

Article

What Motivates Local Governments to Invest in Critical Infrastructure? Lessons from Chile

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Abstract: In this study, we identify institutional factors and processes that foster local government decisions about disaster risk reduction, especially critical infrastructure investments and maintenance. We propose that municipal institutional capacities, organization, leadership, and multilevel governance will affect critical infrastructure investments by local governments. To examine these ideas, we employ qualitative analysis to compare two representative medium-sized cities in Chile. Our results suggest that there are two main institutional factors that constitute the foundation for improvements in critical infrastructure in Chile: municipal institutional context and the local administration's links with decision makers at higher levels of governance. These results imply that future interventions to strengthen local government efforts for disaster risk reduction in terms of critical infrastructures would benefit from a pre-intervention diagnosis of the target location's existing institutional context and linkages with external governance actors.

Keywords: Chile; infrastructure investment; local governments; institutions; disaster risk reduction

1. Introduction

1.1. Disaster Risk Reduction, Sustainable Development, and Critical Infrastructure

Projected predictions by scientists show that extreme weather events and natural disasters will become more frequent and more serious as a result of global warming [1,2]. In many regions of the world, an enormous amount of damage has already interrupted normal life and inflicted huge economic losses, particularly in developing countries [3–5].

Scholars, as well as international frameworks, emphasize the urgent need for efforts linking disaster risk reduction (DRR), mitigation, adaptation and sustainable development at all scales [1,6–13]. Recognizing that disaster risk reduction and sustainable development are different concepts, during the last several decades the international frameworks have made a consistent effort to articulate them. Figure 1 illustrates those efforts in terms of diagnoses, agendas, and recommendations.



Figure 1. Efforts to Articulate Disaster Risk Reduction and Sustainable Development Concepts [6,8–10,12,13].

As is evident in Figure 1, several international frameworks, and an increasing portion of literature, argue that DRR is essential to achieve improved adaptation and sustainable development [6,13,14]. For example, the Sendai Framework 2015–2030 states that DRR is a cost-effective investment in preventing future losses by means of enhancing coping capacities, adaptation, and resilience: “Addressing underlying disaster risk factors through disaster risk-informed public and private investments is more cost-effective than primary reliance on post-disaster response and recovery, and contributes to sustainable development” [9]. As for risk reduction, the Sendai Framework 2015–2030 recommends strengthening capacities for coping, the Intergovernmental Panel on Climate Change (IPCC) identifies a range of concrete options, and the risk reduction literature categorizes, ranks, and recommends specific measures, including development of critical infrastructure [1,14].

International frameworks and a growing literature recognize that critical infrastructure investment and maintenance (hereafter, critical infrastructure) are as important as other DRR activities for sustainable development [1–4,6–14]. These assets provide services that are essential to the social and economic functioning of a society, particularly important in all phases of disaster situations; for example, roads and bridges for the transport of people and goods, electrical systems for water supply and waste treatment plants, as well as health centers to serve people affected by extreme natural events and disasters. Critical infrastructure investments express the extent to which local

governments have incorporated sustainable criteria as a guiding principle, linking DRR with inclusive social welfare.

However, for many populations, the conditions for human safety and security have worsened through a combination of natural stressors, exposure, human interventions, increasing risks, and inadequate provision and maintenance of critical infrastructure [1,2,4].

1.2. Local Governments and Critical Infrastructure

The local scale is particularly important for risk reduction because most human experiences and decisions related to DRR happen at the local level [4,14–25]. At this scale, human security and quality of life depend partly on how local governments provide public goods and services, such as critical infrastructures. Local governments can avoid catastrophes through their participation in efforts to build flood-proof roads, resilient water systems, more efficient electrical systems, enhanced waste recycling capacity, and other relevant conditions for DRR.

In Chile, for example, risk reduction is part of the local governments' mandate. They have powers to guide local development (e.g., regulations, plans, and actions) and budgetary and administrative autonomy, and are responsible for local welfare and development [26,27]. DRR is linked to broader policy domains, including land-use regulations, public infrastructures, delivery of social services, and environmental management. As part of their usual functions, local governments have to decide on critical infrastructure investment.

Much of the critical infrastructure needed to survive increased exposure to extreme events is in the hands of local governments. International frameworks and national governments recognize the need to strengthen local governments to improve critical infrastructures as a way to prepare for such challenges [1,2,14,28], but progress has been slow, especially in developing countries [14]. For example, in a recent review of Chilean efforts, OECD (2016) recommended more investments in both new infrastructure projects and maintenance of existing systems, as well as integrating climatic-change considerations, but most local governments have been slow to alter the historical patterns of public investment decisions [26,29]. The problem is, that local governments often struggle to produce and maintain such essential public goods for their citizens due to various factors, many of which are related to weak or missing institutions [1,14,26].

1.3. Local Governments and Institutional Arrangements

Institutions consist of rules, structures, and procedures with the ability to influence human behaviors and collective action [18,29–87], for example, due to trajectories and legacies, self-enforcing mechanisms, organizational culture, and policy inertia [30,33,34]. Several institutional factors may influence the motivation of local government investments in critical infrastructures. Scholars have recognized a host of factors that can potentially affect local government decisions regarding DRR and adaptation, which we grouped into the categories of capacities, governance, leadership, and political factors, and summarize in Figure 2.

Despite increased attention to institutional arrangements in local governments, there is still limited knowledge of the institutional factors that influence decisions regarding critical infrastructure investments specifically. Relatively little is known concerning the institutional conditions under which local governments are more likely to decide to allocate more of their scarce resources for critical infrastructure improvements. More research is required, and robust, evidence-based knowledge is essential for understanding how existing institutional settings, policies, and practices need to be modified to support local government efforts [1,14,15,17,37,39,53,61].



Figure 2. Institutional Factors Operating as Barriers or Enablers [4,8,10,14–19,36–68].

1.4. Research Question Framework, and Propositions

There is extreme variation in the way Chilean local governments decide to spend their public resources [26]. Despite being exposed to very similar levels of risk and hazards, some invest nothing, while others invest a high proportion of their budgets. This reality raises the question: Why do some local governments in Chile prioritize public investments in critical infrastructure while so many others do not? We address this question through a comparative analysis that examines a set of specific institutional conditions and processes that are likely to influence the likelihood of positive decisions for critical infrastructure investments.

The institutional analysis integrates several factors and relationships that the literature has identified as exerting significant influence on individual and organizational behaviors, decisions, and outcomes [20,29,60,82,83]. Local government routines and expectations are affected by complex and dynamic conditions and processes (e.g., physical, biological, social, institutional) that give rise to uncertainties, information gaps, incentives, and relationships. Municipal critical infrastructure investments are the result of repeated decisions made by local governments under these complex conditions [20]. In this study, the analysis seeks to produce evidence in relation to how a set of selected institutional factors and processes affect local government decisions and outcomes regarding

critical infrastructure investments. We explore relationships between municipal institutional capacities, organization, leadership, multilevel governance, and decisions in terms of critical infrastructure. Specifically, we analyze the effects of municipal institutional capacities, organization, and agents with leadership attributes (hereafter capacities, organization, and leadership) on decisions in two representative medium-sized cities in southern Chile.

One of the most prominently discussed factors in the extant literature is the organizational capacities of public organizations, such as the municipal administration [14–18,37–49,51–53]. Capacities consist of resources available within an organization to enhance coping and reduce disaster risks, strengthen resilience, and include financial, human, managerial and technical expertise [14–17,36–38,40–42,44–47,49]. Scholars have underlined the importance of capacities for risk reduction and adaptation at the local scale [1,14,61,62]. These capacities are essential, for example, for prevention and mitigation activities, updating risk and vulnerability data, and provision of critical infrastructures and maintenance.

