

Beyond inputs and outputs: Process-oriented explanation of institutional change in climate adaptation governance

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Funding information

H2020 Marie Skłodowska-Curie Actions, Grant/Award Number: 659065; Marie Skłodowska-Curi, Grant/Award Number: 659065; European Union's Horizon 2020 research and innovation programme; CR(2) Centre for Climate Change and Resilience (Centro de Ciencia del Clima y la Resiliencia); Universidad de Chile

Abstract

Climate adaptation is a growing imperative across all scales and sectors of governance. This often requires changes in institutions, which can be difficult to realize. Explicitly process-oriented approaches explaining how and why institutional change occurs are lacking. Overcoming this gap is vital to move beyond either input-oriented (e.g., capacity) or output-oriented (e.g., assessment) approaches, to understand how changes actually occur for addressing complex and contested governance issues. This paper analyses causal conditions and mechanisms by which institutions develop in climate adaptation governance. It focuses on urban climate governance through an in-depth case study of Santiago, Chile, over a 12-year period (2005–2017), drawing on primary and secondary data, including 26 semistructured interviews with policy, academic, and civil society actors. It identifies and explains a variety of institutional developments across multiple levels (i.e., programmatic, legislative, and constitutional), through a theory-centric process tracing methodology. This reveals a multiple-response pattern, involving several causal mechanisms and coexisting institutional logics. Findings suggest that although adaptation may be inherently protracted, institutions can nevertheless develop in both related and novel directions. Overall, the paper argues for a new research agenda on process-oriented theorizing and analysis in climate and environmental governance.

KEYWORDS

Chile, climate governance, governance adaptation, gradual change, institutional dynamics, institutions, transformation

1 | INTRODUCTION

Climate adaptation is a growing imperative across all scales and sectors of governance (Bauer, Feichtinger, & Steurer, 2012; Javeline, 2014). For example, it is a major challenge in urban governance, due to the large (and growing) concentrations of people, economic productivity, and thereby climate risks contained in cities (Knieling, 2016; Van

der Heijden, Patterson, Juhola, & Wolfram, 2019; World Bank, 2010), as evidenced by a wide range of climate change-related impacts and disasters (e.g., droughts, floods, and storms) occurring in cities across the globe in recent years. Institutional changes will often be required to adapt governance under climate change (Agarwal, Perrin, Chhatre, Benson, & Kononen, 2012; Birkmann, Garschagen, & Setiadi, 2014; Carmin, Anguelovski, & Roberts, 2012), but this can prove to be

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extremely difficult (Dovers & Hezri, 2010; Huitema et al., 2016). Urban governance typically involves densely networked institutional arrangements and dispersed responsibility and authority, spanning multiple jurisdictional levels within and beyond the urban territory (Bulkeley & Betsill, 2013). Institutional design from a clean slate is thus largely unrealistic. Instead, institutional development for adapting to climate change will need to occur in situ to a large extent, by reworking existing setups and introducing new elements to address gaps or failures. Nonetheless, it should be expected that these processes will often be complex, contested, and sporadic.

Process-oriented explanations of institutional development in climate adaptation governance are needed although remain vastly underdeveloped both theoretically and methodologically. Formative prior work in this line of thinking has focused on (a) the intraorganizational dynamics of municipalities (Aylett, 2013; Taylor, 2016), (b) output-based assessments of adaptation planning (Aguar et al., 2018; Hughes, 2015; Reckien et al., 2018), institutional innovation (Anguelovski & Carmin, 2011) and experimentation (Castán Broto & Bulkeley, 2013), and (c) institutionalization of climate adaptation objectives into municipal planning (Carmin et al., 2012; Roberts, 2008). Beyond this, climate adaptation literature (such as the large body of work on “adaptive capacity,” e.g., Engle & Lemos, 2010; Gupta et al., 2010) often treats institutions as explanatory factors, rather than dependent variables in their own right. This raises questions about exactly how and why processes of institutional change in governance adaptation occur and unfold over time.

Institutions are taken here to refer to “clusters of rights, rules and decision-making procedures that give rise to social practices, assign roles to the participants in these practices, and guide interactions among occupants of these roles” (Young, 2008, xxii) and which span programmatic, legislative, and constitutional levels (Ostrom, 2005; Rhodes, Binder, & Rockman, 2008). Institutions are therefore a key constitutive element of governance, mediating the roles, interactions, and practices of state, private, and civil society actors in regard to an issue area (Jordan, Huitema, van Asselt, & Forster, 2018; Biermann et al., 2010; Young et al., 2008). Institutions are often characterized as inert (Farrelly & Brown, 2011), locked-in (Seto et al., 2016), or path dependent (Barnett et al., 2015), but often, little is said about how institutions innovate and change (i.e., develop) in order to adapt and improve governance. Given the complex, contested, and long-term nature of climate adaptation (Dolšák & Prakash, 2018) and the importance of sociopolitical and environmental contexts conditioning institutional activity (Ostrom, 2005), an explicit institutional development orientation is required. This recognizes that institutions are embedded in time, and that the outcomes of past processes create the conditions for future interventions, as opposed to once-off institutional design (Pierson, 2000). Importantly, such a perspective also “encourages us to remain attentive to the ways in which previous institutional outcomes can channel and constrain later efforts at institutional innovation” (Pierson, 2004, 133).

This paper addresses the question: Under which conditions and through which mechanisms do institutions for climate adaptation develop, and with what consequences for reconfiguring governance?

It aims to explain a multiplicity of institutional developments occurring across levels in climate adaptation governance within the Santiago case and to advance a research agenda on process-oriented theorizing and analysis in climate adaptation governance more broadly. We apply a theory-centric process tracing methodology (Beach & Pedersen, 2013) in a case study of Santiago, Chile, a large national capital city situated in a middle-income country considered to be highly vulnerable to climate change (Magrin et al., 2014), over a 12-year period (2005–2017). The case study draws on primary and secondary data, including 26 key informant interviews and review of academic and grey literature (e.g., policy/planning documents and legislation). The paper proceeds as follows: Section 2 considers institutionalist insights informing the study of institutional development in climate adaptation governance; Section 3 explains the research design and methods; Section 4 introduces the case study and its context; Section 5 presents the case study analysis, and Section 6 discusses key implications arising from the findings, and Section 7 concludes.

2 | INSTITUTIONAL DEVELOPMENT IN CLIMATE ADAPTATION GOVERNANCE

2.1 | Climate adaptation governance

Climate change adaptation refers to “the process of adjustment to actual or expected climate and its effects ... [and] seeks to moderate or avoid harm or exploit beneficial opportunities” (Field et al., 2014, p. 3). More simply, this involves efforts to reduce risks and vulnerabilities expected under climate change. Doing so can make significant demands on institutions because the scale of adjustment may be either small (e.g., incremental) or large (e.g., transformational; Kates, Travis, & Wilbanks, 2012). In general, however, institutional development is typically considered to be difficult to realize and remains poorly understood. For example, Huitema et al. (2016) place the role of creating and building institutions as a central task in climate adaptation governance but observe that “little is known about how and why these choices are made in practice, and how such choices affect the outcomes of our efforts to govern adaptation.”

