	0.00	8.00	Yes
Prior monitoring	63	0.75	1.48	0	0.00	6.00	Yes
Prior commission	63	0.76	1.75	0	0.00	7.00	Yes
Pollution (yes)	63	0.29	0.46	0	0.00	1.00	No
Shipping (yes)	63	0.11	0.32	0	0.00	1.00	No
Fish (yes)	63	0.32	0.47	0	0.00	1.00	No
Construction (yes)	63	0.24	0.43	0	0.00	1.00	No
Bilingual (yes)	63	0.30	0.46	0	0.00	1.00	No
Symmetry	63	0.14	0.21	0	0.03	0.71	No

(Cox, 1972; Therneau et al., 2021) with repeated events (Box-Steffensmeier & Zorn, 2002) and time-varying covariates (Box-Steffensmeier & De Boef, 2006). Time-stamped data allow for highly granular temporal analysis, and our method is more appropriate than econometric panel models such as fixed or random effects estimators. A further significant advantage of the semi-parametric model compared to parametric survival models is its nonrestrictive assumption on the magnitude of an effect over time because the probability of observing an event may change over time. Other parametric survival models require a specific assumption about the distribution of events over time that can make it more difficult to obtain a good fit for the data.

Crucially though, we note that this observational approach does not allow us to interpret our estimates as causal since the variation in our explanatory variables is non-random. For estimates to be interpreted as causal effects, variation in the explanatory variable should be exogenous to the outcome. In our case, however, some factors may influence both initial and subsequent design choices, correlating the regression's error term with explanatory variables. The estimates should therefore be interpreted as correlative rather than causal evidence. Thus, our study provides a first step to theorizing design paths over time. Subsequent research may use, for example, quasi-experimental methods to further test these hypotheses.

Swiss substates' cooperation on water issues is geographically constrained to contiguity by land or lakes, which limits potential concerns of endogeneity. To specify the risk set of substates for which the model allows the creation of agreements, we use substate polygons (meaning the geographical area of the cantons using geographic data) and find 56 contiguous pairs of substates. We further exclude six contiguous substate pairs from this risk set for which our hydrological drainage data suggest no water exchange.[4] The six substates pairs that exchange no water have no incentive to enter bilateral water agreements. Thus, our risk set contains 50 substate dyads. Of these, 21 do not sign agreements, although they could have, and 29 dyads sign 42 agreements, meaning that there are 13 repeated events. As shown in Table 2 and the regression results table, the total number of observations is 21 dyads (sign no agreement) + 42 dyads (sign one or more agreements) = 63 observations. Since we are primarily interested in the path of institutional cooperation over time rather than which substate chooses to cooperate with which other substate, we deem the assumption of independent observations tenable in this particular context.

Standard Cox models investigate the time until a first event occurs. For instance, in medical research, this framework has often been employed to model the time to death of a patient, meaning that after death, observations are no longer at risk of experiencing an event: they drop out of the model's risk set (see e.g., Platt et al., 2004). However, in our case, dyads potentially repeated the cooperation events of entering into agreements. Therefore, observations do not necessarily drop out of the risk set. The Cox proportional hazards model allows a precise specification of the dyads that are at risk, meaning that substates can sign an agreement because they are contiguous and share common waters. Non-contiguous substates do not share a single agreement in Switzerland, making modeling the possibility for them to do so unnecessary. We, therefore, adopt a dyadic approach with the following specification

$$h(t;x;z) = h_0(t) \times \exp(\beta_1 x_{i1} + \cdots + \beta_k x_{ik} + \gamma_1 z_{i1} g(t) + \cdots + \gamma_l z_{il} g(t))$$

The dependent variable of the Cox model is the hazard rate $h(t;x;z)$ where t is time and X is a set of time-invariant covariates where $x_i \in \{1, \ldots k\}$ and Z is a set of l time-varying covariates where $z_i \in \{1, \ldots l\}$ with parameter estimates β and γ expected to influence the rate at which events occur. The function $g(t)$ allows the coefficients Z to vary over time. The last column in Table 2 shows which variables are time-varying. The baseline hazard $h_0(t)$ operates as an intercept and captures the general tendency of an event. The baseline hazard is multiplied by the exponentiated regression function to obtain the predicted hazard at time t.

