

Environmental Disaster Reduction Management at the Local Scale, Institutional

Drivers. Evidence

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Abstract: Strong capacities and local motivation are important ingredients of effective of local government responses to frequent disasters and climate change, but how are the capacities and motivation translated into institutional decisions and why do they sometimes not emerge at all? This research investigates the dynamics of institutional arrangements for the provision of resilient critical infrastructure in municipalities pursuing sustainability. Recognizing the relevance of capacities and leadership in shaping local government decisions and actions, the available institutionalist literature focuses on internal and external dynamics to explain variations in local government behaviors and outcomes. I explore how both internal and external institutional dynamics shape local governance processes and outcomes in Chile. I test hypotheses with regression methods, using longitudinal data from 345 Chilean municipalities over a nine-year period, and analysing the evidence with support of qualitative data. The results reveal: (i) the heterogeneity in infrastructure investment decisions is associated with both municipal capacities and leadership, (ii) municipal robustness—operational rules, planning, managerial flexibility and integration of the administrative processes, and accountability—is the most quantitatively outstanding moderating factor. The evidence leads to deduce that efforts to support local governments in the emerging policy domain of resilient critical infrastructures require special attention alongside incentives that emerge from governance relationships.

Keywords: Chile; local governments; critical infrastructure investment; leadership; capacities; institutional dynamics

Introduction

The critical infrastructures (physical and social interconnected structures) provide services that are essential to the normal functioning of a society. Resilient critical infrastructures at all scales are furthermore required to minimize the risks of multiple hazards and threats, cascading disasters, and negative impacts of climate change. The need for critical infrastructures varies by context. In industrialized countries, the main emphasis for infrastructure is maintenance (hereafter Maintenance), whereas in developing countries, the challenge is investment in building infrastructures (hereafter Investment) to cover basic needs. For example, universal access to public goods such as transport, connectivity, energy, drinking water, and urban equipment (parks, lighting, etc.) is essential

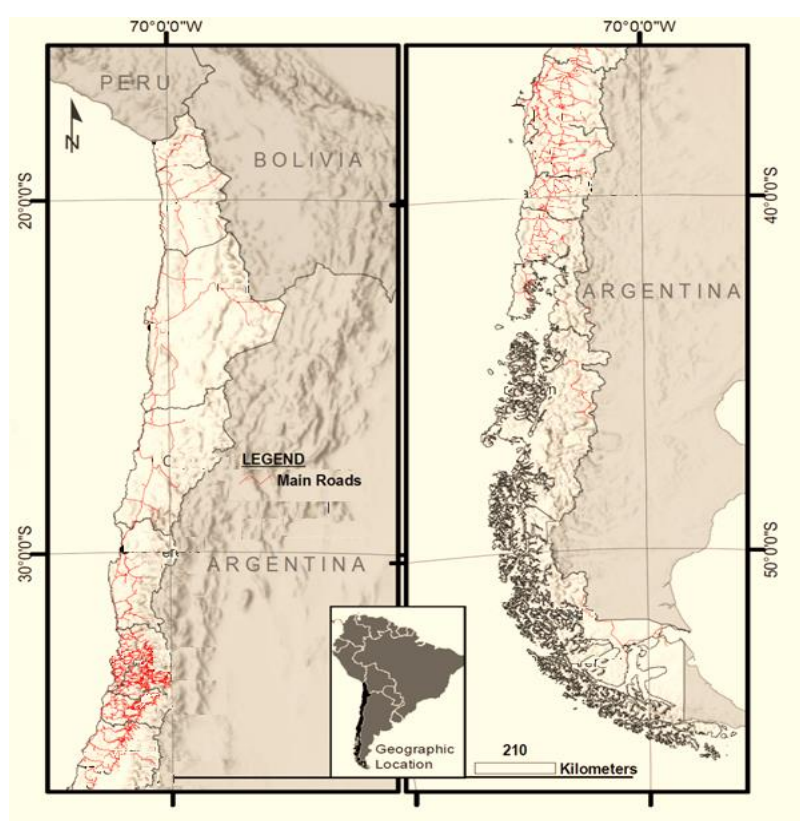
I sought to understand how municipal capacities and motivation of local governments are translated into institutional decisions and outcomes related to Investment in new critical infrastructures as an emerging policy domain compared to conventional infrastructure Maintenance. My research focus on institutional processes that might moderate the relationships between municipal capacities, leadership motivation, and local government Investment (Maintenance) decisions.

The study explore how institutional processes affect the direction and strength of the relation between capacities, leadership, and local government Investment decisions in ordinary municipalities of Chile. I tested the validity of the conjecture on moderation effects of municipal organization and external institutional dynamics with regression methods and interactions, using longitudinal data for almost all Chilean municipalities (345) over a nine-year period.

Chile is a suitable case to analyze how capacities and local government motivation are translated into institutional decisions and outcomes regarding Investment, Figure 1. The 346 municipalities are public corporations with mandates, budgetary autonomy, and staff to

design and execute local development plans, under the leadership of elected mayors and municipal councils. Most of the municipal territories require investments in resilient critical infrastructures to provide basic needs of the population pursuing sustainability. The period 2009–2016 is relevant because it was a time of transition from an emerging policy domain for the engagement and action of local governments in critical infrastructure investments (thereafter Investment).

Figure 1. Chile in South America.



However, there were contrasts in how local governments progressed. Available official information on municipal Investments in Chile indicates that the local governments' average did not substantially change the traditional patterns of managerial maintenance (Valdivieso and Andersson, 2018; OECD, 2017).

