How the content of demands shapes government responsiveness: theory and evidence from Mumbai*

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January 24, 2022

Abstract

When citizens lodge formal complaints with bureaucrats, how does the content of their demands shape government responsiveness? I distinguish between complaints demanding the reallocation of resources between citizens and those that simply require some level of state capacity to address. Bureaucratic handlers are less likely to address reallocating demands because their resolution may generate new complaints by other citizens who lose out because their resources have been redistributed. Furthermore, communities with better services are more likely to make non-reallocating demands, and more responsiveness to these demands can encourage future complaint-making. When controlling for other channels of mediation and political influence, formal complaint institutions can generate a virtuous cycle of complaint-making and responsiveness, but only where levels of service provision are already high. I support the theory using a differences-in-differences design, supervised learning for text classification, and original data on the universe of digital complaints in Mumbai's water sector from 2016-2018.

*Thank you to Isabel Arnade, Anna Glass, and Rahul Truter for your valuable assistance on this project. Thank you to Bhumi Purohit, Alicia Cooperman, Justine Davis, Laura Jákli, Shelby Grossman, Jeremy Horowitz, Leah Rosenzweig, Alesha Porisky, Alison Post, Cesar Zucco Jr., and participants of the Southern Workshop in Empirical Political Science, the Program on Governance and Local Development workshop (University of Gothenberg) and the Inequality and Policy Research Center (Claremont Graduate University) Research Talks series for feedback on earlier drafts. The field research described was conducted under a protocol approved by the Committee for Protection of Human Subjects at the University of California, Berkeley, protocol 2017-04-9808.

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1 Introduction

In low- and middle-income countries (LMICs) where resources are particularly scarce, politicians have been known to strategically allocate resources to different groups of citizens, with brokers or informal leaders serving as channels of communication and distribution between elected officials and citizens (see Golden and Min (2013) for a review). This process of distributive politics often leads to uneven access to public services such as water, electricity, or sanitation by certain ethnic, income, or voting blocs (Bates, 1974; Bardhan and Mookherjee, 2006; Besley et al., 2004; Burgess et al., 2015; Chandra, 2004; Franck and Rainer, 2012; Kumar et al., 2022; Min, 2015; Nichter, 2008; Stokes, 2005).

Formal institutions for participatory governance and complaint-making can create a level playing field for disadvantaged citizens (eg. Blair, 2000; Díaz-Cayeros et al., 2014; Crook et al., 1998; Bardhan and Mookherjee, 2000; Kosec and Wantchekon, 2020; Mansuri and Rao, 2012; Grossman et al., 2014; Olken, 2010; Wampler, 2010; Speer, 2012). Indeed, the World Bank has optimistically promoted the use of such institutions to strengthen the voice of the poor, marginalized, and minoritized (World Bank, 2004). A prerequisite to their success is that citizen complaints are acknowledged, processed, and addressed. When do formal mechanisms for complaint-making yield a response from government officials?

Most research on responsiveness operates within a principal-agent framework and assesses the conditions under which politicians will be accountable to citizens (Cleary, 2007; Faguet, 2014; Goldfrank, 2007; Wampler, 2007) and bureaucrats will be accountable to either citizens or politicians (Björkman and Svensson, 2009; Callen et al., 2020; Dal Bó et al., 2021; Gulzar and Pasquale, 2017; Kosack and Fung, 2014; Olken, 2007; Tsai, 2007). While this literature usually develops expectations about responsiveness in general, there is an emerging recognition that patterns of responsiveness and service delivery vary by service sector (Kramon and Posner, 2013). Yet why might there