RESULTS

Table 3 contains eight columns with results for four different dependent variables—with and without control variables: the hazard of a bilateral substate water agreement (models 1 and 2) and the hazard of an agreement including the three design mechanisms; conflict resolution (models 3 to 4); monitoring (models 5 to 6); and commission (models 7 to 8). Recall that we expect prior conflict resolution and monitoring mechanisms to foster trust and reciprocity, making further cooperation more likely. By contrast, we assume that commissions seek to enlarge their sphere of influence and internalize further cooperation, which should be associated with a lower rate of further agreements with design mechanisms other than commissions. Our hypotheses thus did not specify the type of agreement we expected to follow (or not). In that sense, lines 1–5, with the effects of prior agreements, prior conflict resolution, prior monitoring, and prior commissions for the first two models, contain the information that we need to evaluate our

TABLE 3 Cox proportional hazards model with the square root of the cumulative variable for prior agreements in the time period from 1980 to 2020.

	Agreement		Conflict		Monitoring		Commission	
	1	2	3	4	5	6	7	8
Prior agreement	1.84***	0.88**	1.62**	−18.77	0.76	0.14	1.17	−0.17
	(0.35)	(0.31)	(0.51)	(10.56)	(0.88)	(1.05)	(0.85)	(0.64)
tt(Prior Agreement)				2.18				
				(1.17)				
Prior conflict resolution	−0.31	0.78	1.74**	0.95	−0.90	0.08	−0.78	−0.78
	(0.44)	(0.64)	(0.64)	(0.84)	(0.54)	(0.68)	(0.67)	(0.79)
Prior monitoring	−0.84*	−0.20	−1.13***	0.34	1.26	2.28	−1.14*	0.97*
	(0.34)	(0.40)	(0.30)	(0.47)	(1.08)	(1.53)	(0.54)	(0.44)
Prior commission	−0.16	−0.89*	−1.56***	−1.72**	0.12	−0.99	1.58	1.64*
	(0.36)	(0.41)	(0.41)	(0.60)	(0.52)	(0.57)	(1.16)	(0.75)
Pollution		0.75*		2.54***		1.39*		5.57**
		(0.36)		(0.74)		(0.57)		(1.77)
Shipping		0.42		−0.19		−0.91		2.34
		(0.78)		(1.30)		(0.70)		(1.45)
Fish		−15.49*		−18.63***		1.61*		−1.92
		(7.76)		(0.70)		(0.65)		(1.01)
tt(Fish)		1.92*						
		(0.85)						
Construction		1.46***		1.96***		1.26		2.35**
		(0.43)		(0.58)		(0.71)		(0.88)
Symmetry		−0.14		−0.50		−0.40		4.71*
		(1.17)		(2.88)		(1.07)		(2.26)
Bilingual		0.02		0.58		0.87		2.15*
		(0.36)		(0.52)		(0.73)		(1.01)
AIC	260.125	239.865	104.965	82.124	111.503	104.806	90.561	64.979
BIC	267.076	258.979	108.526	91.918	115.281	114.25	93.393	72.059
Events	42	42	18	18	19	19	15	15
Missings	0	0	0	0	0	0	0	0
PH-Test	0.672	0	0.229	0.095	0.799	0.064	0.026	0.267
Observations	63	63	63	63	63	63	63	63

Note: Standard errors clustered by dyad, $*p<0.05$, $**p<0.01$, $***p<0.001$, PH tests are conducted before time transformation. The number of events stands for the number of times an agreement of a specific type was concluded, while the number of observations is the number of agreements plus the number of agreements which could have been concluded between contiguous cantons (risk set) but for which no agreement was observed. The time transformation tt(.) multiplies the covariate with the logarithm of time plus 20: $x \times \log(t+20)$, the recommended functional form by Therneau et al. (2021).

hypotheses in a strict sense. The first line does not specify the design mechanism of the earlier agreement (that should incentivize or not further agreements). In contrast, models 3–8 are more specific concerning the dependent variables than our hypotheses, as they specify design mechanisms.