As Gupta et al. (2010) note, there has been an “explosion” of research on climate change adaptation over several years. While at that time, the observed focus in the literature was largely on assessing impacts and vulnerability, the focus among social scientists has since shifted in the following decade: first, toward integrative views on the production of adaptive capacities (e.g., Barton, 2013; Engle & Lemos, 2010), and second, toward the assessment and measuring of adaptation progress (e.g., Araos et al., 2016; Reckien et al., 2018), notwithstanding other emerging critical currents, particularly concerning social asymmetries (e.g., Bulkeley, Edwards, & Fuller, 2014) or transformative imperatives bound up with adaptation (e.g., Pelling, O'Brien, & Matyas, 2015). Looking ahead, there is much to be gained by giving greater attention to explaining and theorizing processes of change within climate adaptation governance, especially in ways that allow

such processes to be systematically analyzed and “lifted” from one case to be considered elsewhere.

This is not an easy task. The problem of explaining processes of change in adaptation governance is a long-standing challenge, not only for climate adaptation specifically (Barton, 2013; Biesbroek et al., 2015; Birkmann et al., 2014) but also within environmental governance more broadly (Biermann et al., 2010; Cosens, Gunderson, & Chaffin, 2014; Folke, Hahn, Olsson, & Norberg, 2005). Explanations that do exist in this line of thinking on institutions frequently invoke either individual agency factors (e.g., policy entrepreneurs and change agents) or general capacity factors (e.g., capacity inputs believed to be deliver certain outcomes). Yet both are limited: The former risks providing sanitized accounts of successful developments and can disconnect agency from its structural and cultural context, and the latter provides little in the way of causal explanation for actual developments as they occur and unfold over time, including the struggles involved (e.g., following Capocchia, 2016; Mahoney & Thelen, 2010). What is needed is to trace the process by which a certain (institutional) development occurs, including its scope conditions, causal conditions, mechanisms, and outcome. Moreover, the multilevel and long-term nature of climate change adaptation requires considering a multiplicity of co-occurring developments (i.e., beyond, say, a single plan) and their combined consequences.

2.2 | Insights from institutionalist approaches

A good starting point when taking institutional development (or institutional change) as the dependent variable is to first consider insights from long traditions of institutionalist thinking in political science and sociology. This provides a starting point for studying how and why institutions change, thereby informing abductive explanations of these processes (i.e., linking theory and empirics simultaneously; following Mason, 2002).

Institutional development centers on explaining institutional change and stability within social, political, and historical contexts. Despite being a long-standing topic (Hall & Taylor, 1996; Rhodes et al., 2008), it remains the forefront of environmental governance (Beunen & Patterson, 2016; Young, 2010) and broader political science (Cashore & Howlett, 2007; Mahoney & Thelen, 2010; Streeck & Thelen, 2005). Different lines of thinking focus on different attributes of institutions, particularly the three¹ long-established approaches of historical, rational choice, and sociological institutionalism (Hall & Taylor, 1996; Rhodes et al., 2008). Essentially, historical institutionalism assumes power asymmetries between actors and examines processes of path dependence over time following critical junctures, with particular attention to unintended consequences. Rational choice institutionalism assumes that actors seek to satisfy preferences through strategic behavior within a particular rule set and examines processes by which actors achieve coordination, with particular attention to mutual benefits. Sociological institutionalism

assumes that actors follow certain cultural practices in making decisions and examines processes of interpretation and meaning making to construct social legitimacy, with particular attention to norms and imaginaries shaping conceivable options. Although these distinctions are blurring over time, they nevertheless reflect different underlying logics: the logic of history, consequence, and appropriateness, respectively.

Furthermore, contemporary institutional theory increasingly views institutions as dynamic constructs (Clemens & Cook, 1999; Mahoney & Thelen, 2010; Weyland, 2008). For example, the “gradual institutional change” approach (Mahoney & Thelen, 2010) hypothesizes a variety of specific mechanisms of institutional change occurring under different endogenous conditions. This provides a corrective to prior thinking that arguably places undue reliance on exogenous shocks as explanations for institutional change, by highlighting ongoing endogenous factors driving institutional change. Although, questions arise about how institutions may also change under shifting external contexts (such as climate change), which requires attention to both exogenous and endogenous causal conditions. Hence, an institutional development lens (*sensu* Pierson, 2004) remains useful. Table 1 thereby synthesizes foundational theoretical insights about institutional development processes as a basis for the empirical study in this paper.

3 | RESEARCH DESIGN

We conduct an exploratory in-depth case study analysis of urban climate change adaptation governance in the city of Santiago, Chile. On the basis of theoretical (Section 2) and empirical (Section 4) considerations, we apply a novel research design to meet several analytical needs: (a) a multilevel perspective of institutional order (i.e., spanning programmatic, legislative, and constitutional levels) and possible interplay between them, in order to disaggregate a variety of institutional developments; (b) a study period exceeding a decade, in order to suitably trace institutional developments and their individual and combined effects over time; and (c) a methodology focused on uncovering causal conditions and mechanisms, to develop a process-oriented explanation of observed institutional developments. This approach is visualized in Figure 1 and operationalized as follows:

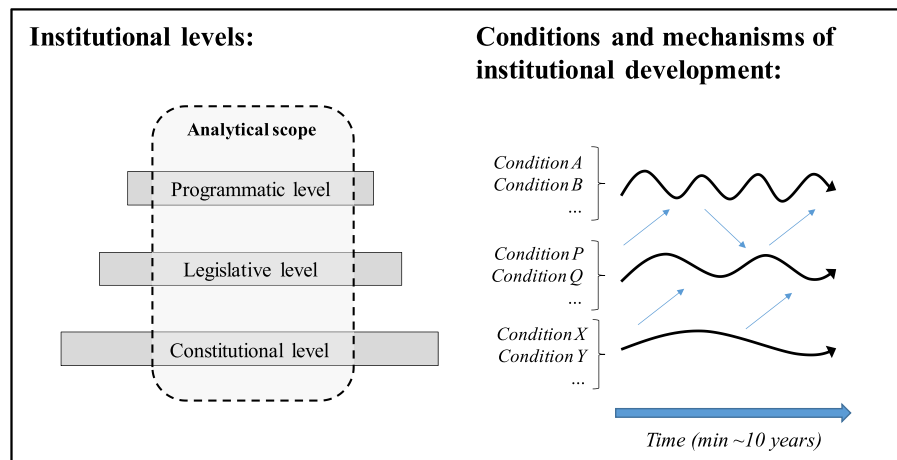
1. A multilevel perspective of institutional order encompassing: a programmatic level centering on operational and strategic aspects, a legislative level centering on legal and regulative aspects, and a constitutional level centering on underlying legal and normative aspects (e.g., following Ostrom, 2005; Rhodes et al., 2008).
2. A study period of 12 years (2005–2017), bounded by three full national presidential cycles, which is relevant to the city scale because of the centralized nature of the national political system (Section 3) and the wave of policy and governance responses to climate change occurring both nationally and within Santiago during this period.

¹A “discursive institutionalism” has also been proposed (Schmidt, 2008), although the extent to which this reflects a genuinely distinct tradition is contested (Bell, 2011) and not taken up here.

TABLE 1 Insights on processes of institutional development relevant to climate adaptation governance, drawing from prominent institutionalist approaches

Attribute	Institutionalism		
	Historical	Rational choice	Sociological
Focal level	Legislative, constitutional	Programmatic, legislative	Programmatic, legislative
Actor interactions	Conflictual	Coordinative	Cultural
Systemic attractors?	No – institutions as outcome of historical processes but with inherent path dependency	Yes – benefit seeking to optimize within structural contexts of rules	Yes – cultural norms and values provide temporal ordering principles
Causal conditions	Critical junctures caused by exogenous shocks, Endogenous contestations over rules and their interpretations	Response to shifts in external context, Outcomes from previous “round” shape new setting, Actors	Shifts in broader social, cultural, or political context, Changes in interpretations, practices, and norms
Causal mechanisms	Radical change in incentive structures following critical junctures, Gradual change through mechanisms such as layering, drift, conversion, or replacement ^a	Rational action based on individual and strategic interests within collective action dilemmas, which may alter rules or incentives over successive timesteps through learning.	Shifts in social legitimacy drive normative agendas, Structural convergence driven by shared or perceived norms across contexts
Temporal pattern	Gradual or rapid	Stepwise	Gradual

^aMahoney and Thelen (2010).