Where local contexts are affected by risks and hazards, municipal organization with regard to accountability mechanisms and routines, internal organization, and transparency may affect decisions that help transform policies into actions and increase the likelihood of positive decisions in critical infrastructure [14,34,50,53–55,57,58]. Supported by expert opinions (public workers, consultants, researchers), one part of the literature draws attention to the accountability of local representative institutions [20,26,27,50,53–55,71,73,87]; for example, in terms of integrity and responsibility of those who exercise positions of power (as opposed to corruption practices), and power equilibrium between the mayor and council [27,54]. Good practices in governance and accountability foster competition and widen the channels through which information on risk conditions flows, so that they have access to local government decision-making processes [1,14,49,73,74]. Comparing cases of municipalities in South Asia and West Africa, Agrawal and Ribot [50] suggest that representation and accountability in local governments are critical to serve local needs efficiently and equitably, because it influences competition, balance of power, and responsibility in municipal decision making. Another part of the literature proposes that municipalities with greater degrees of coordination between departments, flexibility, and good governance practices facilitate beneficial information flows and framing for risk reduction and adaptation [15,18,20,42,57,58,75]. For example, exploring barriers and facilitators of adaptation in Canadian municipalities, Burch [57] encourages improvements in municipal regulations, procedures, and routines, and more interactions between departments and the municipal council. The literature also highlights the importance of transparency as institutional standards of openness toward public scrutiny to make possible the visibility of risks and problems that require actions and interventions [73,76–78]; for example, accessible information on contexts, regulations, budgets, policies, plans, programs, and other issues of potential public interest for disaster risk transparency [1,3]. Access to reliable public information may strengthen risk reduction governance, because it facilitates information flows, communication, opportunities for coordination and feedback for decision makers and informed and more representative public policies [14,37,54].

Previous studies on Chilean municipalities have showed that municipal organization improvements in terms of accountability, transparency, and internal coordination have stimulated both local government DRR and environmental protection efforts [20,26,27]. Relationships between operational rules, autonomy of councilors, balanced power relations, and repeated routines seem to have fostered productive initiatives in local government, interactions with external actors, awareness, and risk reduction efforts. Accountability and transparency in procedures enriched information flows, fostered deliberation about topics and priorities of the agenda, and induced an increasing understanding about biophysical and social contexts. All of these correlated with more actions, expenditures and investments.

Leaders have the ability to influence institutional trajectories [30]. The idea of positive effects of leaders on decisions and municipal outcomes is proposed by a large number of case studies of local governments motivated toward risk reduction, adaptation, and sustainable development reporting

the actions and perceptions of leaders [17,19,36,38,46,61,63,68,72]. For example, illustrating Britain's experience in the health sector in the last quarter of the 19th century, Szreter and Woolcock [19] underline the key role of mayor Joseph Chamberlain of Birmingham, who initiated a process of co-production of innovative solutions to solve complex problems of water supply and sanitation by means of framing solutions and connecting diverse social and political agents. As documented in several studies, attributes that enable actions of leaders are supportive networks and electoral, political, and institutional resources [46,61,64,66,80].

The decisions of local governments may, in part, be a function of multilevel institutional processes. For example, local government commitments to engage in disaster risk reduction may be a function of the extent to which the individuals and organizations within a jurisdiction are able to work together effectively [81]. In Chile's case, many local government decisions are coordinated with decisions made by the national government [26,35]. For that reason, scholars encourage more research on drivers and dynamic institutional processes to yield deeper understandings of decisions and outcomes in all their complexity [15,29,37,44,56,61,81–86]. Focusing on network relationships between organizations at different scales [15], multilevel governance relationships (hereafter, multilevel governance) has also been proposed as part of relevant institutional processes for risk reduction and sustainability [14,44,62].

The evidence from previous research on Chilean municipalities indicates that multilevel governance relationships may affect the behavior of local governments, as well as municipal capacities and organization [20,26,27,70,87]. But it does not adequately explain why such relationships do not always lead to improvements in infrastructures; for example, why municipalities encouraged by proactive national policies for DRR and adaptation do not invest in critical infrastructures, or why municipalities with resources and personnel invest less than others.

Building on this base, we also recognize that multilevel governance may moderate the relationships between municipal capacities, organization, leadership and Chilean local government decisions about infrastructure, as illustrated in Figure 3. We frame multilevel governance as a complex system of nested jurisdictions, where interactions of linked autonomous agents and rules operate at various scales [64,69,82,83,88]. The horizontal and vertical interactions between agents and organizations located at different governance scales (e.g., international, national, regional, local) and local governments, for example in the form of information flows, coordination, supportive relationships, and institutional arrangements, may affect repeated structured situations where local governments make decisions, decreasing or increasing uncertainties, discount rates, expectations, and desirable outcomes [20].

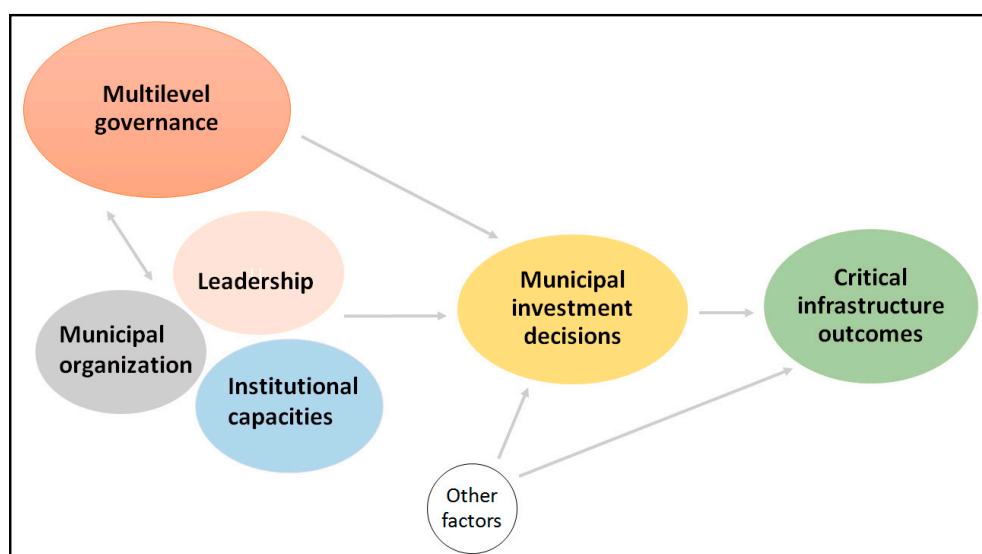


Figure 3. Our Conceptual Framework.

Therefore, we include in the analysis multilevel governance relationships and incentives, namely, the effects that arise through those interactions in both institutional factors (e.g., municipal institutional capacities, organization, and leadership) and decisions. As propositions, we posit *ex-ante* that local government decisions are affected by municipal capacities, organization, and leadership interacting with multilevel governance processes. We analyze to what extent they may foster or hinder local government decisions and outcomes in the Chilean empirical context using comparative analysis of two representative cities in Chile.

Our comparative analysis focuses on local government decision making during 2009–2016 in two medium-sized cities in southern Chile: Osorno and Puerto Montt. We chose to compare these two cases because they represent a greater number of Chilean municipalities. These two cities also share many biophysical and socioeconomic characteristics (e.g., geography, environmental conditions, socioeconomic indicators), but exhibit different institutional arrangements related to decisions about public investment in critical infrastructure. The comparative research design allows us to draw qualitative inferences about the ways in which the differing institutional contexts and governance processes affect investments in critical infrastructure in medium-sized Chilean cities.

1.5. Scope and Contributions

The main goal of this work is to articulate how local government decisions related to critical infrastructure are shaped by complex institutional factors and processes. While previous quantitative work has analyzed the effects of individual institutional factors on public infrastructure investments, our qualitative analysis complements such studies by teasing out the causal processes that link institutional context and multilevel governance with local investments in critical infrastructure.