We use the square root for the count of earlier agreements because our model performs better with this transformation regarding the Cox proportional hazards assumption.[5] Figures 4–7 in Appendix III display the results of individual Schoenefeld tests for each variable for the results in Table 3. They show that the assumption is violated only in model 2 for the covariate for fisheries and the prior agreements in model 4, indicated by a *p*-value below 0.05. For models that violate the Cox proportional hazards assumption of a constant effect size over time, we implement time transformations (see e.g., Therneau & Grambusch, 2000) to alleviate bias for those variables that violate the assumption (Box-Steffensmeier et al., 2004; Jin & Boehmke, 2017; Kropko & Harden, 2020; Licht, 2011; Therneau et al., 2021). We are therefore confident that our models perform well regarding the Cox proportional hazards assumption. The section on robustness checks provides further information.

First, and most generally, we find that prior agreements (independently of the design mechanism) are positively and significantly associated with the rate at which further agreements occur. Exponentiation of the coefficients in log-odds yields hazard ratios, the substantive quantities of interest indicating changes in the likelihood that a new agreement with a particular design mechanism is adopted. In model 2, one additional prior agreement accelerates the conclusion of further agreements and increases the hazard by $\exp\left(0.88 \times \sqrt{1}\right) = 2.41$, an increase to 241% of the base rate. This suggests that agreements do not generally "solve" cantons' water-related issues but are a starting point for further institutionalizing an intergovernmental relationship. This result supports our hypotheses generally, as it suggests that prior agreements reduce transaction costs and are associated with an increasing pace at which further agreements emerge. The result shows that while the accumulation of prior agreements reduces the time to the next agreement, this varies depending on the design mechanisms. Results from models 3–8 suggest that the effect of any general agreement mainly applies to conflict resolution in model 3 but vanishes when adding controls in model 4. Thus, more past agreements between cantons accelerate the establishment of additional agreements generally (models 1–2) but not agreements with any particular design mechanism (models 4–8).

Next, we look more closely at the hypothesized effects of the three design mechanisms of conflict resolution, monitoring, and commission. First, considering agreements in general, irrespective of the design mechanisms these include, only prior commissions have a significant and negative effect (model 2). Results thus corroborate our hypothesis that prior commissions are associated with a delay in additional agreements being concluded. Next, considering specific design mechanisms as dependent variables (models 3–8), there is no evidence in our data for many of our hypotheses, at least once we control for the problem structure. Yet, contrary to our hypothesis, we observe that established conflict resolution mechanisms are not significantly associated with the formation of agreement commissions when including controls (models 7–8).

In line with our hypothesis that monitoring accelerates the inclusion of further design mechanisms, we find evidence that monitoring is associated with a higher rate at which agreement commissions are included in subsequent agreements in model 8. Since prior monitoring does not have a statistically significant effect on any other design mechanism in our specifications with control variables, results for monitoring provide largely insufficient evidence for our hypotheses.

Consistent with our hypothesis, prior commissions are associated with a delay in the inclusion of further conflict resolution mechanisms (model 4). Specifically, we find that a prior commission decreases the hazard of including a conflict resolution mechanism by 82.1%. Figure 2 illustrates this effect with a Kaplan–Meier plot. This plot shows the decreasing probability for a dyad with (blue) or without (red) a commission to do without an additional conflict resolution mechanism (on the y-axis) over time (the x-axis). Consistent with our hypothesis that commissions might seek to enlarge their sphere of influence and develop their agency, commissions by themselves accelerate the creation and the updating of their competencies in the form of further agreements, including commissions.