Literature review

The literature on sustainable development, disaster risk reduction (thereafter DRR), climate change mitigation, and adaptation in cities and municipalities (hereafter sustainable cities literature) has integrated research frameworks and theories on organizational behaviors and governance relationships, which contribute to a deeper understanding of barriers, enablers, and institutional settings related to outcomes at the subnational level.

In the sustainable cities literature budgetary resources are essential for effective DRR and climate-change adaptation (Finder et al. , 2012; Revi et al., 2014). Nevertheless, local government performance also depends on participation, commitments, will, and institutional plans toward goals (Ostrom, 1990). Human resources (e.g., staff, competences and skills) are other recognized dimension of capacity. But, the staff is not always a guarantee for local government performance, particularly in emerging policy domains. In fact, staff may have commitments to managerial routines, operational rules, and several goals (Porac and Thomas, 1990), rejecting innovations if perceived to have no valued benefits (Tullock,1965). In terms of cognitive capacity, procedural and enabling skills facilitate the mobilization of resources to reach specific goals (Bourdieu, 1989); for example, trained professionals can frame issues, use skills to apply methods, prepare and execute projects, or analyze, plan, and communicate. But educational skills and number of professionals in task forces do not ensure progress in sustainability agendas if incentives and motivation are lacking, according to the results from some cases (Valdivieso and Andersson, 2018).

In complex contexts local contexts, where new policy spheres for action are emerging, leadership has become conceptualized as the driver of organizational behavior and studied from several perspectives (internal values, attributes, behaviors, interest, agenda setting, performance and goals, continuity, trajectories of institutional change) (Kingdon, 1984; Bell, 2011). Leaders may be motivated by several processes and mechanisms such as

organizational incentives, changes in the intellectual climate of ideas (Tushman and Anderson, 1986), systemic interactions and isomorphic dynamics (DiMaggio, 1991), and preferences and sources of support. The subnational decisions are often related to interconnected choices (Ostrom, 1990). Factors such as electoral motivation and continuity or changes in electoral coalitions may influence decisions, and outcomes (Dahl, 2006).

In the local governments, mayors or senior officials may use strategies rationally to advance goals they value, for example adaptation planning, DRRR or Investment. However their motivations and issues do not have granted consensus. Operational rules combined with competing development considerations may limit the municipal agendas of motivated leaders (Burch, 2010), local governments (e.g., council-manager, mayor-council) may have effects on municipal outcomes (Bae and Feiock, 2013), and councilors may prioritize several issues depending on their agendas. Therefore, municipal leaders need the support of municipal councils, staff, constituents, stakeholders in society, and regional and national governments (Gupta, Lasage, and Stam, 2007).

Local government decisions and outcomes are driven also by political institutions (e.g., electoral systems, encoded prescriptions, collections of standard operating procedures), on one hand. At present, there is a growing agreement among scholars, international frameworks, and policy makers that the organizational contexts shape decisions and outcomes.

On the other hand, rational behavior of utility-maximizer individuals drives decisions in organizations (e.g., salary, promotion, reputation, goals, constraints) (Tullock, 1965). Organizational behavior is in part, therefore, the consequence of the interlocking choices by maximizer individuals and subunits, each acting in terms of expectations, preferences, and rational choices. But, the fact that individual behavior in organizations is embedded within

prevailing encoded prescriptions, structures, and organizational logics, the free play of individual will and calculation have restrictions.

Public organizations and staff tend to reproduce routines in mature organizations, with little room for innovations. According to Tullok (1965), staff professionals are inclined to be conservative and reluctant to change because they have their own internal incentive structures and make rational decisions to minimize risks. Downs (1967) asserts that when leaders of organizations become more willing to shift goals and introduce new ways of doing things, they have difficulty getting other members of the organization and their subordinates to adopt new behavior patterns. Hence, attaining the goals of emerging policy agendas may take decades (Greenwood and Suddaby, 2006), and the institutional change is usually incremental (Ostrom, 1990).

Organizational hierarchy and compartmentalized functions hinder functional efficiency because many intermediaries distort information flows and undermine internal coordination, responsibility, and performance. To overcome the challenge and increase robustness (the property of being strong to achieve organizational goals), Downs (1967) proposes that all organizations should institutionalize some kind of coordination mechanism by enforcing a certain level of consistency based on the behavior of its members, such as objective measurements of performance (standards), evaluation systems, reports, audits, training, or planning. Hence, organizations need some kind of coordination, mechanisms to ensure information flows, and administrative procedures (Wilson, 1989). These ideas are close to what is understood in sustainable cities literature as robust institutional arrangements, accountability, and transparency (e.g., responsibility, liability, access to accurate information) (Revi et al. 2014). Transparent and accountable organizational arrangements also may enrich governance outcomes. Therefore, the literature of sustainable cities shares consensus around the benefits of planning and accountability to advance the emerging policy

of adaptation (Carmin, Anguelovski and Roberts, 2012; Revi et al., 2014; Dodman and Satterthwaite, 2008; Finder et al, 2012). Planning, coordination, and communicative rationality foster accountability and transparency, as case studies in different contexts report (e.g., routines of communication with reliable updated information, monitoring, and assessments) (Holgate , 2007; Agrawal and Ribot, 1999; Valdivieso and Bernas, 2014).

Positivist legal theories identify the state as a legal order with binding authority over all actions taking place within its area of jurisdiction and sovereignty (rules of the game), as the main external institutional factor that explains organizational behavior (Kelsen,1946). But norms are intentional objects (Valdivieso, 1998), that is, interpretable and applied by agents (e.g., rational, with beliefs, interests, ability to learn) who make decisions in complex situations that change over time and space (Ostrom, 1990).