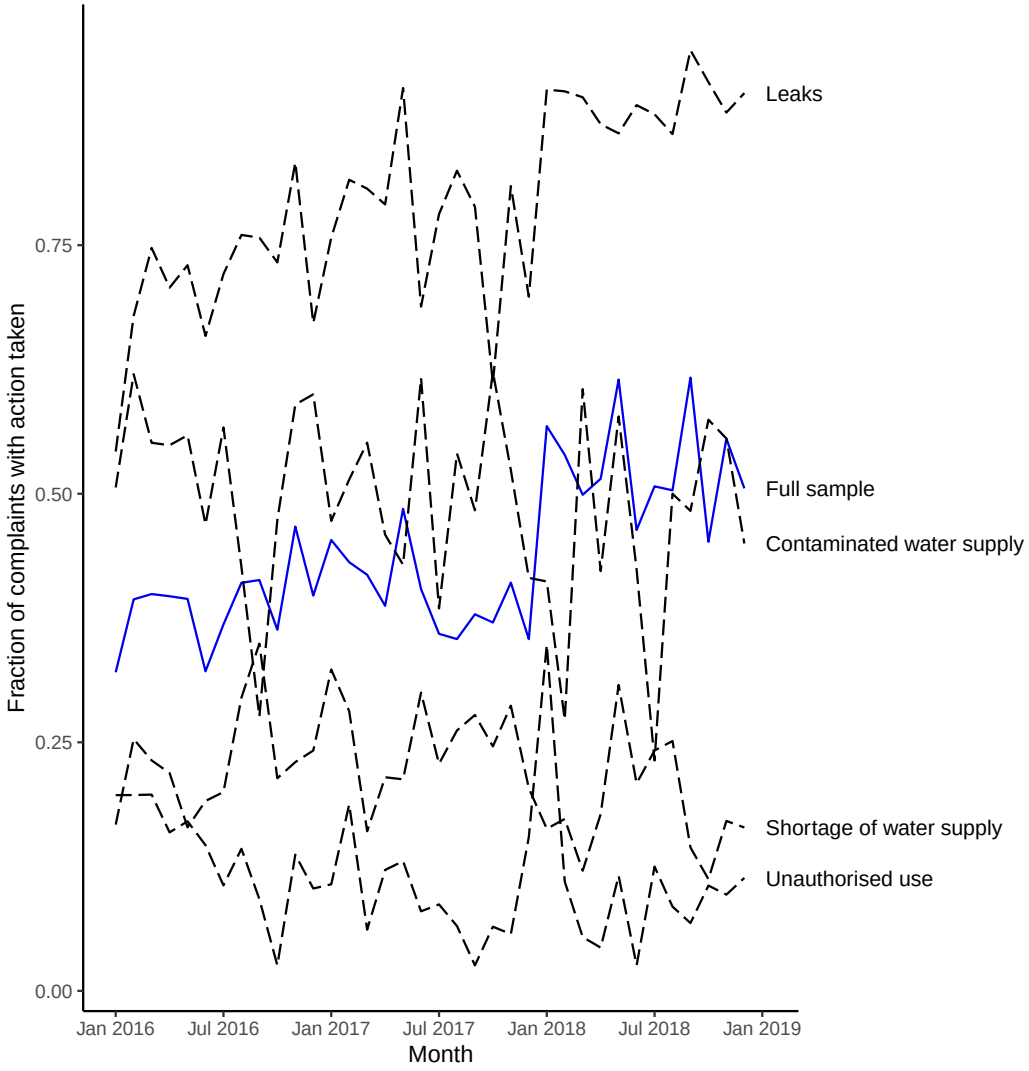
exist variation in responsiveness even *within* a sector? Figure 1, for example, shows that officials within Mumbai's water sector respond at different rates to digitally placed complaints about different types of problems, such as leaks, shortages, and contamination.[1]

I explain this variation by creating a stylized distinction between complaints that are *reallocating* and *non-reallocating* demands. The resolution of a reallocating demand, such as a complaint about insufficient hours of electricity in a system that cannot provide 24x7 access to all citizens, requires redistributing resources, or either hours of service, from other citizens to the complainant. Addressing non-reallocating demands, on the other hand, such as a complaint about a downed power line, simply requires some amount of state capacity to address and does not require the redistribution of resources already allocated to another citizen. Addressing reallocating demands is likely to generate more complaints by other citizens. While the resolution of both types of complaints is constrained by local capacity, addressing reallocating demands complaints has broader distributional consequences which handling bureaucrats may be unable or unwilling to enact at scale. Holding aside cases when handling bureaucrats are themselves involved in a process of political mediation, I thus expect that non-reallocating complaints are more likely to be addressed than reallocating demands.

I further argue that this distinction is fundamental to understanding the potential for formal institutions to generate equity in service delivery because the incidence of complaint-type will vary with characteristics of where complainants live. First, the incidence of complaint-type is likely to be correlated with existing levels of service provision. I expect most non-reallocating demands to originate in places where levels of service provision are already high, and for reallocating demands to tend to originate in places where levels of service provision are relatively lower. Second, this insight is

[1]More information about the data in this figure is provided in the paper's sections on data and methodology.

Figure 1: Rates of action taken in response to complaints about water-related complaints submitted to Mumbai's digital complaints portal.



important in light of the finding that responsiveness generates more complaint-making because citizens will make complaints when and where they believe the will get a response (Kruks-Wisner, 2018; Dipoppa and Grossman, 2020; Trucco, 2017; Goldfrank, 2002).