Concerning control variables, we first observe that different design mechanisms tend to be more or less prevalent in almost all issue areas. In the area of water pollution, all design mechanisms are popular.

By contrast, the effects of shipping and construction remain statistically insignificant. Fishing issues rely on monitoring most easily and are unlikely to use actual conflict resolution mechanisms. We did not estimate the effect of fishing on conflict resolution mechanisms in model 4 because our data do not consist of a single bilateral agreement on fishing with conflict resolution mechanisms. There is no strong evidence in this data on the contextual effects of bilingualism or the symmetry of the water resource itself. Concerning cultural diversity, for instance, when an agreement involves partners from both the French- and German-speaking substates of Switzerland, commissions are a likely design mechanism. The statistically significant effect for the bilingual variable in model 8 suggests that commissions are attractive as a design mechanism to deal with cultural diversity and different languages. This result suggests that linguistic diversity and resulting challenges are compensated by formalizing the cooperative relationship through commissions, which may provide more flexibility for coordination and cooperation. Concerning the symmetry of water exchange, it seems that effects of (a-)symmetry are less pronounced in the studied federalist system than what is usually observed in international water-related cooperation (Beck et al., 2010; Mitchell & Keilbach, 2001; Schlager et al., 1994; Zawahri & Mitchell, 2011). This could be due to entanglement through frequent interaction in such highly institutionalized polycentric or multilevel networks. These aspects of federalist systems foster trust and reciprocity and generate high reputational costs for non-cooperative behavior. There is also the potential of a higher-order authority to step in if problems are not solved at the level of sub-state cooperation (Milinski et al., 2002; Ostrom, 2010; Poteete et al., 2010; Rothstein, 2005). Our non-finding with high-quality GIS data on drainage systems is in line with Beck et al. (2014), who use a similar approach and find no effect for asymmetric hydrological interdependencies on cooperation in international basins.

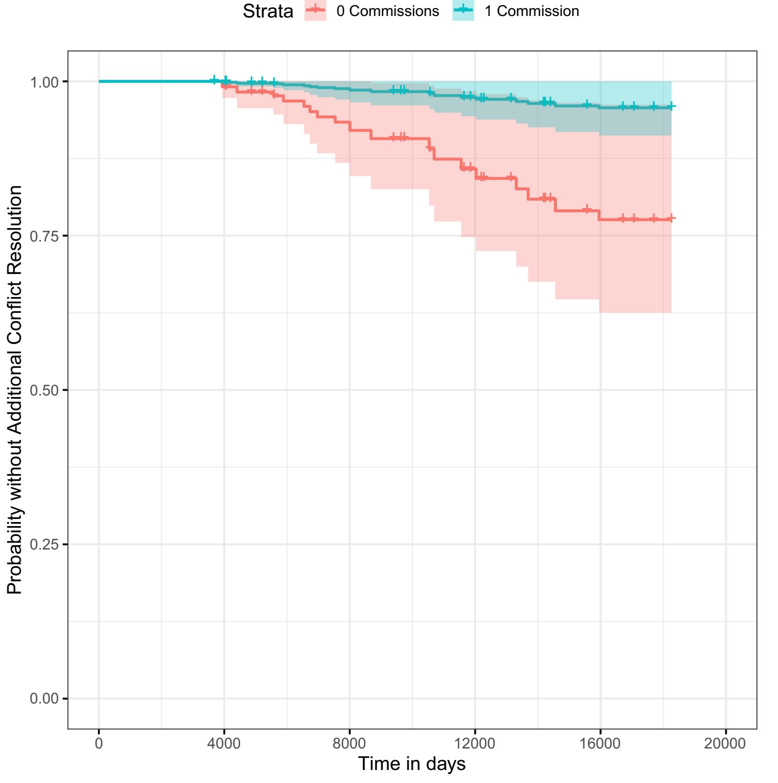

FIGURE 2 Kaplan–Meier estimates for model 4 in Table 3 illustrate the marginal effect of commissions on the probability to manage shared resources without conflict resolution mechanisms. Ticks illustrate events.