Structural functionalist approaches shed light on systemic dynamics shaping outcomes such as interactions and integration between the institutional environments and organizations. Organizations are conceptualized as parts of a larger system, subsystems with multiple overlapping connections, operating at several scales (March and Olsen, 1976). Stimuli, reactions, and feedback processes induce resilient maintenance, adaptation, or change, for example, dialectical contradictions, emerging new players and new ideas, changes in prescriptions within the system, interactions and mechanisms of competition, or other factors that may affect perceptions (raising awareness of alternative logics), generate uncertainties, and open the possibility for change (Greenwood and Suddaby, 2006). In game theory frameworks of new institutional literature, a variety of interactive dynamics between goals, strategies, structures, roles, and rational choices make players in each game use other players for their purposes (March, 1991). Through these processes, diffusion and cooperation may occur, producing functional results. Therefore, macro- and middle-level action arenas, such

as national and regional, and decisions on policies and plans may affect contexts and behaviors of local governments.

Recognizing this type of dynamic, the juxtaposition of jurisdictions, and polycentric relationships between multiple organizations around issues to be governed, scholars from several disciplines converge around the concepts multilevel governance (e.g., norms, structures, agents, interactive dynamics, functional outcomes) (Hooghe and Marks, 2002). The literature on sustainable cities reports on external dynamics, incentives, and interactions positively influencing local governments' decisions (Revi et al., 2014).

However, gaps exist between external prescriptions, policies, and incentives, on one side, and concrete local government contexts and outcomes on the other (Ostrom, 1990; Nuno, Rode and McQuarrie, 2018). Policy failures may emerge from a wide range of factors operating between and within organizations in a context of systemic interactions with contradictory and conflicting legal prescriptions, poorly encoded rights boundaries and mandates, levels of uncertainty in policy knowledge and practice, dilemmas emerging from poor communication and coordination, mistrust and high opportunity costs, and disagreements and power asymmetries leading to conflicts (Urwin and Jordan, 2008).

Modeling

In this study, the outcome variables under analysis are Investment (in new infrastructure) and Maintenance (of current infrastructure) in thousands of Chilean Pesos (CLP) per inhabitant (average of 657 CLP = 1 USD during our study period 2009-2016).

The data of our sample of 346 municipalities shows that all local governments in Chile invest to extend the life of current infrastructure, Maintenance, which is easier and cheaper than investing in new infrastructure (e.g., Investment). Several local governments do not invest in new projects at all (e.g., resilient roads, water, electrical utilities,). Therefore, the variable Investment is nonlinear, it accumulates at zero for several local governments

reporting zero Investment. This situation is referred as a corner solution (Wooldridge, 2010), the standard linear (panel) model is not the best methodological approach in this setting. Hence, we implement a Tobit regression model specifying that the investment variable is limited from the left at zero. Formally, the expected value of the annual investment per inhabitant at t in municipality i is defined as:

$$E(y_{it}|X\beta) = \Pr(y_{it} > 0|X\beta) * E(y_{it}|X\beta, y_{it} > 0) \quad (1)$$

Equation 1 assumes that the expected per capita investment among municipalities and across time, y_{it} , depends nonlinearly on a vector of variables X and a vector of parameters β . The nonlinearity arises when we observe that for some municipalities and some time periods $\Pr(y_{it} > 0|X\beta) = 0$, which is the source of the observed null investment for some local governments. Supposing the panel model includes a unit-specific effect, γ_i , and an idiosyncratic error term, ε_{it} , the Tobit model assumes that $\gamma_i + \varepsilon_{it}$ is normally distributed with zero mean and variance σ^2 . This assumption provides a structural form for equation 1:

$$E(y_{it}|X\beta) = \Phi\left(\frac{X\beta}{\sigma}\right)X\beta + \sigma\phi\left(\frac{X\beta}{\sigma}\right), \quad (2)$$

where $\Phi(\cdot)$ is the normal standard (cumulative) distribution function and $\phi(\cdot)$ is the normal standard density function. Equation 2 clearly shows that the model is nonlinear since both the distribution, $\Phi(\cdot)$, and the density, $\phi(\cdot)$, are not linear in the vector X , which creates the marginal effects, i.e., the impact of a one-unit change in any of the variables in the vector X is not captured in one of the parameters in vector β .

According to the literature review, effects of leadership and capacities may be part of a configuration of factors moderated by organizational processes and external institutional dynamics. We assume that municipal organization arrangements and external institutional dynamic variables may function as moderators affecting the direction and strength of the relation between dependent and independent variables. In a linear regression setting,

moderating effects are specified as multiplicative terms (e.g., interaction). Consequently, we use a similar representation along with time effects (γ_t), unit effects (γ_i), and other controls:

$$y_{it} = \alpha + \beta_1 x_{it1} + \beta_2 x_{it2} + \beta_3 x_{it3} + \beta_4 x_{it1} x_{it3} + Controls + \gamma_t + \gamma_i + \varepsilon_{it} \quad (3)$$

Equation 3 defines that the output variable (Investment or Maintenance) is driven by x_{it1} (e.g., capacity variables), x_{it2} (e.g., leadership variables), and x_{it3} (e.g., municipal organization or external institutional variables). The last variable plays a double role: a direct effect, and a mediating effect between x_{it1} and x_{it2} and y_{it} . In our setting, the direct effect is seen as a control to concentrate on the moderating effect.