**FIGURE 1** Schematic of the research design [Colour figure can be viewed at wileyonlinelibrary.com]

3. A methodological technique of theory-centric process tracing (Beach & Pedersen, 2013), applied abductively (i.e., involving recursive interaction linking theory and empirical data; Mason, 2002), in order to interpretively identify causal conditions (i.e., explanatory factors) and causal mechanisms (i.e., processes), as well as the context in which they are activated and the outcomes they produce.

3.1 | Process tracing

Process tracing is an approach to studying causal conditions and mechanisms, which has seen growing attention and advancement

(Beach & Pedersen, 2013; Falleti & Lynch, 2009; Mahoney, 2012). It is a within-case method that aims to elucidate causal influence based on a logic of asymmetry and determinism. Asymmetry involves a focus on conditions that (positively) explain an outcome, without also seeking to explain the opposite (negative) outcome in the same analytical moment. Determinism involves positively explaining outcomes within a single case, rather than on a probabilistic or comparative basis. It aims to abstract causal mechanisms from a case that can “travel” (i.e., hold broader resonance) to other cases fitting similar scope conditions (Beach & Pedersen, 2013; Capano & Howlett, 2019; Falleti & Lynch, 2009). Causal mechanisms are defined as “a theory of a system of interlocking parts that transmits causal forces from X to Y”... [where] “each of the parts of the causal mechanism can be conceptualized as composed of entities that undertake activities”... “where the activities

are the producers of change, or what transmits causal forces through a mechanism" (Beach & Pedersen, 2013, p. 29). Importantly, process tracing does not preclude a recognition of complex causality; it simply aims to bring analytical clarity to specifying exactly how, why, and under what conditions certain changes occur, which is often left fuzzy in input-based or output-based analyses. Composite approaches of multiple mechanisms might be required for holistic explanation in complex situations (as this paper explores).

Process tracing enables looking at 'how' and 'why' questions, with the ambition to develop "mid-range" theories (Beach & Pedersen, 2013; Falleti & Lynch, 2009; i.e., qualified propositions) about processes of change within (and potentially beyond) a single case. Different approaches to process tracing exist, including theory testing (deductive specification and testing of a theory-derived causal mechanism) and theory building (inductive identification of a causal mechanism based on empirics and theory; Beach & Pedersen, 2013, pp. 14–18). We adopt a primarily "theory-building" orientation, which is useful when an outcome is known but the mechanism contributing to causing it is not, although our approach is also abductive in working across theory and empirics simultaneously.

3.2 | Data collection

Data collection involved a mixed-methods approach comprising key informant interviews and review of available academic and grey literature (e.g., policy/planning documents and legislation; Mason, 2002). Primary data collection was conducted between 2016 and 2017 and involved 26 semistructured interviews with policy, academic, and civil society actors. These were conducted in two rounds ($n_1 = 15$, $n_2 = 11$) approximately 4 months apart in 2016 (April/May, September/October) to allow scoping investigation and follow-up elaboration. Informants were drawn from multiple sectors, jurisdictional levels, and networks to ensure that a broad range of relevant perspectives were captured. The breakdown of interviews is as follows: national government ($n = 4$), national government (regional operation; $n = 6$), regional government ($n = 3$), municipal government ($n = 1$), academia ($n = 10$), and NGOs ($n = 2$). Informants from the private sector (particularly the main water company in Santiago) could not be obtained despite extensive efforts; thus, we sought to elucidate these aspects from other actors with close experience (e.g., government and academia) as far as possible. Documents were captured for an additional 12 months following interviews to enable ongoing policy and planning

processes discussed in interviews to unfold and to capture the full study period (Section 5).

A total of 27 key informants were interviewed in 26 interviews (some interviews contained multiple informants, and four informants appeared in both rounds). Interviews ranged from 0.5 to 1.5 hr in duration and were conducted in a professional setting nominated by the informants. Interviews were conducted in either Spanish ($n = 13$) or English ($n = 13$) by two of the authors, one fluent in Spanish and one who employed a professional translator, and all were transcribed into English prior to analysis. Interviews were conducted mostly face-to-face in Chile ($n = 23$) with a small number conducted via skype ($n = 3$). Informants were selected based on involvement in water and/or climate adaptation activities relating to Santiago, contacts via a local research network (Centro de Ciencia del Clima y la Resiliencia, CR2) and recommendations from interviewees via "snowballing" (Patton, 2002). Interview questions in Round 1 covered climate risks, adaptation planning, water management, actors, and effects. Interview questions in Round 2 covered the institutional framework for adaptation and water management, institutional developments, actors, knowledge systems, political dynamics, and outcomes to date.

3.3 | Analytical procedure

The analysis first identifies the most prominent institutional developments observed, then seeks to explain each one individually based on qualified judgments from the available evidence, and finally examines their combined pattern and effect. Primary and secondary data were triangulated wherever possible using multiple observations from the same type of source (e.g., interviews) or multiple observations from different sources (e.g., interviews and documents) and weighted according to the resulting strength of evidence. This was performed through structured evidence assessment scrutinizing each part of a causal mechanism and then allocating an overall assessment of confidence in the presence of the whole mechanism based on the "weakest link" (Table 2). This essentially makes a conservative judgment about the overall suggested mechanism by considering the extent to which all "parts" are known, in order to avoid overclaiming confidence. Several types of evidence were considered: accounts (primary and secondary), traces (e.g., artifacts of processes), sequences (e.g., chronologies), and patterns (e.g., recurring effects; Beach & Pedersen, 2013). Strength-of-evidence tests scrutinize discriminatory power and certainty (Beach & Pedersen, 2013; Collier, 2011; Mahoney,

TABLE 2 Structured evidence assessment rubric for evaluating causal mechanisms

Strength-of-evidence test for each part of a mechanism ^a	Confidence in total mechanism ^b
"Straw-in-the-wind" test (low discrimination, low certainty)	Low
"Hoop" test (moderate discrimination, low certainty)	Moderate
"Smoking gun" test (high discrimination, high certainty but not exclusive)	High
"Doubly decisive" test (high discrimination, high certainty eliminates others)	Very high

^aSources: Beach and Pedersen (2013), Collier (2011), Mahoney (2012), and Van Evera (1997).

^bAuthors' determination.

2012; Van Evera, 1997), which provides a way to systematically combine multiple sources of evidence and make transparent analytical judgments.

4 | THE CONTEXT OF CLIMATE CHANGE ADAPTATION IN SANTIAGO, CHILE

4.1 | Climate adaptation challenges

Santiago is already experiencing a range of climate change impacts and advancing policy and governance responses, both nationally and within the city proper, over the last 10–15 years. Santiago is a major city situated in a middle income OECD (Organisation for Economic Co-operation and Development) nation, with a population of approximately 7 million (~40% of the national population) that is projected to reach 8 million by 2030 (Barton, 2013; Krellenberg & Hansjürgens, 2014). It faces significant climate risks particularly relating to water, including more frequent and intense droughts (Bonelli, Vicuña, Meza, Gironás, & Barton, 2014), winter flooding (Krellenberg & Hansjürgens, 2014), and melting glaciers (MMA/CONAMA, 2011) affecting seasonal and long-term water supplies and impacts that disproportionately affect vulnerable groups (Barton, 2013; Krellenberg et al., 2014). The Santiago region has been under extended drought since 2009 (CR2, 2015). This occurs on the backdrop of long-standing water management challenges, both regionally and nationally, particularly linked to the allocation of water within the semiarid climate (Bauer, 2015; Bonelli et al., 2014).