The results of our comparative analysis produce a more nuanced view of the relationship between institutional drivers, processes, and decision-outcomes. To preview our results, we find that capacities, organization, and leadership influence decisions in critical infrastructure in terms of impact and directionality, depending on multilevel governance, especially the relationships between regional and local governments. The evidence from the Chilean local governments suggests that an appropriate balance between municipal capacities, organization, leadership, and multilevel governance may represent the local institutional foundation for achieving improvements in critical infrastructures.

This new knowledge can help develop a well-founded model specification for future quantitative work with an econometric model to more deductively test hypotheses about the complex institutional relationships and interventions that strengthen local government efforts in DRR. Such interventions would benefit from a pre-intervention diagnosis of the target locations' existing institutional context. Our study provides the basic building blocks for a diagnostic tool that may be used for this purpose. The rest of the paper is structured as follows: First, the methodological design section explains our procedures for case selection, data collection, and analysis. The results section contains the analysis of our propositions about effects of institutional capacities, organization, leadership, and multilevel governance on decisions with regard to critical infrastructure investment. The discussion section proposes a nuanced vision of the relationship between institutional explanatory factors, processes, and local government decisions.

2. Methodological Design

2.1. Chile, Case Selection

Chile is an appropriate case for studying variations of local decisions in DRR regarding critical infrastructures due to its geography and heterogeneity, exposure to risks, hazards, and natural disasters, and having the same institutional structure at the national level [1,26,35,87,89]. This country is of particular interest because all municipalities are part of the same national governance regime, subject to the same national public policies and have access to the same public programs, but there are many subnational variations in DRR, particularly in terms of critical infrastructure investments [26].

In selecting case studies to analyze our theoretical propositions, we focus on municipalities located in south-central Chile, where 86% of the country's population lives and the area is affected by deterioration of environmental conditions, disaster risks, and climate change [65]. We looked for representative cases of the Chilean geography (valley and coastline), population and urbanization processes, environmental conditions, socioeconomic indicators, different institutional factors related to critical infrastructure investment, as well as the availability of data for the period 2009–2016.

From this process, we identified Osorno and Puerto Montt in Los Lagos region, Figure 4 and Table 1.

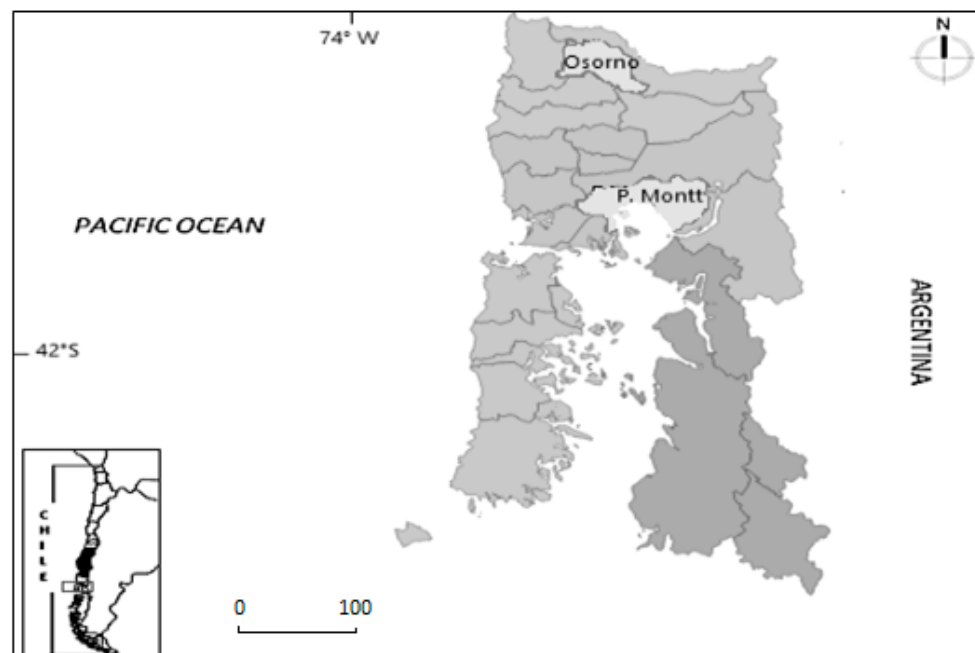


Figure 4. Selected municipalities in Los Lagos region, Chile.

Table 1. Municipal contexts of Osorno and Puerto Montt, Chile, 2009–2016.

Municipal contexts	Osorno	Puerto Montt
Characterization		
Location	Valley/mountain	Coastline/mountain
Geographical coordinates	(40°34' S 73°09' W)	(41°28' S 72°56' W)
Area (km ²)	951.3	1673
Population	145,475	238,455
Urban (percentage)	92.1	87.9
Ethnic (percentage)	27.8	16.4
Socioeconomic fragilities		
Human Development Index ranking ^a	94	131
Low education (percentage)	45.1	47.5
Poverty (percentage)	19.6	17.7
Without pension system access (percentage)	30.4	34.6
Without bank card access (percentage)	45.4	44.6
Without credit card access (percentage)	83.5	82.2
Risk perception (binary, 0 = no, 1 = yes)		
Climate Change	1	1
Climatic/geophysical hazards	1	1
Pollution (air, water, soil)	1	1
Forest fires	0	1
Population living in dangerous places	1	1
Inadequate critical infrastructures	1	1
Others ^b	1	1

Table 1. Cont.

Municipal contexts	Osorno	Puerto Montt
Extreme events and disasters (experience)		
Climatic/geophysical events (2011–2014)	55	110
Emergency zones declared by decrees (2008–2014)	6	3
Loss due to wildfire (hectares), 1985–2016	1290.19	10,967.44
Local governments outcomes (2009–2016)		
IIM topics covered by each council during 12 months-period	332	193
IIM per inhabitant (in USD) ^c	1375	744.6

^a Total, 346 Chilean municipalities, ^b Biological, technological, ^c IIM, investment in critical infrastructure and maintenance.

Despite the difference in geographical location (Figure 4 and Table 1), Osorno and Puerto Montt share fundamental similarities with 346 Chilean municipalities from the point of view of vulnerability regarding environmental conditions at risk, natural hazards, experiences with extreme natural events, socioeconomic fragilities, and lack of critical infrastructures. They represent 57 Chilean municipalities, experiencing accelerated urbanization processes with 65% of the Chilean population and multiple risk factors [90–93]. Approximately one-quarter of the populations are exposed to biological, environmental, geophysical, hydro-meteorological, and technological hazards, extreme natural events (e.g., climatic, natural), and disasters. The principal sources of hazards for people living at risk are accelerated urbanization and populations living in dangerous areas, contamination caused by production activities (e.g., salmon industry, intensive agricultural and livestock land use), socioeconomic fragilities, and inadequate provision of physical and social critical infrastructures (e.g., roads, bridges, water and waste treatments, health centers). On average, these populations have middle-low Human Development Index scores, are confronted with environmental challenges due to overexploitation of natural resources (marine, rivers, soil, and forest), and are threatened by extreme events (earthquakes, pollution crises, volcanic eruptions, floods, droughts, and forest fires).

When it comes to how the local governments have organized themselves to respond to these risks, however, these two municipalities are very different. During 2009–2016, the municipal council of Osorno thematized DRR issues an average of 332 times per year in its meetings [94]. Municipal records document repeated situations of councilors and municipal staff reporting on municipal context conditions, framing and disseminating knowledge on risk and environmental issues, and proposing initiatives for council consideration. In Puerto Montt, there was a lower thematization of issues related to risk reduction (annual average of 193 times) [95]; routines during council meetings consisted of reviewing issues with incomplete information, and municipal staff contributing minimally with risk reduction assessments. Unlike Puerto Montt, Osorno had environmental and risk reduction departments that produced information on critical infrastructure and maintenance needs, and they differed in the degree of supportive network relationships, Osorno had more alliances and collaborative agreements with diverse actors in the private, social, and public sectors [90–93,96,97].