In a linear model, the effect of a marginal change in x_{it1} on the expected value y_{it} is identified in $\beta_1 + \beta_4 \bar{x}_{it3}$ and the moderating effect of x_{it3} in the effect of x_{it1} on y_{it} is identified in β_4 . This result in a linear model is clear if we assume that all variables are continuous, and we take the derivatives

Methodological design

To explore evidence around the idea on moderating effects of institutional dynamics, the analysis includes a total of 345 Chilean municipalities.

Investment and Maintenance are dependent variables. During the period 2009–2016, new critical infrastructures were designed to cover citizens' needs and development goals, complying with Chilean national standards (e.g., DRR, adaptation, and environmental protection). The projects were designed by the municipalities, the local governments financed the costs with their own resources and by applying for funds at national and regional levels. The designs were highly time consuming and expensive, and required specialized studies and evaluation stages. Maintenance projects cost less for preparation in terms of financial resources, personnel, and studies, and the approval was faster. For

Investment, we included costs of critical infrastructures, for Maintenance costs of repairs, modifications, and cleaning, activities. I acquired the data available at the Chilean National Investment System and in municipal annual public accounts. Table 1 summarizes descriptive statistics (per capita Investment and Maintenance between 2009 and 2016, thousands of current CLP).

Table 1: Output variables

Statistics	Investment	Maintenance
Mean	139	235
SD	551	865
Min	0	0
Percentile 10%	0	9
Percentile 25%	3	26
Median	29	73
Percentile 75%	102	185
Percentile 90%	265	428
Max	15,571	18,736
N	2,760	2,426
Panels	345	343

Note. Output variables and descriptive statistics for 345 Chilean municipalities; Min, minimum value; Max, maximum value; SD, standard deviation; N, number; Amounts of CLP for Investment and Maintenance are given in thousands of current Chilean pesos.

As for municipal capacity variable, the analysis includes the variable “partFCM”: proportion of the total municipal budget from the Municipal Common Fund (MCF), which is a redistributive scheme in Chile that transfers monetary resources from high-income to low-income municipalities. The variable reflects long-term relative budgetary deprivation, which in turn identifies municipalities historically less developed. Since Chile had consistent growth during 2009–2016, we expect municipalities with few infrastructure measures to have a high “partFCM” and to invest relatively more in new projects compared to Maintenance because they do not have much infrastructure to maintain. Following human capacities are also included: total number of municipal employees, proportions of the employees working in the environmental field, proportion on civil protection and emergencies, and proportion holding a bachelor’s degree (measures staff

professionalization), and mayor's education level. I expect that more intense human capital may be associated with higher levels of Investment.

As for leadership, backed by mandates, mayors lead the municipal agenda and are generally motivated to maximize Investment because it brings the attention of the citizens. The leadership variables indicate the following attributes: proportions of mayor's winning votes (e.g., reveals electoral support and commitment to citizens' needs), of members of the municipal council in the same political coalition as the mayor (e.g., represents support), the mayor belonging to the same political coalition as the country's president (e.g., indicates political support), and being in a second term (e.g., continuity, experience). High levels of leadership attributes may be associated with higher levels of Investment.

Three variables measure municipal institutional robustness. First, autonomy of the municipal council is a rate index based on reading and coding available council regulations using a binary criteria (0,1), recoded into three categories (high, medium, low). It includes prescriptions of accountability (specialized commissions, hearings and audit, free access to information about municipal actions, and free expression in council meetings). Second, a rate index is based on available prescriptions of municipal internal organization using a binary criteria (0,1), also recoded as high, medium, and low. This variable quantifies information on institutionalized planning, operational rules on management (e.g., performance agreements, incentives, evaluations), coordination, and integration (e.g., land planning, DRR, adaptation, environment, infrastructures). Third, compliance with standards of transparency consists of data on municipal compliance with normative prescriptions (e.g., requirements of transparency in websites, by request, and presential) based on data from external audits carried out by the National Council for Transparency. Accountable municipal councils, robustness, and transparency may enhance the effects of variables representing capacities and leadership on Investment.

In Chile, financial transfers from national and regional governments to local governments represent institutional incentives of the multilevel governance. During the period 2009–2016, the sampled municipalities received monetary funds from ministries and regional governments to improve management and urban equipment. Therefore, the variable measures annual per capita monetary transfers from the Undersecretary of Ministry of Interior (SUBDERE). Regional governments also share responsibilities for critical infrastructure, environment, and civil protection, and is measured by annual per capita monetary transfers. Finally, “horizontal_network” measures monetary inflows and outflows between municipalities.

The control variables account for the possible heterogeneity that does not come from the main specifications, measuring attributes of location, climate, population, socioeconomic fragilities and deprivation in infrastructures, extreme weather events and disasters, and territorial administration.

The data collection and analysis consisted of sequential steps. First, operationalization of concepts and selection of metrics. Second, data collection in several official sources. Third, population of databases, normalization of variables, recoding, and observation of central tendency measures. Fourth, application of criteria for variable selection, i.e., accuracy of available data, validation by academic workshops, and consults with experts. The use of a rich set of control variables provided more accurate quantitative estimates for the error term, ε_{it} , and was conditionally independent of any of the target variables included in the models. Fifth, programming in STATA No. 16 using XTTobit command according to our model specification. Sixth, analysis of the regression model coefficients interpreting marginal changes in the dependent and independent variables, taking into consideration the fitness of the models. Seventh, selection of standard deviation and median as metrics to compare and discuss the results.