In this paper, we focus on water as a specific issue of urban climate adaptation. This is a core challenge in Santiago and one that is institutionally and politically complex. Other climate adaptation issues also exist (e.g., heat, air pollution, and ecosystem protection) but are not the focus here for clarity. Empirically, the case resonates with experiences of other large cities in middle-income/emerging economy nations facing interlinked climate change and human development challenges.

4.2 | Multilevel governance setting

Recognition of the need for urban climate adaptation emerged in Santiago during the early 2010s (Barton, 2013; Romero-Lankao, Hughes, Rosas-Huerta, Borquez, & Gnatz, 2013). This occurred alongside growing national policy interest on climate change that began in the mid-2000s, initially with a focus on emissions mitigation (CNACC, 2006) and later broadening to also emphasize adaptation from the early 2010s. Consequently, urban climate adaptation activities have been driven both from within and above the city, raising challenges of both fragmentation and centralization. Fragmentation occurs due to the many territorial jurisdictions: The Greater Santiago metropolitan area contains 34 municipalities, located within the Metropolitan Region of Santiago (one of 16 Regions nationally) covering 52 municipalities. Yet the broader national political system is centralized (Siavelis, 2016), which sharply constrains authority at regional and

municipal levels. For example, the head of the regional government (GORE Santiago) is an *intendente* appointed by the president,² and national government ministries have regional secretariats of ministries (SEREMIs) operating alongside regional government administrations.

Policymaking powers relating to many aspects of climate adaptation and water lie largely with the national government. The Ministry of Environment (MMA) coordinates climate change activities; the Ministry of Public Works (MOP) contains the Directorate General of Water (DGA), which administers water allocation (e.g., granting water rights), and the Superintendency of Water and Sanitary Services (SISS), which regulates urban water supply (e.g., reliability, tariffs). Regional Government has subordinate roles in spatial planning and environmental assessment. Municipal government has limited roles in water management.

The National Water Code provides the framework for water allocation, including water rights for urban areas, based on a system of private water rights established in the National Constitution (Bauer, 2015; Valdés-Pineda et al., 2014). The National Constitution, introduced in 1980 during dictatorship rule (1973–1990), retains a strong free-market orientation despite reforms during the early 2000s (Collier & Sater, 2004). Although the Constitution recognizes water as a public asset, it also grants the ability to create permanent private water rights transferable within a market framework (Vergara & Rivera, 2018). The main water utility in Santiago (Aguas Andinas) owns about 25% of water rights in the Maipo Basin (containing Santiago), which it has been gradually increasing in recent years (Bonelli et al., 2014, 366), with the remaining consumptive water rights owned mainly by agricultural and mining companies. Water allocations are proportional, with legislative recognition of the need to prioritize drinking water, although the ability to resolve conflict over prioritization is questioned (Bauer, 2015; Valdés-Pineda et al., 2014, p. 2562).

5 | FINDINGS

5.1 | Institutional developments

Six prominent institutional developments relating to urban climate adaptation during the study period are observed (Table 3). These include activities focused on “general” climate adaptation and/or water specifically.

First, municipal adaptation planning occurred through the joint development of adaptation plans by six municipalities in inner Santiago for the first time (AdaptChile, 2016). This was facilitated by a local nonprofit organization (AdaptChile) formed in 2013, which secured funding from international donors (e.g., German and British embassies and EUROCLIMA) to support the development of adaptation planning and networking (Interviews 9, 18, and 21). This is significant because of a history of lack of coordination between municipalities, lack of previous engagement in climate change adaptation (Interviews 2, 15, and

²Although steps are being made toward decentralizing political powers in recent years, including election of regional councilors since 2009 (Law 20.390) and introduction of an elected Regional Governor from 2020 (Law 20.990).

TABLE 3 Institutional developments related to urban climate adaptation in Santiago

Institutional development	Approximate period	Actors involved	Jurisdictional level	Institutional level
1. Municipal adaptation planning	2013–2015	Six inner-city municipalities; AdaptChile	Municipal	Programmatic
2. Regional adaptation planning	2009–2012	GORE Santiago; SEREMI MMA, Helmholtz Centre (Germany); Ministry of Environment (MMA); Universidad de Chile; Universidad Católica	Regional	Programmatic
3. Urban water system adaptation	2013–2016	Aguas Andinas; Superintendency of Water and Sanitary Services (SISS)	Regional	Programmatic
4. National adaptation planning	2010–2017	Ministry of Environment (MMA); Government of Chile; Several other ministries	National	Programmatic
5. National Office/Division of Climate Change	2010, 2016	Ministry of Environment (MMA); Government of Chile	National	Legislative
6. National Water Code modification	Mid-1990s to present	National Congress; Several ministries; Citizens; Private water users (e.g., agriculture, mining, and water supply companies)	National	Constitutional

21), and fragmentation across the metropolitan region (Interview 9) and with regional government (Interview 24). Moreover, municipalities grapple with the centralized nature of policymaking (Barton, 2013, p. 1921), have little competence with water issues (Interviews 7, 8, 9, 16, and 18), and have limited budgets for adaptation (Romero-Lankao et al., 2013, p. 795; Interview 7 and 8), especially in poorer parts of the city (Krellenberg et al., 2014, Interview 2). Yet growing public and political awareness of climate change is triggering interest among some municipalities (Interviews 3 and 18). This development has sparked unprecedented direct interactions between municipalities and the MMA (Interviews 9, 18, and 26), and the formation of a national network of municipalities on climate change (Red Chilena de Municipios Frente al Cambio Climático; AdaptChile, 2018).

Second, regional adaptation planning has involved the development of a regional adaptation plan (CAS, CAS, GORE, MMA, SEREMI MMA, 2012) and subsequent efforts to integrate and implement this plan within regional government. Planning was initiated by an international research project aiming to support climate adaptation in Santiago (ClimateAdaptationSantiago, CAS), following a previous international research project on megacities and environmental risks (Heinrichs, Krellenberg, Hansjürgens, & Martínez, 2012). CAS generated extended stakeholder engagement and identification of priorities at the urban-regional scale for the first time (Interviews 10, 19, and 24) and has influenced subsequent adaptation thinking (Interviews 19 and 24). The plan was broadly endorsed but experienced problems regarding subsequent funding and implementation (Interviews 7, 9, 10, 11, 17, and 26). Further questions arise about the possible veto role of the regional *intendente*: when the 2012 plan was completed, the then *intendente* was purportedly “winding down” and seemingly hesitant to

support new initiatives (Interview 10). A separate multistakeholder initiative (Maipo Plan de Adaptación) further studied urban–rural interactions in water planning (Interviews 10, 11, 17, and 22). More recently, urban resilience planning is pursued under the aegis of the 100 Resilient Cities initiative, chaired by the *intendente* (Interview 24), although the relation between “adaptation” and “resilience” is unclear (Interview 9).