Robustness checks

To assess the robustness of our measurement approach behind the results presented in Table 3, we also investigate the effects of (a) a simple cumulative prior agreement variable and prior design mechanisms, (b) a dichotomous variable that distinguishes no prior agreements from one or more prior agreements and prior design mechanisms, and (c) the cumulative number of prior agreements and prior design mechanisms for the period from the year 1945 to 2020.

Two out of three additional models (Tables 5 and 7 in Appendix II) indicate that prior commissions are associated with a lower rate of including conflict resolution mechanisms subsequently. For the third specification (Table 6 in Appendix II), this estimate, while pointing in the same direction, remains statistically insignificant. The finding that prior commissions are associated with a higher rate of further treaties, including commissions as a design mechanism, is, however, confirmed through a significant effect only in one out of three additional specifications (Table 7 in Appendix II), with the effects in the other two specifications (Tables 5 and 6 in Appendix II) again showing the expected sign but remaining insignificant. In general, we observe no robust effects for coefficients for which the Cox PH assumption was violated and where we correct it with time transformations.

DISCUSSION AND CONCLUSIONS

In this study, we investigate institutional design paths in federal cooperation. We show that institutional design depends not only on the characteristics of the problems they aim to solve (Mitchell, 2006; Mitchell & Keilbach, 2001; Schlager et al., 1994) but also on parties' prior institutional choices. Focusing on agreements between Swiss substates in the water sector (Fischer & Jager, 2020), we analyze established institutional design mechanisms of conflict resolution, monitoring, and commission to assess design paths of intergovernmental cooperation. Theoretically, we expect that conflict resolution and monitoring foster trust and reciprocity that increase the cost of defection and therefore accelerate institutionalization through further agreements (Tir & Stinnett, 2011; Wolf, 1997). We further argue that agreement commissions achieve a certain degree of independence and acquire agency that might delay the institutionalization of further other design mechanisms (Koremenos, 2008; Koremenos et al., 2001) due to the assumed interest of bureaucrats to enlarge their sphere of influence. Commissions are, to some degree, a substitute or umbrella for other design mechanisms. Thus, we expected agreements with commissions to slow down institutional layering because commissions acquire competencies they seek to maintain (Barnett & Duvall, 2004). Instead, we find that agreements establishing commissions drive further agreements establishing or updating commissions.

Our findings point to specific institutional design paths. Specifically, our findings concerning the effect of commissions align with our hypothesis, that is, previous experience with commissions reduces the development of other design mechanisms. They are compatible with our broader argument that commissions might create an umbrella for further institutionalization and that commission bureaucrats strive to enlarge their power by acquiring agency. However, for the design mechanism of conflict resolution, our analysis did not provide evidence that conflict resolution is a stepping-stone toward deeper institutionalization in creating commissions. On the contrary, it seems to make such a path less likely. This design mechanism provides an alternative path of its own. The three mechanisms of conflict resolution, monitoring, and commissions are not mutually exclusive and can be present in parallel within legal documents. However, once two substates have selected a given mechanism, this mechanism is often reproduced in further agreements.

We can observe these issue-specific pathways in the summary figures in Figure 3. In the first subfigure in the top left, we see that agreements for intercantonal pollution problems can take any or none of the design features we are looking at here. Where the problem is symmetric (Symm) or spans cantons operating in different languages (Biling), we are more likely to see the commission (CM) design choice chosen. While all four options are open, a design that includes monitoring can subsequently lead to a