To discuss the quantitative findings, the analysis integrates observations of a sample of municipalities located in south-central Chile, where 86% of the country's population lives, composed of 98 representative territories with the total population at risk regarding lack of critical infrastructures and geographical, social, economic, and environmental conditions (FONDECYT, 2021). I adopted selection criteria to identify representative nine cases of the sample with similarities (e.g., challenging environmental conditions, socioeconomic indicators) but contrasting outcomes related to local government decisions in Investment. The cases represent municipalities experiencing accelerated urbanization processes, socioeconomic fragilities, populations living at risk, and deprivation in infrastructures. The nine communities were in need of more Investment (in new and resilient infrastructures), but the local governments contrasted in engagement and performance, as well as in citizen satisfaction with the municipalities.

I used survey results from face-to-face semi-structured interviews with directors of civil protection and emergencies of 98 municipalities in nine regions between April 2015 and December 2016 to deepen the discussion of the quantitative analysis results (FONDECYT, 2021). The survey contained 33 open and pre-coded questions on the subject of our research. Other primary sources were consulted to obtain additional information. The data on the nine illustrative cases were collected from several sources, i.e., interviews with municipal officials, primary sources, and official data. The collected information was organized in databases to produce inputs for the analysis. The observations are integrated in the discussion of the quantitative analysis results. To go deeper into the discussion of the quantitative results through contextualized comparative analysis, the data collected from interviews, official records, and statistical sources were triangulated to compare among the nine illustrative cases, combining content analysis and descriptive statistical data analysis.

Results

Capacities, leadership, and moderating effect of municipal organization

Beginning with the autonomous effect of capacity and leadership attribute variables, Table 1 shows that municipalities more dependent on the MCF (partFCM_rate variable) increase Investment, and municipalities with more professional employees put more money into Maintenance. On one hand, 1% annual increase in dependence on the MCF is associated with an annual extra investment of 846 CLP per inhabitant. It means that a municipality one standard deviation more dependent on MCF compared to the average of the sample increases Investment annually by 12%. On the other hand, 1% increase in the number of professional staff predicts an increase in Maintenance of 4,776 CLP per inhabitant, i.e, a municipality with one standard deviation more professionals on its payroll is expected to spend 20% more in Maintenance than the average municipality.

Table 1. Moderating effects of municipal internal organization using the municipal council accountability index (iacm) variable.

Variables	Model 1: Investment	Model 2: Maintenance
partFCM_rate	0.84614***	-118.346
medium x partFCM_rate	-1.206.112	-5.64391**
high x partFCM_rate	0.3806593	-191.648
num_plantacontrata	-0.02152	0.11696
medium x num_plantacontrata	-0.0654751	-0.08083
high x num_plantacontrata	-0.0350401	0.22803
pmarate	0.32313	199.059
medium x pmarate	1.270.784	-435.189
high x pmarate	1.643.535	-344.245
perate	0.56664	341.424
medium x perate	-1.574.757	-1.564.425
high x perate	-4.497.749	-2.281.455
prof_muni_rate	-0.61795	4.77559***
medium x prof_muni_rate	0.5767846	13.78759***
high x prof_muni_rate	1.623.527	0.25064
edumayor (technical)	-307.692	2.317.893
medium x edumayor	-8.723.003	-15.953.990

high x edumayor	5.397.387	-2.402.755
edumayor (professional)	323.677	358.932
medium x edumayor	-5.878.114	-4.888.378
high x edumayor	3.552.982	-1.279.376
mayorvote_rate	0.34824	291.780
medium x mayorvote_rate	4.85202***	-14.26488***
high x mayorvote_rate	3.508.063	-12.90603**
council_coalition	-0.404916**	-1.684582**
medium x council_coalition	-0.491772	1.998.828
high x council_coalition	-0.71.5589	1.797.725
Rulingparty	18.42414**	-1.286.452
medium x rulingparty	-2.691.243	388.681
high x rulingparty	1.343.677	6.652.708
Incumbent	14.46393*	1.614.288
medium x incumbent	4.585.507	10.859.117
high x incumbent	2.184.817	5.999.462
Controls	YES	YES
Fixed effects at the region level	YES	YES
Time fixed effects	YES	YES
RE (municipality)	YES	YES
Adjusted Rho-squared	0.1996	0.2262
Number of observations	1626	1454

*10%, **5%, ***1% significance level

Regarding leadership attribute variables, Table 1. First, where mayoral support from the municipal council in terms of political coalition representation increases by 1%, annual Investment decreases by 449 CLP per inhabitant, and annual Maintenance decreases. It means that if mayoral coalition representation is one standard deviation higher than the average, we expect that Investment to decrease by 7.7%. Second, if the mayor and the national president are in the same political coalition, annual Investment increases by 13%. Third, when the mayor is in his or her second term or more, annual investment increases by 10.4%.

When we shift attention into moderating effects of the municipal organizational dimension, i.e., municipal council autonomy (iacm) on capacities, that in our framework express accountability, model specification 2 (Table 1) reveals two main consequences on

Maintenance. The local government receiving more financial resources from the MCF expends less on Maintenance when the municipal council manifests more accountability in terms of autonomy (e.g., medium compared to low). On average, where the municipal organization benefits from a council with more autonomy, a 1% increase in funding from the MCF reduces annual Maintenance by 5,644 CLP per inhabitant, i.e., 48%. Nevertheless, where a municipality has municipal council autonomy and one standard deviation more professional employees, Maintenance will increase by 58.7%.

Looking at complementary specifications, models 5–6 (Table A1, Appendix), using the municipal organization variable “orgm” as the moderator (e.g., municipal organization with planning, performance agreements, interdepartmental coordination, integration) exhibits the following results. When the municipal organization is highly robust, 1% increase in the dependence on the MCF is associated with a rise in Investment by 122%.