Third, separate activities regarding adaptation in the urban water system have been pursued by the main (private) water supply and sewage company in Santiago (*Aguas Andinas*). Santiago has experienced several water supply disruptions in recent years (2008, 2013, 2016) due to high turbidity events, linked to intensified storms and rising snow lines in source watersheds (Interviews 22 and 25). This has triggered public and political debate (Interview 25), which plays out against the backdrop of long-term societal debates about public–private relations over water in Chile. Relations between *Aguas Andinas* and the public regulator (SISS) are typically viewed positively in the city itself (e.g., high reliability and block tariffs with subsidies for poor households; Interviews 13, 22, and 25; SISS, 2015). However, current approaches are described as being “at the limit” because despite mutual concern about climate risks, further investments imply higher tariffs that are viewed uneasily (Interview 25). In response, *Aguas Andinas* has made agreements with agricultural actors to avoid water cuts to the city during drought (Interviews 16 and 22), which seem at least partly driven by reputational and regulatory risks (Interviews 18, 19 and 25). Yet major questions remain regarding the ability of existing urban regulatory frameworks to accommodate climate change uncertainty (Interviews 5 and 13) and “unexpected events” (Interview 22).

Fourth, national adaptation planning involves the development of several adaptation and climate change plans over the last decade, including 2008–2012 National Climate Change Action Plan (CONAMA, 2010), 2014 National Adaptation Plan (DCC MMA, 2017), and 2017–2022 National Adaptation Plan (DCC MMA, 2017). The Office/Division of Climate Change within the MMA (see below) has actively pushed a national climate change agenda, particularly focusing on adaptation (Interview 16). National adaptation planning increasingly details actions and responsibilities, including institutional, legal, and financial proposals, such as for a national climate law most recently (DCC MMA, 2017). This responds to coordination challenges between ministries in the absence of formal mandates, despite good will oftentimes present (Interviews 6, 16, and 26). For example, one interviewee reflected: “when an action arrives at another ministry, the minister asks ‘why should I be responsible for this measure?’” (Interview 6). Nonetheless, it is thought that “we have progressed even though we don’t have the legal framework” (Interview 26). International climate change commitments also motivate national adaptation planning (MMA, 2016; MMA/CONAMA, 2011). Urban climate adaptation is increasingly prominent within national priorities (MMA, forthcoming), as is water supply (DCC MMA, 2017, p. 20; MMA, forthcoming, Measure 8), although the scope appears circumscribed around public sector responsibilities, which is significant given the privatized water system.

Fifth, an office of climate change was created within the MMA in 2010 (Law 20.147), later upgraded to a division of climate change (DCC) in 2016/17 also containing a Department of Adaptation to Climate Change and Capacity Development (DCC MMA, 2017, pp. 21–23). The MMA was created by upgrading the previous Commission of the Environment (CONAMA), introduced in 1996, to the status of a ministry. This was a long-standing discussion where an OECD country evaluation (OECD & ECLAC, 2005) recommending to strengthen the institutional framework for environmental management to align with other OECD countries (Interview 23) provided the “final push” (Interview 26). Sustained presidential leadership has also been crucial: in 2009 an Inter-Ministerial Committee on Climate change was formed by presidential decree (MMA/CONAMA, 2011, p. 16), and “there has been a continuity” regarding adaptation as an important issue across three Presidential administrations spanning both right and left of the political spectrum (Interview 16). The Office/Division of Climate Change has been pivotal in progressing climate adaptation nationally, including actively linking with urban–regional activities in Santiago (Interviews 16, 18, and 26).

Sixth, there have been protracted efforts to modify the National Water Code over the last two decades (Bauer, 2015), particularly as the current Water Code is often criticized for allowing little public control over private water rights. In the Maipo Basin containing Santiago, water rights are fully allocated (Interviews 9, 20, and 25). These debates have been reanimated by growing awareness of climate change impacts in recent years, particularly triggered by the “mega drought” that began around 2009 (CR2, 2015). Yet the Water Code is often described as rigid (Interviews 13, 19, and 20), and “very old, static, and [not recognizing] adaptation” (Interview 13). This rigidity

is both legal and also cultural linked to entrenched private property norms (Interviews 5, 11, and 19). The first major modification occurred in 2005 (Law 20.107) aiming to improve water information, strengthen regulation of future (but not existing) water rights, incorporate new environmental provisions, and establish fees for nonuse of water rights (Bauer, 2015, 152; Valdés-Pineda et al., 2014; Vergara & Rivera, 2018) to reduce financial speculation (Interviews 3, 10, 18, and 20). Although these efforts began in the early 1990s, they were heavily contested such that in the end, they “barely touched the core principles of private property rights, market forces, and a weak state” (Bauer, 2015, p. 154). Further changes have been pursued since 2011. An amendment strengthening regulatory enforcement (Law 21.064), although another more ambitious amendment addressing competing water uses (Boletín 7543–12) remains unclear despite congressional approvals and senate review in 2016–17.

5.2 | Explanatory mechanisms

This section seeks to explain the six developments in Section 5.1 by identifying sufficient causal conditions and mechanisms, within identified scope conditions. These explanations are shown in Figures 2, 3, and 4. Causal conditions are shown in rounded boxes; outcomes are shown in square greyed boxes, and scope conditions are indicated with dashed lines; each part of a mechanism is labeled with a letter, for example, A, B, C, and so on. The identification of mechanisms draws on Table 1 on an individual (i.e., one by one) basis, in line with the exploratory aim of the paper to explain the diversity of changes observed empirically in light of existing theory.

Municipal adaptation planning is explained by a mechanism of norm promotion (high confidence) that here refers to entrepreneurial activity to forge “social connections between previously unlinked persons or sites” (McAdam, Tarrow, & Tilly, 2008) for normative reasons about the need for local climate action. All parts are evidenced by primary accounts. Additionally, Part A shows pattern evidence of a lack of prior activity, and Parts B–D show trace evidence of many published documents on activities occurring. Thus, Parts A, C, and D pass “smoking gun” tests because they are confirmed with high uniqueness although without definitively ruling out other possibilities, and Part B passes a “doubly decisive” test as it is highly certain and definitive.

Regional adaptation planning is explained by sequential mechanisms of layering (medium confidence), which refers to the introduction of new arrangements alongside existing ones (Mahoney & Thelen, 2010), and path dependency (medium confidence) whereby the new plan struggled to embed within the existing institutional and political setting. All parts are evidenced by primary accounts. Additionally, Parts A–C show trace evidence of the published plan and its process. However, the precise dynamics of Part C (plan adoption) and Part D (postplanning) have high certainty but low uniqueness. Thus, Parts A and B pass smoking gun tests because they are confirmed although other factors could have also been involved, whereas Parts C and D pass “hoop” tests because they are affirmed but not definitive.