2.2. Data Collection

We collected data from primary and secondary sources in these two cases during 2016 and 2018 and conducted interviews in Osorno and Puerto Montt with municipal officials, social leaders, and householders, as shown in Figure 5 and Appendix A.

The application of interviews included: (1) training of the research team and eight undergraduate students to conduct interviews (social workers); (2) selection of representative territories in the two municipalities regarding population and risk factors with advice from qualified local informants, municipal development plans, and territorial information; and (3) examination of results from focus groups and workshops.

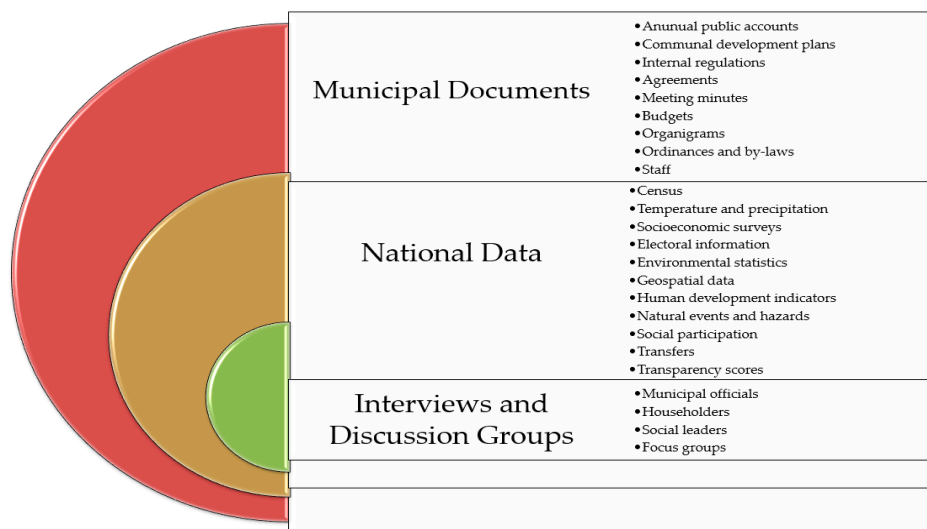


Figure 5. Data and Sources; details in Appendix A.

When documenting these cases, we reviewed available municipal official records for 2009–2016, such as annual public accounts of the mayors, communal development plans, municipal internal regulations, municipal budgets, and meeting minutes of municipal councils, as shown in Figure 5 and Appendix A.

2.3. Data Analysis

Considering our previous studies, interviews, and records of Osorno and Puerto Montt, Figure 5 and Appendix A [27,94,95], we identified municipal councils as institutional spaces where local governments made decisions in repeated situations (municipal councils meet semimonthly to make decisions related to community plans, expenditures, investments, and municipal programs). They govern and make decisions on local policies, plans, programs, budgets, investments and actions. They have mandates, operational rules, and make their decisions taking into account available capacities, municipal organization, political will, and relationships. Therefore, the data analysis seeks to find evidence regarding our propositions about relationships between those institutional factors, processes, and decisions.

To increase the credibility and validity of the research results through mapping out the richness and complexity of local government decisions and explanatory institutional factors, we triangulated data collected from primary and secondary sources (interviews, official records, and statistics), Figure 5, to document relevant aspects, applying and combining several research procedures for the data analysis such as content analysis, network analysis, and descriptive statistical data analysis. We populated databases with information from primary sources on decisions and outcomes, municipal councils' routines, institutional capacities, organization, mayors' attributes and supportive networks, and relationships with multiple actors with which the council interacts with respect to DRR, particularly critical infrastructure.

Searching for evidence related to our propositions, we applied the following procedures. For the analysis of local government decisions and outcomes, we populated a database with records of critical infrastructure investments between 2009 and 2016 [96–98], complementing it with information provided by other sources (interviews, reports, municipal council minutes), Appendix A. To observe the manifestation of institutional capacities, we selected data regarding financial and human resources from collected information [96,97,99–103]. For municipal organization, we analyzed municipal internal regulations, reports, interviews, and transparency scores [96,97,104–106]. We documented leadership attributes triangulating interviews, reports, and electoral and political affiliation data [94–97,107].

To obtain measures of multilevel governance relationships, we applied networks of archival documentation and content analysis of interviews, Appendix A [94–97].

While examining theoretical expectations, we designed indexes representing decisions and outcomes (dependent variable) and institutional factors and processes (independent variables) to compare, and expressed these indicators in proportions, Figure 6. We selected the indicator municipal critical infrastructure investments between 2009 and 2016 as a dependent variable. Fourteen indicators represent four categories of explanatory factors of municipal institutional capacities, organization, leadership, and multilevel governance.



Figure 6. Operationalization: Indicators and Description [90,91,93–95,100–104]. DRR, disaster risk reduction. IIM, critical infrastructure investments and maintenance.

3. Results and Discussion

The institutional arrangements of Osorno and Puerto Montt stand in stark contrast to each other, and this difference helps explain why Osorno achieved higher investments in critical infrastructures. The local government of Osorno prioritized risk reduction with plans, actions, and investment to improve critical infrastructures and environmental protection [94,96,98,101]. In contrast, Puerto Montt reacted with engagement when emergencies occurred or critical infrastructure collapsed [95,97,98,102]. Records from Puerto Montt indicate low investments, whereas Osorno appears to enjoy many robust institutional conditions and has greater investments in this area. Table 2 summarizes the evidence from several sources in relation to these contrasts.

Comparing Osorno and Puerto Montt with regard to institutional explanatory factors, Figure 7 and Tables 2 and 3 show that Osorno was the municipality with the highest and most balanced scores across indicators on institutional conditions. During 2009–2016, Osorno enjoyed relatively favorable institutional conditions as measured by indicators for personnel, interdepartmental organization, municipal council support, multilevel governance interactions, and supportive networks (bi- and multidirectional relationships). Supportive relationships between organizations and mayors/councils are bidirectional, and involvement of a third actor are multidirectional [27]. Especially noteworthy are the differences between the two municipalities in interdepartmental coordination, and interactions with external actors and multilevel governance relations, as well as the quality of those interactions. More robust institutional conditions in Osorno enabled its municipal administration to invest more in critical infrastructure development and maintenance (IIM in Figure 7 below) [90–107].