With respect to the moderating effect of the municipal organizational dimension on leadership attributes, the mayor’s electoral support becomes statistically significant when it is moderated by a higher level of council autonomy, according to the coefficients of model 2 (Table 1). Where the municipal council shows more autonomy (medium compared to low), each extra percentage point of the mayor’s winning votes is associated with increased Investment, i.e., 35%. Furthermore, the increase in the mayor’s electoral support moderated by a higher level of board autonomy is associated with a 55% drop in Maintenance. Model 5 (Table A1) also shows that where the organization is more robust, an extra percentage point in the mayor’s electoral support is associated with an increase in Investment by 160%.

Capacities, leadership, and moderating effect of institutional external dynamics

Table 2 displays model estimates of capacities, leadership, and moderating effects of external institutional dynamic variables. The variable “subdeinvesttrans,” monetary transfers

from the national government (thereafter transfers), manifest multilevel governance incentives at the national level.

Table 2: Moderating effects of external multilevel governance using **subdeinvesttrans**.

Variables	Model 3: Investment	Model 4: Maintenance
partFCM_rate	0.95611***	-2.03521*
interaction x partFCM_rate	0.00469	-0.14008***
num_plantacontrata	-0.22450	0.35171
interaction x num_plantacontrata	-0.00593	0.01361
Pmarate	-220363	-1157431
interaction x pmarate	-0.07790	-0.49204*
Perate	-0.21570	816.279
interaction x perate	2.080.444	0.35228**
prof_muni_rate	-0.61014	4.38795**
interaction x prof_muni_rate	-0.00315	0.12606***
edumayor (technical)	234.609	-1.615.647
interaction x edumayor	-0.842372	-0.20869
edumayor (professional)	-.842372***	-2322270
interaction x edumayor	-1.214724***	-0.15584
mayorvote_rate	0.30316	4.21960**
interaction x mayorvote_rate	-0.01622*	0.02872
council_coalition	-0.529106***	-1.577342**
interaction x council_coalition	-0.010583***	-0.357629**
Rulingparty	16.70460**	-2.807.512
interaction x rulingparty	-.2678327	-1.91807***
Incumbent	22.44683***	2.661.684
interaction x incumbent	1.113316***	3.38906***
Control	YES	YES
Fixed effects at the region level (15 regions)	YES	YES
Time fixed effects	YES	YES
RE (municipality)	YES	YES
Adjusted Rho-squared	0.2349	0.2543
Number of observations	1626	1.454

*10%, **5%, ***1% significance level

Centering the attention on the autonomous effects of leadership attribute variables on Investment and Maintenance decisions, Table 2. a new effect emerges of mayoral electoral support (model 4). One percent increase in a mayor's voting support increases Maintenance

by 4,220 CLP. This means that if a mayor's electoral support is one standard deviation larger than the average, we expect Maintenance to increase by 18%.

Hence, after considering all model specifications, we add the positive repercussion of the mayor's electoral support on Maintenance [(mayorvote_rate(+) → Maintenance(+))] to the list of autonomous effects already reported, i.e., partFCM_rate(+), council_coalition(-), rulingparty(+), incumbent(+) → Investment(+); and prof_muni_rate(+), council_coalition (→) Maintenance(+).

Examining the moderating influence of transfers interacting with capacity variables, the models in Table 2 report effects on Maintenance, but only one on Investment (models 3 and 4). The latter result shows that if transfers increase by 1,000 CLP per inhabitant, Investment decreases by 1,215 CLP per inhabitant, where local governments are led by mayors with tertiary education (compared to those whose mayors do not have bachelor's degrees). It means that if we double the amount of median transfers that municipalities receive, Investment decreases by 10.5% in municipalities led by mayors with tertiary education. Regarding Maintenance, a 1,000 CLP increase in transfers is associated with a decrease in Maintenance by 140 CLP, where a municipality is 1% more financially dependent on the MCF, and by 492 CLP where staff connected to environmental-related activities increases by 1%. If we double the median transfers in a municipality that has one standard deviation more workers of this type, Maintenance decreases by 12.5% with respect to the average Maintenance in our sample. The increase in transfer is also connected to an increase in Maintenance by 352 CLP where the personnel working on civil protection and emergency-related activities increase by 1%. If we double the median transfers in a municipality that has one standard deviation more workers in this category, Maintenance increases by 9%. The increase in transfers induces further increase in Maintenance by 126 CLP for each additional

percentage point of professional employees working for the municipality. Hence, if we double the median transfers, Maintenance increase by 6.4%.

With respect to the moderating consequences of transfers on the relationship between mayoral leadership attributes and the outcome variables, models 3 and 4 indicate the following effects. First, each extra percentage point of a mayor's winning votes in the election interacting with more transfers decreases Investment by 1.4%. Second, for each additional percentage of mayoral political representation in the municipal council (same political coalition) and increase of transfers, Investment decreases by 2.2% and Maintenance by 43%. Third, Maintenance decreases by 9.7% in municipalities where the mayor is in the same party coalition as Chile's president and that receives more transfers. Fourth, Investment increases by 9.6% and Maintenance by 17.3% in municipalities with mayors that are in their second term or more and that receive more transfers.