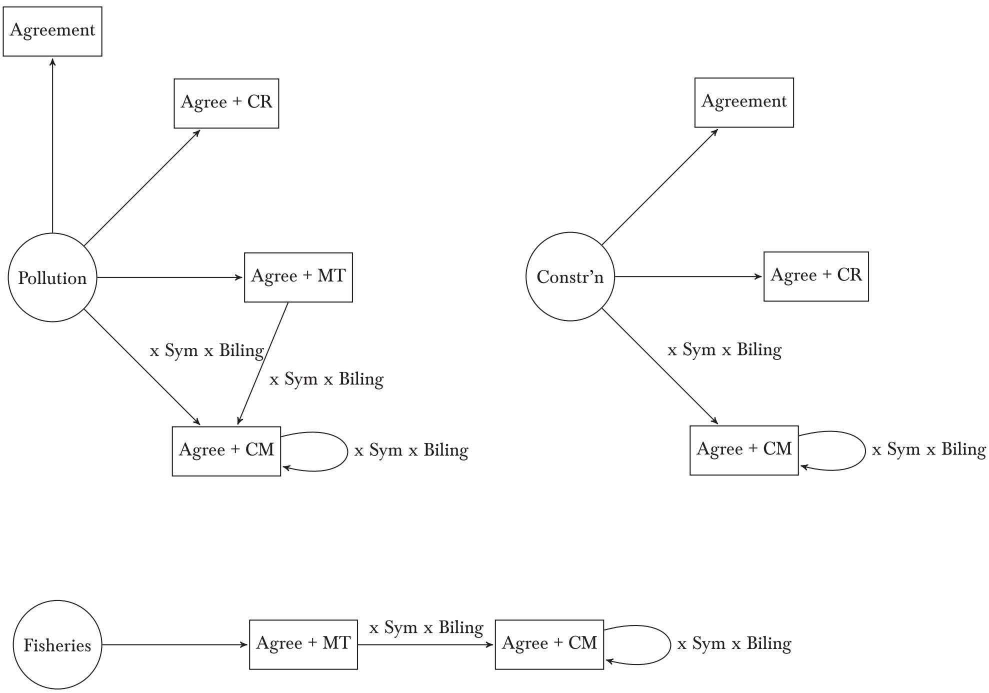

FIGURE 3 Issue-specific pathways.

commission being established (though this does not seem to be a robust finding). Commission extensions can supplement an established commission. In the second subfigure on the top right, we see that monitoring is rarely an option when construction is the issue. Again, where problem symmetry and bilingualism are present, commissions are a popular choice with a positive feedback loop. Lastly, in the final subfigure, we see a single, distinct path of institutional design. In the first place, only monitoring provisions are likely. However, after this, and especially where there is problem symmetry and bilingualism, we may see commissions established, again with positive feedback on this endpoint.

Results from this article have implications for the broader literature on institutional change (Dryzek, 2016; Howlett & Rayner, 2006b; March & Olsen, 1989; Martin & Sunley, 2006; Moore, 2017; North, 1990; Weaver, 2010; Williamson, 2000). First, the literature on inter-governmental cooperation argues that agreement commissions may point contracting substates to further issues and may therefore proliferate institutionalization (Tir & Stinnett, 2009). The results of our analysis are consistent with our hypothesis that commissions are likely to expand their mandate while slowing down the inclusion of further conflict resolution mechanisms. Second, path dependency is characterized by potentially random historical switch points triggering increasing returns and incremental change until a new equilibrium is reached (North, 1990; Pierson, 2000). Consistent with path dependency, agreements are concluded more quickly when substates already share prior agreements. Our analysis shows that prior choices of institutional design are likely to affect the likelihood of institutional change. The results imply that commissions can have the opposite effect on the institutionalization of the relationship between two substates than is predominantly argued in the intergovernmental cooperation literature (Tir & Stinnett, 2009), unless they update their own competencies. They indicate that institutional design can have positive and negative feedback. In sum, this article thus contributes to the literature on institutional change and cooperation by arguing that not all institutional cooperation is self-reinforcing but that the effect of prior institutionalization can go in both directions and create specific paths, depending on prior design choices.