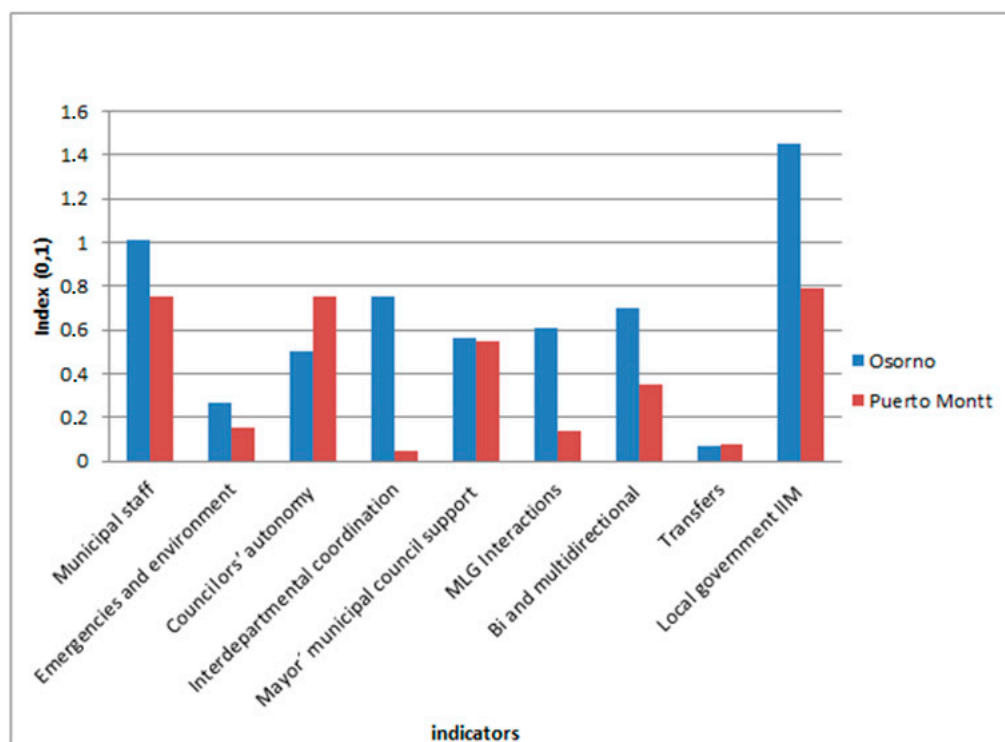


Figure 7. Indicators of institutional explanatory factors, processes and outcomes.

Table 2. Contrasting behaviors and institutional arrangements between Osorno and Puerto Montt.

Evidence	
Osorno	
Critical infrastructure investments:	higher ^{a,b,c}
Disaster risk reduction (DRR) actions (e.g., plans, programs):	higher ^{a,b,c}
Financial and human resources, and technical expertise for DRR and critical infrastructures:	higher ^{a,c}
Interdepartmental coordination:	higher ^{a,b,c}
Transparency:	similar ^c
Mayoral leadership	
Motivation:	higher ^{a,b,c}
Electoral support:	similar ^{b,c}
Political support:	high ^{a,b,c}
Municipal council support:	high ^{b,c}
Multilevel governance	higher ^{a,b,c}
Quantity:	higher ^{a,b,c}
Supportive networks:	
Financial transfers:	lower ^c
Puerto Montt	
Critical infrastructure investments:	lower ^{a,c}
DRR actions (e.g., plans, programs):	lower ^{a,b,c}
Financial and human resources, and technical expertise for DRR and critical infrastructures:	lower ^{a,c}
Interdepartmental coordination:	lower ^{a,b,c}
Transparency:	similar ^c
Mayoral leadership	
Motivation:	lower ^{a,b,c}
Electoral support:	similar ^{b,c}
Political support:	similar ^{a,b,c}
Municipal council support:	similar ^{b,c}
Multilevel governance	
Quantity:	lower ^{a,b,c}
Supportive networks:	lower ^{a,b,c}
Financial transfers:	higher ^c

^a Interviews, ^b Council meeting minutes, ^c Registers and data.

Table 3. Critical infrastructure outcomes and institutional conditions for Osorno and Puerto Montt, Chile, 2009–2016.

Indicator	Osorno	Puerto Montt
Disaster risk reduction outcomes		
Municipal investments in infrastructure and maintenance (IIM)	Higher (1.45)	Lower (0.79)
Institutional factors		
<i>Municipal institutional capacities</i>		
Municipal income	Higher (0.52)	Lower (0.43)
Municipal personnel	Higher (0.23)	Lower (0.15)
Municipal personnel for emergencies and environment	Higher (0.27)	Lower (0.18)
<i>Municipal organization</i>		
Councilors' autonomy	Lower (0.50)	Higher (0.75)
Interdepartmental coordination	Higher (0.75)	Lower (0.05)
Transparency	Lower (0.59)	Higher (0.74)
<i>Leadership attributes</i>		
Mayor's electoral support	Higher (0.54)	Lower (0.50)
Mayor's political support	Middle (0.50)	Middle (0.50)
Mayor's municipal council support	Higher (0.56)	Lower (0.55)
Institutional process		
<i>Multilevel governance</i>		
Interactions	Higher (0.61)	Lower (0.14)
Central government	Higher (0.23)	Lower (0.08)
Regional government	Higher (0.04)	Lower (0.03)
Bidirectional + Multidirectional	Higher (0.70)	Lower (0.35)

3.1. Municipal Institutional Capacities and Local Government Decisions

Municipal officials of Osorno and Puerto Montt whom we interviewed, associated DRR activities with budgets, staff, and technical expertise as key factors for investments and actions related to critical infrastructures (see Appendix A). Comparing the two case studies covering 2009–2016, Tables 2 and 3, the municipality of Osorno had more financial resources. On average for 2009–2016, the local government invested more than 20% of those resources in critical infrastructure and maintenance (roads, urban equipment, electrical, sanitary, solid waste treatment), environmental management, and prevention [90,91,96,98]. The municipality had sufficient resources to finance personnel and operational costs for the departments of emergencies, environmental protection, and green infrastructures [96,99,101,103].

Additionally, Osorno had more contracted municipal workers per inhabitant than Puerto Montt [103,108]. Part of this staff produced relevant information on biophysical conditions, infrastructures, and risks [90,91,94,96]. On one side, professionals affiliated with the departments of environment and green infrastructures advised the municipal council by monitoring and reporting the environmental situation of the municipality, such as air and water pollution, climatic indicators, and external applications for funding. Moreover, the emergency offices had permanent personnel and resources to evaluate conditions of critical infrastructures, maintenance needs, and preparedness activities for risk reduction. In this case, more resources and available personnel correlated with more critical infrastructure investment.

In Puerto Montt, however, institutional capacities in terms of personnel had minimal impact on efforts to improve critical infrastructures. During 2009–2016, Puerto Montt increased municipal personnel and the share of personnel dedicated to risk reduction (emergencies and environment) [97,100,102,103], but invested less than Osorno in critical infrastructures [92,93,97,98]. Additional personnel met minimal risk reduction assessments, which usually occur in the aftermath of extreme events [95,97], and their activities had no major impact on information flows that were considered by the local government to make investment decisions [95]. On the contrary, the increase in municipal personnel and other expenditures restricted the availability of resources to invest in infrastructures [95,100,103].

The interactions between municipal capacities and multilevel governance processes may produce disincentives. Between 2009 and 2016, Puerto Montt broadened its relationships with neighboring municipalities in relation to infrastructure projects (e.g., information flows, coordination meetings) [95,100,103], and received more central and regional government transfers [95,97,102,103], but these trends combined with increasing municipal staff were associated with decisions to allocate more of the scarce municipal resources to other goals and not infrastructures [95]. For example, in 2014, Puerto Montt received regional government transfers that could have encouraged more municipal investment in sanitation infrastructures to reduce risks derived from a growing population and critical pollution, and the interactions with neighboring municipalities in relation to a provincial landfill project increased, but, the local government decided not to use its own resources to match these external funds, and as a result ended up investing less of its own resources in support of these infrastructure initiatives.

3.2. Municipal Organization and Critical Infrastructures

During 2009–2016, Osorno stands out for accountable municipal structure, transparency, orderly and efficient administration, interdepartmental coordination, and fluid relationships with agents and organizations operating at several scales, Tables 2 and 3: improvements in municipal operational rules; progress in transparency standards; and agreements, programs, and collaborations with external organizations (e.g., regional government, public services, private sector) [94,104,106]. All these attributes correlated with actions to improve critical infrastructures and environmental protection, such as new agreements, investments, monitoring, and ordinances [91,96].

The municipal records document repeated situations of councilors and municipal staff reporting on municipal context conditions, framing and disseminating knowledge on risk and environmental issues affecting critical infrastructures, and proposing investment initiatives for council consideration.

For example, the municipal council called attention to DDR issues related to infrastructure frequently in its meetings during this period. Councilors frequently identified risk reduction concerns and infrastructures in association with priorities of municipal policies, such as environmental identity and protection, vulnerability reduction, economic growth, and urban territorial development. The local government made efforts to adjust the municipal development plan with regional and national plans, policies, and opportunities to perform better.