Discussion of the findings

The models included in the analysis show that there is nonlinear effects of capacities and attributes variables of leaders on local government decisions and their outcomes in terms of Investment and Maintenance, that municipal organization variables and external institutional dynamics moderate the effects of those variables. The data analyses on capacities, leadership, and moderating effects lead to two main results. First, variables that represent leadership attributes (e.g., electoral, municipal, and political support) are quantitatively more important than the municipal capacity variables (e.g., financial and human resources) to explain how motivations translate into Investment. Second, the municipal organization variables have the most robust moderating effect in some capacity and leadership variables.

The evidence reveals that two capacity variables are particularly relevant to explain local government decisions in Investment and Maintenance: financial capacities and number of professionals.

Chilean municipalities with more financial resources from the MCF invest more in resilient critical infrastructures, approximately 12% more than the average. This result reflects the need of more resilient infrastructures to address citizens' need. We interpret the result as desirable and positive because the degree of dependence on MCF is associated with lack of the stock of resilient critical infrastructure.

Consistent with theories of internal organization and findings by sustainable cities literature on barriers regarding the emerging policy domain of adaptation planning, the evidence from Chile suggests that municipal professional staff is devoted to executing managerial tasks in Maintenance rather than working on planning and investment in new infrastructures. During 2009–2016, a Chilean municipality with more professionals on its payroll invested between 18% and 26% more resources in Maintenance than the average municipalities. The behavior of Chilean public servants is shaped partly by the weight of the inherited legalistic tradition (e.g., public administration, state centralization by law, the administrative statute for public workers, cascading labor hierarchies, and an efficient public audit system). The Chilean legislation prescribes continuity for most municipal employees, depending on performance of encoded and monitored functions, and most of the municipal professionals make their careers within the same municipality. Furthermore, the municipalities must fulfill shared functions with several public organizations (e.g., health, education, employment, social security); therefore, municipal workers are usually stressed trying to fulfill several objectives at the same time, with overlapping functions and often contradictory goals.

In the survey applied to the sample of 98 municipalities, 83% of senior professional officials reported compliance with what is indicated by law and by higher senior authorities as important reasons to invest efforts in Maintenance. Regarding the nine illustrative case studies, the available council meeting minutes document recurrent behaviors of professional officials during 2009–2016: commitment and evaluations according to encoded norms that justified the prioritization of efforts on Maintenance in council meetings and study commissions.

The literature proposes relationships between electoral behavior, outcomes, and local government investments. In Chile, the regressions show that increased electoral support for mayors is associated with more Maintenance, i.e., in a municipality where the mayoral electoral support increases 1%, Maintenance increases between 13% and 18% compared to the average municipalities. The reasons have to do with the institutional context and incentives. The mayors with electoral support must show concrete results in Investment during their four-year period of governance or, if it is not possible, in Maintenance. Their decisions are contingent on several factors that are not always under their control (e.g., availability of funds, legal issues, administrative procedures by other organizations, context pressures, municipal organization, and willingness of municipal staff). Aiming to report results, they prioritized maintenance projects (e.g., lower administrative procedures, decrease in costs and time, feasibility, efficient work of professionals, visibility).

The literature reports that municipal council support in terms of political will and convergent development goals affects local government outcomes in the emerging policy domain such as planning (Carmin, Anguelovski and Roberts, 2012; Revi et al., 2014). In Chile, the estimates show that mayoral political coalition representation in municipal council decreased Investment. This result is particularly interesting and reveals links between local politics, governance, internal dynamics, and outcomes, at least in the following dimensions.

First, political electoral competition in Chile began to be highly polarized at all scales in the first half of the 2010s. Where the local government agendas were controlled by political coalitions, local politicians tended to prioritize expenditures on issues guided by political compromises, electoral calculation, and expectation of electoral outcomes. The combination of mayoral personalized administration and lack of political competition (balance) fostered furthermore laziness within the local government, weakening accountability, at least in relation to Investment. The documented routines in municipal council meetings of the nine illustrative cases provide evidence of those dynamics.

The literature of sustainable cities reports that the continuity of decision makers is relevant in emerging policy domains, for example, in the first stages of adaptation planning (Carmin, Nadkarni and Rhie, 2012). The estimates of Chile consistently show that incumbency of the mayor increases Investment. The achievement of Investment projects may take years because the preparation requires several studies and procedures, interactions with other institutions that operate according to their own priorities and times, and compliance with several requirements (e.g., legal studies, reports, permits from various services, assessments). In these circumstances, the continuity is essential for projects to succeed.

According to the literature review, political support at other scales of governance may open opportunities to advance in emerging local government agendas, for example, support from legislators and high political authorities. In Chile, the regressions consistently show that closeness of the mayor to the ruling party increases the likelihood of Investment.

The theories of organizational dynamics and experiences of sustainable cities suggest that some attributes of municipal organization create differences between local governments in progress and performance in emerging policy domains, for example, planning. In Chile, the municipal organization robustness presents the most quantitatively important moderation effects, impacting the behavior of some leadership attributes variables. For example, the

largest moderating effect on the relationship between mayor electoral support and Investment is driven by the level of robustness in municipal organization (orgm) in view of planning, coordination, and integration. Chilean local governments with motivated mayors who have electoral support and organizational robustness invest 160% more than the average municipalities. Likewise, local governments that receive more financial resources from the MCF and have institutional robustness invest around 122% more than the average. Hence, we infer that the connection between motivated mayors (accounting for electoral preferences and financial resources) and Investment depend to a large degree on the municipal robustness in terms of operational rules, planning, coordination, and integration.