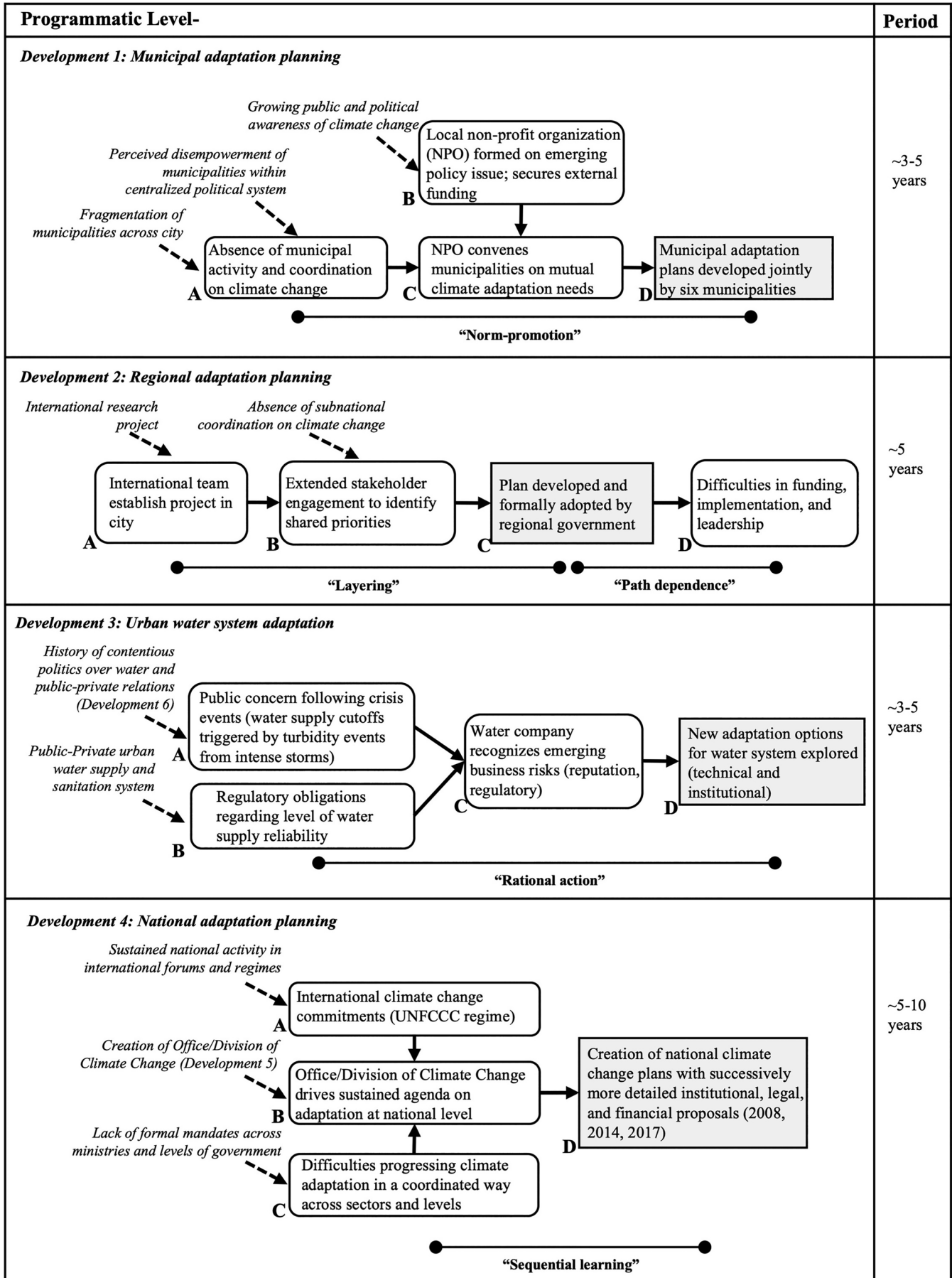


FIGURE 2 Institutional development at programmatic level

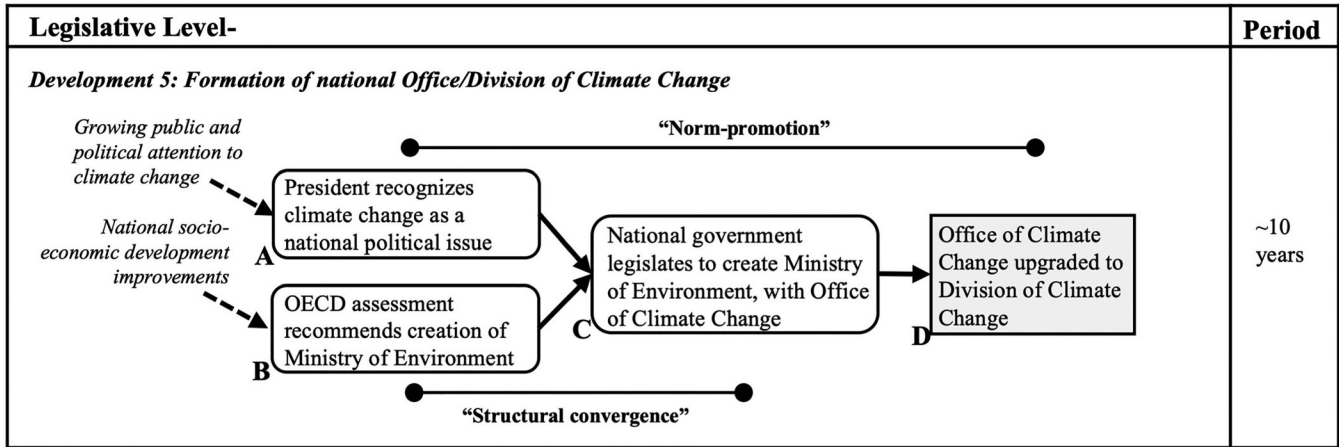


FIGURE 3 Institutional development at legislative level

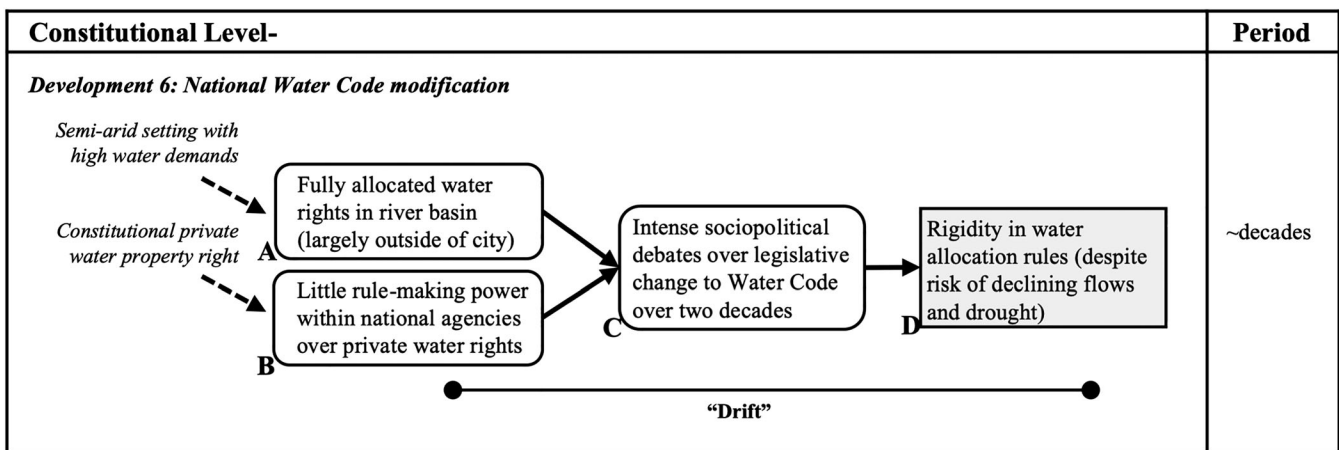


FIGURE 4 Institutional development at constitutional level

Urban water supply system adaptation is explained by a mechanism of rational action (low confidence), which refers to an actor (i.e., the private water company) seeking to minimize external risks to their interests (i.e., business risks from climate change). All parts are evidenced by primary accounts. Additionally, trace evidence exists of Part A (e.g., news stories) and of Part B (e.g., public regulatory documentation). However, there is an absence of primary account evidence (from within the water company itself) and little secondary evidence in the public domain of Parts C and D. Thus, Parts A and B pass hoop tests because their relevance is affirmed but not confirmed, whereas Parts C and D pass “straw in the wind” tests as uniqueness and certainty remain low.