During 2014, Osorno's municipal council organized several meetings and public hearings with regional government officials, public services, and private entities to learn more about how to reduce air pollution, protect rivers, and reduce risks through critical infrastructure investment (e.g., decontamination plan, sanitary landfill, road infrastructure, and flood protection among other issues) [94]. National and regional civil servants shared technical knowledge and reported on possibilities to co-finance solutions (e.g., road, water, and sewerage infrastructures) such as available regional funds and criteria to apply for those resources. Private sector representatives collaborated with technical information and monitoring on risks caused by extractive interventions in rivers. The councilors followed up on these issues in their study commissions, interacting with external organizations. In turn, the municipal administration effectively managed commitments and transfers of financial resources from ministries, public services, and private sector [96]. This process fostered decisions and municipal actions to improve infrastructures and environmental protection [90,96]. For example, central government transfers to finance the retrofitting of fuelwood heaters and the thermal insulation of buildings that encouraged municipal investments and water-quality monitoring carried out with external and municipal resources.

In contrast, in Puerto Montt we observed that improvements in operational rules for accountability, transparency, or municipal organization did not correlate with local government efforts regarding critical infrastructures, seen in Tables 2 and 3 [93,95,97,98,106]. Political changes and the imbalance of power affected the continuity of municipal programs and activities [95]. Routines in council meetings consisted of reviewing issues with incomplete information, interventions of study commissions describing procedures for delegated tasks, few interactions with external actors, and lower degrees of identification and articulation of issues related to risk reduction [95].

In order to reinforce the internal municipal organization, Puerto Montt's local government tried to improve managerial practices, organizational performance, and transparency, by means of goals and performance agreements, regulating the obligation of department directors to attend council meetings, and putting more information on municipal websites [95,97,105,106]. However, these municipal departments tended to work in isolation and without much synergistic relationship with the municipal council.

The mayor in Puerto Montt cultivated strong links with political and social organizations, but these relationships consisted mainly of the transmission of information on specific issues for which interactions were already prescribed or supported (e.g., mayor's public accounts, proclamation of candidacies, access to grants) [95,97]. The municipal council rarely had hearings with external organizations or other social actors to deal with risk issues or infrastructures [95]. Compared to Osorno, Puerto Montt had fewer supportive and reciprocal interactions with external organizations with jurisdiction in critical infrastructures, Tables 2 and 3 [94,97].

The available public information on municipal budget combined with increasing external organization pressures to obtain resources (e.g., subsidies, grants, benefits) operated as barriers for infrastructure investment or risk reduction engagement, because these demands led to frequent budget reallocations, or completely stopped risk reduction actions [94]. The local government of Puerto Montt gave subsidies to social organizations according to their requests and the support that those requests found in the municipality (mayor, councilors or municipal staff). It generated pressure on the municipal budget and budgetary changes. For example, during 2013 and 2014, Puerto Montt introduced changes in the municipal initial budget to spend resources that could have been used in critical infrastructures for other purposes such as subsidies to social organizations. In this context,

the increasing amount of resources received through transfers from the central government did not foster more critical infrastructure investments [97,103].

3.3. Leadership and Critical Infrastructures

Unanimously, all municipal officials that we interviewed highlighted the figure of the mayor as the leader of municipal policies, and his motivation as a central authority for DRR and critical infrastructure investments, Appendix A.

The center-left mayor of Puerto Montt, G. Paredes Rojas, enjoyed continuity in a position as councilor during 2000–2008, was elected mayor in 2008 and reelected in 2012 with an absolute majority, and had the support of the majority of the councilors of his political coalition [95,107]. With trajectory as a social leader, Mayor Paredes Rojas had supportive network relationships with social organizations [94]. However, he had little interest in DRR as a theme, which he constructed in a different way, framing municipal needs and interests as more revenue and social support [92,93,95,97]. This type of leadership is reiterated in many other Chilean municipalities [20,26,27,70].

Mayoral motivation can change, however, as a consequence of other institutional factors. For example, multilevel governance incentives can foster critical infrastructure efforts, such as mobilization of new resources, visibility, or reputation. In Puerto Montt, DRR and critical infrastructures became a local government priority with the occurrence of extreme events and disasters such as the Calbuco volcano eruptions (2014–2015), environmental crises caused by the red tide (2016), recurrent emergency situations caused by heavy rains and floods, and when critical infrastructures collapsed and the municipality was overwhelmed in dealing with these problems [95]. These issues appeared in the local government agenda possibly because they were high-visibility issues and many social organization leaders and electors expected the leadership to respond by acquiring external resources. These incentives motivated short-term efforts and municipal expenditures. However, when these issues no longer appeared in mass media reports, municipal interest ceased as well.

In contrast to Puerto Montt, the municipal leadership in Osorno correlated with steady local government efforts for critical infrastructure improvements during 2009–2016. In this case, institutional change, continuity in position of a motivated mayor, capacities, organization, and well-functioning supportive networks fostered these efforts [90,91,94,96,99,101,104].

Educator and Senior Director of Social Organizations J. Tejeda initiated the institutional change supported by the center-left mayor and later legislator M. Saint-Jean (2004–2008) through reforms in municipal organization, hiring personnel, and expanding the municipal budget [94]. His prioritization of actions related to sustainable development and risk reduction was consistent with a combination of international cooperation agreements, legislative reforms, and provisions of budget laws to strengthen environmental protection [25,26,35,70,89]. Under his leadership, the local government approved a robust ordinance for environmental protection [94].

Later, between 2008 and 2016, under the political entrepreneurship of auditor accountant, businessman, former councilor, center-left provincial and regional governor, and strongly supported Mayor J. A. Bertin, the local government moved forward through incremental reforms in municipal organization, especially on efficient management [90,91,94,96]. Notable accomplishments during his term were the Environmental Action Plan (2010) and Strategic Municipal Plans (2010–2013, 2014–2017), the updating of a land-use plan (2010), modern territorial information systems, the creation of new municipal departments for environment and green infrastructures and maintenance with risk reduction responsibilities (2010, 2014), offices of prevention, civil protection and emergencies in the departments of Finance and Municipal Management, modern risk reduction standards for infrastructures and buildings, and an environmental innovation fund (2010), among other achievements. In Osorno, both the mayor and councilors had fluid political relationships and links with national government agencies. Well-functioning, supportive relationships and technical expertise enabled Mayor Bertin to carry out complex and controversial projects, such as the provincial solid waste treatment plant (2014–2016).

The evidence from the comparative analysis sheds light on how institutional context and process affect local government decision making. The comparison of cases indicates that a single institutional factor observed in isolation does not explain much variation in local government decisions regarding infrastructures. In fact, the evidence points out that staff increase or improvements in internal organization by themselves do not always lead to more investments in critical infrastructure.

Our analysis finds that local government performance in this area is a function of a host of institutional factors. For example, the relationships between capacities, robust municipal institutional arrangements, motivated mayors, and upper-level support, when considered together, constitute important ingredients of municipal governance of critical infrastructure. The differentiated effects of inter-governmental transfers in the two cases suggest that multilevel governance incentives may crowd out infrastructure investments in local governments, especially in places where accountable and efficient local governments interact with other organizations in more complex governance networks. In fact, the Osorno case shows that interplay between institutional capacities, robust internal organization, support networks, motivated leadership, and incentives from multilevel governance relationships represent a more promising institutional context for critical infrastructure improvements. The positive effect of capabilities, organization and leadership on infrastructure is particularly strong when combined with the incentives of multilevel governance.

These results of the comparative analysis lead to a more nuanced view of the relationship between institutional drivers, processes, and decision outcomes that we will discuss in more detail below.