The results of the survey applied to the 98 municipalities further indicate that there is an association between municipal organizational attributes and the local government outcomes. Twenty-five municipalities (25%) with plans for infrastructure DRR and climate-change adaptation reported more engagement than the average of the sample in activities related to infrastructure Investment, DRR, and climate-change adaptation, while 43 municipalities (44%) without planning were below the average. In 57 municipalities with more organizational robustness than the average, civil protection and emergency directors participated in activities related to infrastructure investment, whereas directors did so only in nine municipalities of the group with a lower degree of robustness. A comparison of illustrative cases shows how these interactions operated. In Panguipulli, Osorno, La Florida, and Concepción, DRR, environmental protection, and infrastructure planning were highly institutionalized, with collaboration between departments and more integration than in other cases. Since the mid-2000s, the local governments of those four municipalities introduced reforms in the municipal organization, such as internal regulations to improve management, institutionalization of departments for risk management and environmental protection, and plans with performance agreements and monitoring systems. These changes incentivized

increased awareness and engagement regarding citizens' needs, risk reduction, goal improvements, organizational routines, and new investments.

The municipal councils and accountability practices are important organizational attributes for performance with equitable provision of public goods (Agrawal and Ribot, 1999; Satterthwaite, 1997). In the regression models, municipal council autonomy becomes quantitatively relevant in positively moderating the effect of electoral motivation of the mayor for Investment. Municipalities with higher municipal council autonomy governed by mayors with electoral support invested 35% more than the average municipality in new infrastructures. Furthermore, where MCF increased by 1%, local governments with municipal council autonomy invested 55% less in Maintenance.

In Chile, the grade for municipal council autonomy is contingent on institutional arrangements such as internal regulations and displayed by weekly council meetings and study commissions, where proposals related to policies, plans, programs, personnel, budgets, and projects are discussed. As policy makers, the councilors are in position to provide valuable information, disseminating awareness on issues, introducing frameworks, deliberation, and voting. During 2009–2016, Chilean legislation reinforced the role of the councilors to oversee municipal policies, expanding the areas and topics of municipal management that require agreement of municipal councils. In La Florida, Concepción, Osorno, and Panguipulli, municipal councils with high degrees of autonomy granted by internal regulations proactively supported Investments (e.g., disseminating awareness, requesting information, assessments, proposing projects to improve infrastructures). Municipal councilors understood technical issues, monitored and supervised the employment of municipal resources, controlled expenditures in Maintenance, and ensured efficiency..

Conclusions and implications

The evidence of ordinary Chilean local governments (motivated and not with DRR, and climate-change adaptation adaptation) shows interactions between institutional contexts, capacities, leadership, and outcomes, for instance the relevant role of organizational robustness attributes and accountability. Where more Investment in critical infrastructure is required, organizational robustness and accountability are essential ingredients to achieve progress, making feasible that capacities and leadership motivation translate into decisions and results. Following attributes of the organizational system are particularly relevant: planning and procedures linking human behaviors with objectives (operational rules and rules in use), communication and coordination, integration by administrative procedures and daily routines (repeated situations, where everybody take decisions and are co-responsible for outcomes), and accountability practices (e.g., municipal council, departments, units, individuals).

The Chilean experience teach that performance is not the consequence of motivation per se. Mayors as decision makers, motivated o not by Investment, take decisions depending on features of the organizational system such as planning, communication, coordination, integration, and accountability. Hence, any improvement in the organizational system or institutional environment increase the probability to move foward from motivations into results.

Appendix A

Table A1: Moderating effects of Municipal internal Organization (orgm) variables

Variables	Model 3: Investment	Model 4: Maintenance
partFCM_rate	0.82661***	-113.760
medium (base: low) x partFCM_rate	-0.6967037	-329817
high (base: bajo) x partFCM_rate	8.48499***	-304.874
num_plantacontrata	-0.02611	-0.08732
medium (base: low) x num_plantacontrata	-0.0462983	-0.05548
high (base: low) x num_plantacontrata	-0.1441931	-0.30195
pmarate	204944	548.559
medium (base: low) x pmarate	3.332.897	-324.323
high (base: low) x pmarate	6.094.854	9.077.675
perate	0.81822	368.485
medium (base: low) x perate	-7.453.823	-1.558.892
high (base: low) x perate	-1.712.324	-1.353.712
prof_muni_rate	-0.55399	5.51509***
medium (base: low) x prof_muni_rate	1167583	9.28556**
high (base: low) x prof_muni_rate	-4.114.763	-252113
edumayor (technical)	180.420	1.881.865
medium (base: low) x edumayor	-2.750.327	-6.866.637
high (base: low) x edumayor	1.380.645	-2.413.567
edumayor (professional)	563.107	-482.699
medium (base: low) x edumayor	-3.258.027	-4.949.822
high (base: low) x edumayor	128.997	-17.148.606
mayorvote_rate	1.09634**	306.746
medium (base: low) x mayorvote_rate	1710782	-10.71454**
high (base: low) x mayorvote_rate	38.26841***	-1101569
council_coalition	-0.270838	-1.428652*
medium (base: low) x council_coalition	-0.818493	2.230.169
high (base: low) x council_coalition	2661787	1.899.637
rulingparty	19.94061***	-1.530.918
medium (base: low) x rulingparty	9.328.835	967.592
high (base: low) x rulingparty	7.984.552	371.413
incumbent	16.36236**	720.539
medium (base: low) x incumbent	5.697.539	4.573.341
high (base: low) x incumbent	-9.170.789	1.853.434
Control	YES	YES
Fixed effects at the region level (15 regions)	YES	YES
Time fixed effects	YES	YES
RE (municipality)	YES	YES
Adjusted Rho-squared	0.2205	0.2174
Number of observations	1.626	1.454

*10%, **5%, ***1% significance level

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