National adaptation planning is explained by a mechanism of sequential learning (high confidence) that refers to successive adaptive changes in thinking and action of policy actors over time concerning feasible adaptation planning priorities and strategies. All parts are evidenced by primary accounts. Additionally, Parts B and D show extensive trace evidence exists (i.e., planning and policy documents), which together produce pattern and sequence evidence showing efforts to advance a regime agenda growing over time. Within this corpus, primary and secondary evidence is found for

Parts A and C. Thus, Parts B and D pass doubly decisive tests, and Parts A and C pass smoking gun tests.

The formation of a national Office/Division of Climate Change is explained by simultaneous mechanisms of norm promotion (medium confidence) from the presidential level, and structural convergence (high confidence), in that national environment management arrangements were explicitly compared with OECD countries. All parts are evidenced by primary accounts. Additionally, definitive trace and sequence evidence exists (i.e., legislative record and planning and policy documents) for Parts B, C, and D. However, there could also be alternative explanations for Part A (e.g., other political factors), which remain unaccounted. Thus, Parts C and D pass doubly decisive tests because they are confirmed definitively; Part B passes a smoking gun test because it is confirmed but other factors could have also been involved, and Part A passes a hoop test because it is affirmed but not confirmed.

Efforts to modify the Water Code is explained by a mechanism of drift (high confidence) that refers to institutions that remain stable (e.g., path dependent) despite changes in their context (Mahoney & Thelen, 2010). All parts are evidenced by multiple primary accounts. Additionally, all parts are supported by extensive secondary account

evidence (e.g., scholarly work) on the legislative and constitutional framework for water management and evolving sociopolitical debates, as well as trace evidence (e.g., legislative record) and sequence evidence (e.g., incorporation of climate change into debates linked to drought experience). Thus, Parts A, B, C, and D pass doubly decisive tests because they are confirmed definitively.

5.3 | Multiple response pattern

In combination, the six mechanisms from Section 5.2 reveal a multiple response pattern of institutional development across several levels of institutional order and over differing timeframes (Figure 5). Most activity has occurred at the programmatic level, although this is underpinned by an early legislative level development (establishment of the Office/Division of Climate Change) and its subsequent effects, revealing synergistic interplay. On the other hand, the rigidity of the National Water Code at a constitutional level hinders developments by public authorities to address changing hydrological conditions, revealing antagonistic interplay. Furthermore, institutional developments dealing with general climate adaptation appear to remain fragmented from those dealing specifically with water allocation. Although coordination is improving here (Interviews 4, 6, and 13), the two spheres remain grounded in differing institutional frameworks and norms regarding public and private responsibilities, reflecting entrenched historical path dependencies.

Therefore, to what extent are these various institutional developments actually reconfiguring urban governance in response to changing circumstances under climate change? Much rests on the

cumulative potential of current (and future) developments. For example, further institutional developments proposed, such as a national legal framework for climate change, may help to consolidate a durable urban adaptation regime. However, if issue fragmentation persists, then contestation between incumbents (exploiting veto power to maintain the status quo) and change agents (exploiting distributed developments to challenge the status quo) may increase over time. This particularly concerns water allocation, where the potential for conflict seems significant. Yet pragmatic opportunities for development here may well be limited to modest changes to the National Water Code to incorporate stronger public interest duties and continuing to strengthen regulatory capacity wherever possible (following Bauer, 2015, p. 167).

Based on these findings, it appears that combined institutional developments to date provide a basis for some degree of governance adaptation to address urban water issues under climate change. While getting to this point has involved a multiplicity of developments, further progressing adaptation in governance seems to require bold action. For example, two key areas for this are being pursued concern implementing a new legal framework for climate adaptation and ongoing efforts to modify the National Water Code. Such changes do appear to be required in order to address rapidly growing climate risks. On the other hand, the absence of bold action may not necessarily preclude further adaptation progress, although it may limit possibilities in light of increasing contestation over declining water resources and impacted human well-being under climate change. In other words, the current picture show a promising, yet tentative, “work in progress” toward adaptation in governance under climate change.

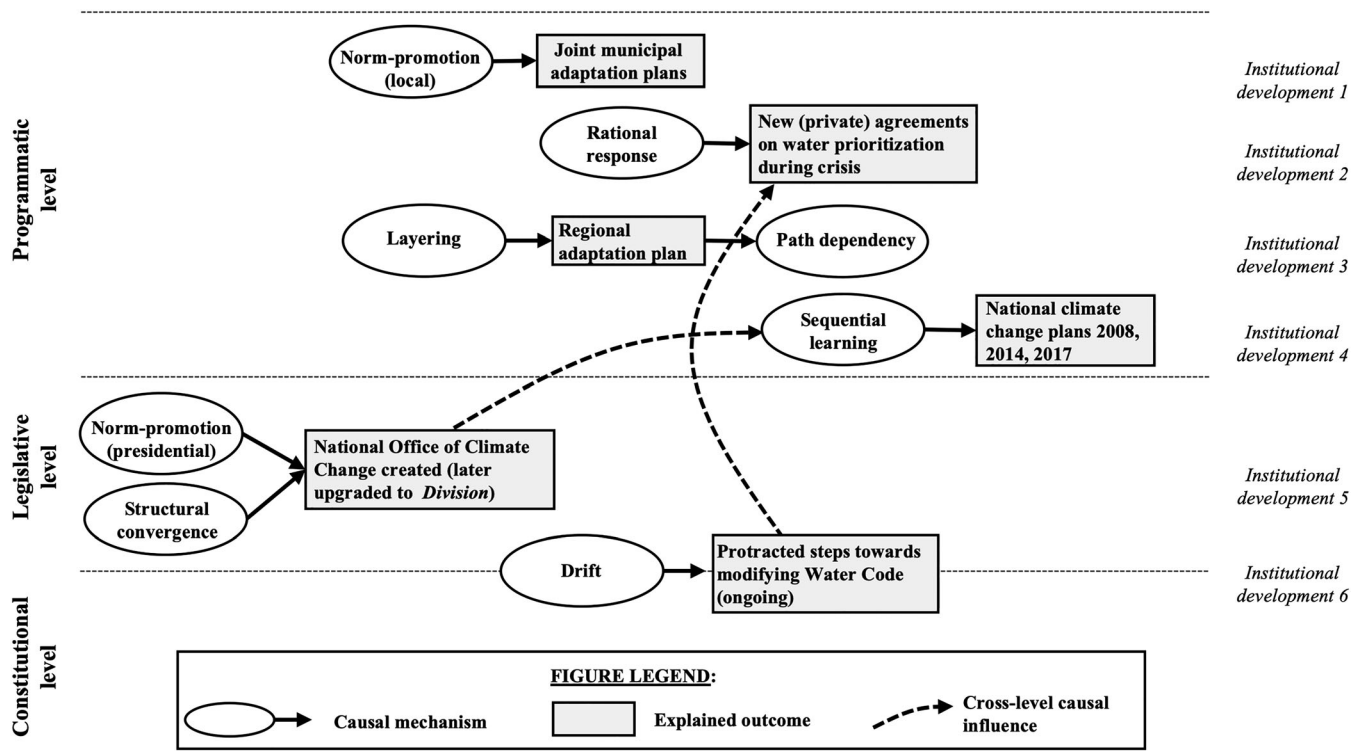


FIGURE 5 Combined view of institutional developments in urban climate adaptation in Santiago, Chile

6 | DISCUSSION

Findings contribute to climate adaptation governance theory in several ways: First, revealing the coexistence of multiple institutional logics shaping processes of institutional development and patterns of adaptation in governance; second, reflecting on ways of (re)conceptualizing institutional possibilities for adaptation; and third, providing a window into the diversity of actors involved in shaping institutional development.