3.4. Discussion

The available quantitative evidence from previous research on Chilean municipalities indicates that variables measuring municipal capacities, organization, leadership, and multilevel governance relationships are positively correlated with local government decisions in DRR [26,27,87].

The results of our qualitative analysis regarding the case of Osorno during 2009–2016 are fully consistent with those quantitative results. Considering 14 indicators that represent the explanatory factors of municipal institutional capacities, organization, leadership, and multilevel governance, we observed that Osorno was the municipality with the highest and most balanced scores across indicators. Osorno had the advantage of beneficial institutional conditions that encouraged local government critical infrastructure investments: municipal budget, staff, interdepartmental organization, leadership with electoral, political, and municipal council support, supportive external networks, and multilevel governance incentives.

However, the evidence from Puerto Montt indicates that some of the same institutional conditions did not have beneficial effects from the point of view of decisions regarding critical infrastructure investments there. In fact, institutional capacities (e.g., personnel) had a minimal impact on efforts to improve critical infrastructure. Progress in transparency encouraged the pressure of external actors to obtain municipal resources, possibly influencing uncertainties, expectations, and preferences of the mayor and municipal councilors (e.g., electoral support, short-term considerations), leading to decisions that restricted the availability of municipal resources for infrastructures. On the other hand, central and regional transfers and more engagement with neighboring municipalities in infrastructure projects reinforced the lack of motivation of the local government to address DRR and put their scarce municipal resources into infrastructure. The extra resources encouraged the substitution of resources and the use of institutional capacities to respond to special-interest demands in other areas.

The evidence from Puerto Montt is as important as Osorno's to reach a deeper understanding of the complex institutional dynamics that shape decisions. The experience of Puerto Montt demonstrates that explanatory institutional factors identified by previous quantitative research as linear effects on local government decisions actually operate in a more complex way as components of interconnected institutional settings that induce decisions. For this reason, we articulate a more nuanced vision of the relationship between local institutional factors and local government decisions.

Corroborating our ex-ante propositions, the contrasting cases of Osorno and Puerto Montt document that municipal capacities, organization, and leadership may increase or decrease the probability of local government efforts in critical infrastructures, depending on the moderating effects of institutional processes, especially at the regional and national levels of governance.

The evidence from these analyses demonstrates that municipal capacity variables do not always have a linear effect on decisions regarding infrastructure investments. Consistent also with previous quantitative work [26], we find that variables measuring the technical capacity of a local government, such as the education of the mayor and the number of personnel per capita, are not necessarily correlated to adaptation performance among local governments. A more nuanced understanding of the impact and directionality of human resources on infrastructure investments becomes possible when the analysis explicitly considers the influence of multilevel governance processes. Municipal organization in terms of accountability, transparency, and internal organization does not always lead to increased DRR awareness and infrastructure investment by local governments. Progress in accountability or municipal internal organization and more upper-level transfers may generate insufficient or detrimental incentives for decisions on critical infrastructures. On the other hand, strong mayors with supportive networks (e.g., electoral, political, municipal) may change their motivations when multilevel governance processes produce adequate incentives. However, the interplay between strong mayors and relatively large transfers may contribute to lower-performing local government dynamics, producing less investment in infrastructure improvements.

Focusing on governance, we observe that multilevel relationships were very influential moderating factors for the effects of capacities, organization, and leadership on decisions for critical infrastructure. The impacts of these institutional components in our study cases turned out to be conditional on governance relationships. This qualitative result helps explain better why the hypothesis of one key institutional variable affecting decisions was rejected in previous quantitative research, and why test, and simulations suggested a more complex explanation [26].

4. Conclusions and Implications

4.1. Lessons Learned from the Institutional Analysis of This Study

Our comparative institutional analysis is the result of a systematic, multi-step research process: (1) articulate an intuitive idea of how factors and processes of the local institutional context might matter for local government decisions in critical infrastructure investment informed by a literature review, (2) select cases that demonstrate contrasts in terms of local government institutional arrangements to systematically tease out how these might influence decision making about local infrastructure investments, (3) code measures of causal institutional factors that case studies demonstrate to be influential for outcomes through interviews and document review, (4) examine consistency of qualitative findings compared to existing quantitative evidence from previous research with large samples of local governments in Chile. Each of these steps produced results that are interesting in their own right, contributing complementary perspectives to a more nuanced understanding of how institutions influence municipal budget allocation decisions. It is not simple to reach a deeper understanding of these complex relationships between institutional contexts and decisions. Consequently, our institutional analysis used this examination procedure to capture the complex decision processes more accurately.

The limitations of this study include the relatively short time period considered (2009–2016). The reason for this limited focus is the lack of accurate information and data before 2009. Another limitation is the quality and nature of available data. To some extent, we overcame these limitations by a rigorous selection of representative cases, sources of information, and data, application of procedures to operationalize concepts in the form of manifest variables, and a robust methodological design that combined procedures for the qualitative analysis, as well as conducting consistency checks with quantitative results using similar or even identical metrics as ours.

This study on Chilean municipalities has produced several useful lessons. First, research should not be limited to consider only successful cases that confirm assumptions. It is important to learn from the experience of cases where these assumptions are not met, because this helps to better understand the relationships between contexts, explanatory factors, decisions, and results, increasing the likelihood of desirable interventions in accordance with the logics of those contexts. This means that it is often more informative and theoretically more interesting to select cases based on contrasts in values of the hypothesized causal factors rather than on the outcome variables of interest [109]. Second, factors that have impact in one particular context do not always operate equally in all contexts due to the existence of underlying factors related to specific and varying contextual features in each unique place. Third, explanatory models of decisions and results cannot fully capture the complexity of the reality of local contexts. For example, in municipal governments, decisions are a function of other interconnected decisions made by several agents and organizations that often occur simultaneously in a dynamic and interactive way. For this reason, qualitative research may be a necessary and powerful complement to quantitative analysis because qualitative studies do a better job of capturing such context-dependent dynamics.

Recognizing that the municipalities require capacities in coping with DRR, particularly for critical infrastructure investments, the results of our analysis lead to questioning the proposition that the main institutional driver to local government decisions is at all times the institutional capacities. Analyzing local government decisions on critical infrastructure in Chilean municipalities during 2009–2016, we have not found conclusive evidence in support of the conventional wisdom that the key institutional driver to local government decisions is always the institutional capacities in terms of human and financial resources, and/or technical expertise. This insight leads us to formulate a more nuanced vision of the institutional dynamics in Chilean municipalities.

Documenting cases with regard to critical infrastructure investments, we conclude that the effects of financial and human resources are contingent on interactions with other factors and the moderating effects of multilevel governance. Financial, human and technical resources can increase or decrease the probability of decisions for infrastructures, depending on the institutional processes that influence the incentive structures of decision-makers.

Focusing exclusively on municipal organization, for example with a perspective of institutional change and path dependency processes always explaining municipal behaviors and outcomes, reforms to foster modernization of managerial structures and/or accountability would ensure improvements in critical infrastructures, DRR, adaptation, and sustainable development [1,14,31,34,40,55,57]. We would expect to observe similar behaviors and outcomes in all Chilean municipalities in view of the fact that this centralized country has strong political institutions, availability of national policies, instruments for critical infrastructure investments, and local governments that have modernized their municipal structures following guidelines of international frameworks, national legislation and decentralization policies during the last two decades [20,25,27,29,89].

However, the idea of municipal organization with strictly linear effects on local government outcomes overlooks that the operability of organizations rests on changing contexts and agents that interpret and use them in complex and dynamic contexts [30,58,110]. For that reason, despite capacities, managerial organization or transparency improvements, these changes have not uniformly produced desirable results in Chilean municipalities when it comes to critical infrastructure investments. It appears that if local governments are to be successful, they do need some basic administrative capacity and modern organization, but there are also other factors that account for producing decisions and outcomes.