Results from this article are relevant for many different fields of research in political science and public policy research. For example, contrary to earlier work on intergovernmental cooperation in federal systems (Bowman, 2004; Fischer & Jager, 2020; Heikkila et al., 2011; Woods & Bowman, 2018), common pool resource governance (Heikkila et al., 2011; Ostrom, 1990, 1993), and institutional collective action (Feiock, 2013; Feiock & Scholz, 2010), we advance a sequential understanding of cooperation (Howlett & Rayner, 2006b). While explanations for the specific design of intergovernmental cooperation have often been explained based on problem characteristics (Feiock, 2013; Schlager et al., 1994), incentive structures (Bolleyer, 2006; Feiock, 2013), or actor interdependencies (Fischer & Jager, 2020; Herzog & Ingold, 2019; Hollway & Koskinen, 2016), we show that prior institutional choices and related design paths may also play a role. We distinguish inter-governmental substate cooperation by the different design mechanisms chosen (Koremenos et al., 2001; Ostrom, 1990, 1993; Tir & Stinnett, 2011), focusing theory in this area on particular choices substate representatives might make.

Empirically, we contribute by qualitatively categorizing agreement texts for the design mechanisms. We collect agreement data with high temporal granularity in the form of agreement signature dates (time stamps) and model these quantitatively using a Cox proportional hazards model. This model provides correlational evidence on which factors are associated with increasing or decreasing the rate at which new agreements are introduced. Controlling for the problem structure, using the hydrological symmetry of water exchange as an alternative explanation in the literature on water cooperation with GIS data, we report robust evidence for our main finding that design mechanisms create separate endpoints of these institutional design paths. That is, our study cannot offer estimations of the causal effects of prior design choices on the future evolution of federal cooperation. However, the results are indicative and promote further theorizing and testing in the area.

This study opens new avenues for research on substate and institutional design. Since the prior institutional choices by substates are not completely random but are instead shaped by conscious decisions of negotiators, future research will need to find ways to establish causal effects of prior agreements on the development of institutional design paths over time (e.g., through drawing on ideas of regression discontinuity design, or Heckman-style selection models). Future research should also investigate if our findings from the Swiss federal system also hold for other contexts, and how exactly institutional pathways unfold on the ground. For instance, future research could use votes in the ratification chambers as quasi-random variation in the explanatory variable, the earlier institutional design features, in a regression discontinuity design. Such data may be more likely to be available at the national level. Moreover, while the Swiss federal system is characterized by strong incentives and a broad palette of design options for voluntary horizontal cooperation, other federations pose different incentives and opportunity structures for intergovernmental cooperation. Moving attention to other levels, additional research on, for example, local, municipal, or international levels (Laurens et al., 2023) would further our understanding of the institutional trajectories of cooperation and therefore provide practically important knowledge for institutional design at various scales.

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ENDNOTES

1 This can also be seen in our Swiss data in the Appendix I (p. 3), where all three mechanisms appear in all these issue areas; for instance, agreements around fisheries contain a whole palette of mechanisms for monitoring, conflict resolution, or commission, while for example, the cantons of Basel-Stadt and Basel-Landschaft employed the same mechanism of commissions to deal with shipping and water pollution within their shared waters.

2 Our online supplementary materials provide an interactive animation of the evolution of bilateral cooperation over time.

3 Other issues are border issues or hydropower issues. These were not included because there are either very few bilateral agreements (hydropower) or because they only contain new coordinates for the border demarcation between two substates but no new substantive treaty provisions.

4 These are Bern and Nidwalden, Bern and Uri, Fribourg and Neuenburg, Glarus and Graubünden, Nidwalden and Schwyz, Uri and Wallis. Thus, in those cases, the substate borders largely follow watershed delineations. None of these substate dyads share a water agreement.

5 The assumption requires the effects for different strata in the data to be proportional over time. Figure 2 in the results section shows that this is the case.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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