6.1 | Coexisting logics

The findings indicate that multiple simultaneous logics (i.e., appropriateness, consequence, and history) need to be recognized in explaining institutional development in urban climate adaptation governance, and these may pull in different directions. For example, a logic of appropriateness underpins Development 1 (municipal adaptation planning), through promotion of norms concerning the importance of local climate action. A logic of appropriateness collides with a logic of history in Development 2 (regional adaptation planning), where regional climate adaptation activities were layered on existing path-dependent regional governance arrangements that were not ultimately accommodating (i.e., conflictual). A logic of consequence underpins Development 3 (urban water system adaptation), through rational calculations about (business) risk arising from climate impacts. Logics of consequence (and appropriateness) underpin Development 4 (national adaptation planning), where nationwide climate vulnerabilities motivate national-level climate action, advanced through sequential learning over time. Logics of appropriateness (and consequence) underpin Development 5 (formation of national Office/Division of Climate Change), where normative concerns about addressing climate change combined with norms (and interests) for joining the OECD. Lastly, a logic of appropriateness collides with a logic of history in Development 6 (National Water Code modification), where the social legitimacy of the existing water allocation framework is continuously and increasingly challenged but proves very difficult to change due to entrenched interests and path dependencies of the current setup. Altogether, this implies a need for theoretical eclecticism to explain institutional development in a real “messy” governance setting, which resonates with the long-standing call of Hall and Taylor (1996) for cross-fertilization between different lines of institutionalist thinking. The approach developed here shows how this may be achieved by disaggregating different institutional developments across levels and over time, within a broader combined picture, in order to empirically anchor theoretical bricolage.

6.2 | Improving governance in “sticky” situations

The findings reveal that institutional developments occurring are highly contingent historically and politically. In other words, they do not occur on a clean slate but arise and unfold within the existing setting. Most broadly, this suggests that there is definitely “no panacea”

(following Ostrom, 2007) for addressing the institutional aspects of climate adaptation. Diverse and concerted efforts are needed over extended periods of time to make inroads toward reconfiguring governance, given the crosscutting challenge of climate adaptation. This breaks down the idea of a single moment of redesign, instead indicating that improvement is a long, slow process (e.g., following Storper, 2014). But at the same time, scholars need to engage with this reality proactively rather than seeing it as insurmountable. The Santiago case provides clear empirical evidence for the core claim of Mahoney and Thelen (2010) that social actors are constantly finding opportunities within the cracks of current systems.

Climate and environmental governance scholars must take up this challenge to understand how and why such changes occur, what their effects are, and what opportunities this therefore affords to find improvements. Institutions will always be sticky, but that does not mean that they cannot develop in both related and novel directions. Indeed, climate adaptation scholars increasingly observe empirically a key need for not only attention to institutions directly concerned with adaptation (such as urban water) but also to transformations in broader political arrangements and contexts, sometimes termed “triple-loop learning” (Johannessen et al., 2019; Mian, 2014). Our study opens up new ways of advancing this agenda by situating analysis of climate adaptation governance in a historical perspective of institutional and political development.

6.3 | State–private–civil society relations in adaptation governance

The findings of this study also provide intriguing insights into the interaction between state, private, and civil society actors in realizing institutional development in climate adaptation governance. The Santiago case shows how both state and non-state actors play key roles in driving development, at different levels and times. Although state action has been crucial in many ways, including an early legislative change (Development 5) providing a key foundation for ongoing activities (Development 4), both private and civil society actors have also played decisive roles at certain moments, including a nonprofit organization (Development 1), academia (Development 2), and private water company (Development 3). Together, this paints a nuanced picture on the role of the state in adaptation governance, sometimes leading and sometimes responding, in interaction with non-state actors. Nonetheless, the state remains central in advancing adaptation governance in Santiago, particularly in advancing bold next steps that consolidate current achievements, but this raises questions about the interactive and potentially complementary roles of different actors, suggesting that somewhat ad hoc approaches may actually be productive in initiating institutional development in difficult circumstances.

This observation takes on particular significance in light of emerging theory on polycentric governance, which has been rapidly advancing in recent years in climate and environmental governance (e.g., Heikkilä, Villamayor-Tomas, & Garrick, 2018; Jordan et al., 2018; Thiel & Moser, 2018), especially in terms of the role of diverse sources of

agency within processes of change. Understanding the dynamics of change in polycentric systems is at the frontier of theory building in this field. Our findings contribute in two linked ways: first, by “zooming in” to unravel and scrutinize causal mechanisms of institutional change and second, by “zooming out” to situate these processes of change in a larger historical perspective of institutional and political development.

7 | CONCLUSIONS: ADVANCING A PROCESS-ORIENTED RESEARCH AGENDA

In this paper, we apply and demonstrate an approach for disambiguating institutional developments across levels and over time, to explain how and why they occur, and their effect on reconfiguring governance. This contributes to advancing process-oriented explanations of institutional change, moving beyond input-oriented or output-oriented approaches, instead to focus on the processes in between. More broadly, it contributes to new ways of explaining the production of adaptiveness in governance, in a way that also relates these processes to bigger picture political development in a historical perspective (Sjöstedt, 2019). Methodologically, the approach applied has potential to support nuanced comparative analysis. Process tracing inherently focuses on single cases, yet it aspires to identify causal mechanisms in a way that can travel beyond a single case (Beach & Pedersen, 2013). The abductive approach in this paper continuously relates causal explanation to broader theory, thus supporting comparative study of institutional change processes across individual cases (in this study, cities).

Progressing climate adaptation governance in theory and practice requires giving much more attention to understanding processes of change, including institutional, political, and social aspects. In particular, this requires leveraging existing social theories from disciplinary literatures (which remain vastly underutilized to date in the climate adaptation literature), combined with in-depth abductive analysis (i.e., bringing theory and empirics into close dialog) in order to understand complex and messy adaptation situations. Doing so will not only lead to process-oriented insights in specific cases but will also support comparative analysis by developing explanations in a form that can be more readily compared at an analytical-theoretical (rather than solely empirical) level. Our argument aligns with previous calls in a similar vein (e.g., Biesbroek et al., 2015), but we also bring specific attention to institutional aspects. Although a key constitutive element of governance, institutions are still often treated as static, and remain undertheorized in climate adaptation literature.

Climate change adaptation is a governance challenge par excellence (Termeer, Dewulf, & Breeman, 2013). Addressing it will be a long-term challenge, one that demands scholars to examine not only problems but also how solutions arise. Greater attention to understanding processes of institutional and political change is urgently needed in this regard.

ACKNOWLEDGMENTS

The authors gratefully acknowledge institutional hosting and funding from Universidad de Chile, Chile in 2016 and the institutional support the CR(2) Centre for Climate Change and Resilience (Centro de Ciencia del Clima y la Resiliencia). James Patterson gratefully acknowledges funding received from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement number 659065.

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How to cite this article: Patterson J, de Voogt DL, Sapiains R. Beyond inputs and outputs: Process-oriented explanation of institutional change in climate adaptation governance. *Env Pol Gov*. 2019;29:360–375. <https://doi.org/10.1002/eet.1865>