The conceptualization and descriptions of leaders as individual agents motivated by championing risk reduction or adaptation to take action, do not explain much when contrasting cases and institutional setting contexts are overlooked. The notion of leaders as drivers by themselves ignores that individuals interact with institutional contexts that enable or hinder decisions and actions [30,58,80,110]. Leadership may have a key role in initiating institutional change, but leaders can be held back by

lack of support, institutional inertia, organizational cultures, and political factors. They need trusting relationships and supportive networks. For example, the experience of Osorno between 2004 and 2016 indicates that senior officials and mayors increased local government engagement in critical infrastructures because they were supported by several institutional conditions' capacities, legacies, municipal organization, and multilevel relationships.

Considering this complexity, our research included the effects of multilevel governance relationships to explain why some local governments behave differently from others. The evidence suggests that the effects of municipal capacities, organization, and leadership depend on existing multilevel governance relationships and incentives, in particular relationships between local and regional governments. Our results suggest that one of the multilevel governance dimensions that we need to understand better in future research is the role of connections between regional and local governments. To date, most of the existing literature focuses only on interplay between national policies, municipal network relationships, and local governments.

Even when the results point out the relevance of multilevel governance, as suggested by an increasing literature related to sustainable cities and the experiences of the International Council for Local Environmental Initiatives [15,37,38,44,49,51,56,62,84], the analysis reveals that the multilevel governance incentives do not necessarily lead to positive decisions for critical infrastructures. Local government decisions are functions of the often-complex interplay between local institutional factors and governance processes at other levels of decision making.

In sum, our analysis leads to the conclusion that a deeper understanding of local government decisions in critical infrastructure investments can emerge only when dimensions and factors are considered in a dynamics multi-level perspective rather than analyzing only single factors, or processes in a piece-meal fashion.

4.2. Implications

One of the benefits of this comparative analysis of cases is that the findings can be used to inform future quantitative studies by providing theoretical justifications for selecting variables to include in the statistical models [111,112]. Based on our qualitative evidence, we argue that the effects of capacities, organization, or leadership on optimal local government decisions may be contingent on the moderating effects of multilevel governance and interactions with other factors generally in Chilean municipalities. Therefore, as implication, we propose a suitably specified model for testing this argument with observations from a larger sample of local governments, during a longer period of time.

Evidence from the qualitative analysis allows us to propose that municipal critical infrastructure investment is in part the outcome of local governments' decisions for development and to cope with anticipated risks, climate change, and environmental hazards. Local governments decide to allocate financial resources by taking into account opportunity costs (e.g., alternative uses for these resources). Despite the potential benefits, some local governments do not prioritize those investments in practice. The reason is the influence of institutional factors on collective choices, which induce decision-makers to overcome high discount rates, fixed costs, or diminishing returns associated with those investments.

The evidence from Chilean local governments indicates that capacities, organization, and leadership influence the balance of expected costs and benefits. Infrastructure investments and expenditure decisions taken in repeated situations (e.g., municipal council meetings) are a reflection of these circumstances. On the other hand, multilevel governance relationships (e.g., information flows, coordination, incentives) appear to moderate the relationships between those institutional factors and decision outcome. In Figure 8 (middle column), institutional capacities, organization, and leadership are attributes of interest on the side of causal factors, influencing not only investment decisions but also the institutional contexts that in turn affect each phase of the causal path. At the same time, we propose that multilevel governance relationships interact with these factors moderating their effects on decisions and outcomes (Figure 8, first column). We include a feedback loop from governance

outcomes to the institutional context as part of the process that influences future decision making, accounting for the evolutionary nature of institutions, and at the same time calling for longitudinal analyses in future studies of local DRR efforts.

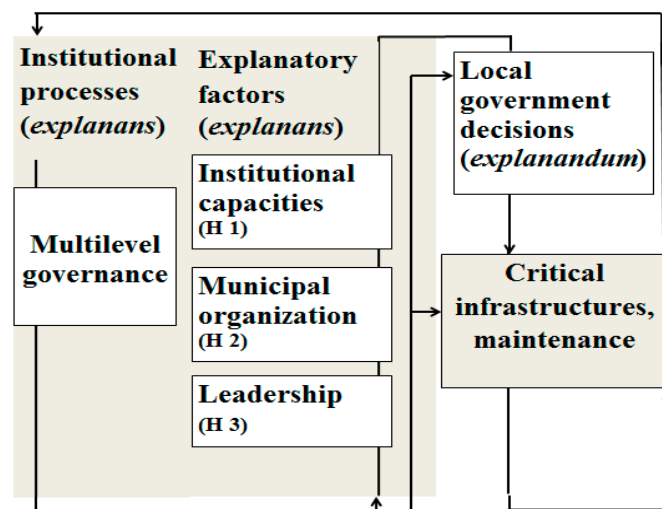


Figure 8. Illustration of the conceptual framework for research.

Finally, one of the policy implications of our work is that government actors at regional and national levels, who are contemplating interventions to improve local critical infrastructure, can use our study to design their own diagnostic analysis of the existing local institutional factors that may help or hinder specific interventions. Through such diagnosis, government authorities at the national and regional levels are in a position to select interventions that have a higher likelihood of actually producing the desired results. If policy makers decide to design new interventions, researchers can play a fundamental role when it comes to diagnosing institutional settings and evaluating the emerging effects of such interventions. One way in which researchers can help stimulate institutional innovations and to explore their possible behavioral effects is by designing framed behavioral experiments that mimic actual intervention ideas. The results from such experiments can inform policy makers about the likely responses of such intervention ideas, and help avoid creating unintentional consequences of policy interventions [70,88,113].

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Appendix A

Table A1. Data and Sources.

Documentation and Data	Sources
Municipal documents	
Annual public accounts of the mayors, 2009–2016	Municipal secretaries, planning offices, and websites; National Municipal Information System
Communal development plans, 2009–2016	Municipal secretaries and websites
Councils' internal regulations, 2009–2016	Municipal websites
Costs of critical infrastructure investments, 2009–2016	Ministry of Social Development, National Investment System
Local government agreements, 2009–2016	Ministry of Finance
Meeting minutes of municipal councils, 2014	Municipal secretaries and websites
Municipal budgets, 2009–2016	National Municipal Information System
Municipal organigrams, 2009–2016	Municipal websites
Municipal ordinances and by-laws, 2009–2016	Municipal websites
Staff (studies, functions, remuneration), 2009–2016	National Municipal Information System; municipal websites
National data	
Census, 2002 and 2016	National Statistics Institute
Data on temperature and precipitation (daily, monthly, annual), 2009–2016	Ministry of Agriculture, National Agroclimatic Network meteorological stations; Meteorological Direction; National Environmental Information System
Databases of socioeconomic surveys, 2009, 2011, 2013, 2015	Ministry of Housing
Electoral information 2008, 2012, 2016	Chilean Electoral Service
Environmental statistics	National Statistics Institute
Geospatial data infrastructure	Ministry of National Territory (<i>Bienes Nacionales</i>)
Human development indicators	United Nations Development Programme
Records of extreme natural events and hazards, 1970–2014	United Nations DesInventar Open Source Initiative; National Forestry Corporation
Social participation and organizations, 2009–2016	National Municipal Information System; National Service of the Civil Registry and Identification
Transfers 2009–2016	Ministry of Finance, Registry of Collaborators
Transparency scores (audits), 2012, 2013, 2014	National Council for Transparency
Semi-structured interviews^a	
Municipal officials (12) ^b	
Householders (71)	
Focus groups (5)	

^a Chronological record of interviews: (1) householders January, March to June 2017, March to July 2018; (2) municipal officials: March, June, August 2017; ^b Directors of environment, emergencies, planning, finance, public works, and social organizations, five in Osorno and seven in Puerto Montt.

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