The theory suggests the existence of two equilibria for complaint-making and responsiveness. In one equilibrium, citizens have high levels of service delivery, make non-reallocating demands, and receive responses that encourage future complaint-making. In the other, low-levels of service delivery are accompanied by reallocating demands that are less likely to receive responses and, therefore, less likely to encourage future making. The variation in responsiveness to different types of complaints and the effect of this variation on citizens' expectations can therefore lead to an enduring divergence in community levels of complaint-making and service provision.

I empirically illustrate the argument through an analysis of formal complaints lodged in Mumbai's water sector, where both pipe leaks and shortages are endemic. In this context, I categorize complaints about leaks as non-reallocating demands, and those about shortages as reallocating demands. Importantly, bureaucrats handling complaints have the ability to make small short-term alterations to water supply schedules to address water shortages within neighborhoods. While complaints here are usually made through political networks and other informal means (Björkman, 2015; Anand, 2011), citizens can also lodge formal complaints with the city online, through an app, or on the phone. I collected the universe of complaints lodged from 2016-2018 through the website used for tracking these complaints and developed a dataset of 21,384 unique complaints about water. I then use supervised machine learning techniques to classify the text of the complaints and responses.

Using this data, I present three sets of empirical results that support my theory. First, I show that not only do officials respond to complaints about leaks at higher rates than they respond to complaints about shortages, but an increase in the overall number of complaints about shortages is met with a lower response rate while an an

increase in the number of complaints about leaks is not. This suggests that complaints about shortages more quickly run up against capacity constraints than those about leaks. The analysis is conducted within a single municipal ward over time to control for other variables that might affect responsiveness, such as state capacity or external avenues for mediation and political influence. Second, I show that as the ward-level mean hours of daily water supply, a measure of levels of service provision, increases, the number of complaints about leaks increases while the number of complaints about shortages decreases. This pattern indicates that the incidence of complaint-type varies with existing levels of service provision. Third, in the context of a water supply cut across part of the city in March 2017, a difference-in-differences design reveals that the cut increases the incidence of complaints about shortages, but only where past responsiveness to complaints has been relatively high. This pattern is further driven by high levels of responsiveness to complaints about leaks rather than complaints about shortages, thereby confirming that responsiveness indeed generates complaint-making, but only with respect to complaints for which absolute levels of responsiveness are high. Overall the data suggest that areas with different levels of service provision will make different types of complaints, which in turn vary in their likelihood of getting a response. This variation is further an important predictor of subsequent complaint-making.

The theory and findings make at least four contributions to research on service delivery, bureaucratic constraints, and governance interventions. First, I develop a novel theory to explain intra-sector variation in service delivery and government responsiveness to complaints made to a bureaucratic official. This is, to my knowledge, one of the first studies of the content of complaints in either a formal or informal setting. Second, this theory moves beyond a principal-agent framework and instead explores how the bureaucrats' constraints can shape their behavior. Third, the study illustrates how in the short term, formal institutions for complaint-making may not have much power to shift entrenched patterns of service delivery. It is possible that they will be more effective in addressing inequities in service provision when they are managed or influenced by

those more directly accountable to citizens, namely politicians. Finally, this study uses data and theory to bridge literature on complaint-making and responsiveness, thereby illustrating how the behaviors of citizens and government officials shape each other over time.

2 Formal institutions for complaint-making

A substantial body of research on the distributive politics of LMICs has found that when delivering scarce government resources such as water, electricity, sanitation, or jobs, politicians are strategic in allocating them to certain groups over others within a constituency (Dixit and Londregan, 1996; Golden and Min, 2013). In particular, researchers have found that the delivery of important public services such as water or electricity favor certain ethnic/religious groups (eg. Bates, 1974; Besley et al., 2004; Burgess et al., 2015; Chandra, 2004; Franck and Rainer, 2012) socioeconomic classes (Bardhan and Mookherjee, 2006; Kumar et al., 2022; Min, 2015), and areas with core (or swing) voters (Nichter, 2008; Stokes, 2005).

This allocation often entails communication between politicians and voters through brokers (Stokes et al., 2013), other types of informal leaders (Jha et al., 2007; Krishna, 2011), or community organizations (Auerbach, 2017; Cooperman, 2019; Spater and Wibbels, 2021). Politicians and parties rely on these intermediaries and informal organizations to provide information on voters behavior preferences. Citizens rely on them to communicate their needs to, make demands of, or solve problems with the state (Brierley and Nathan, 2021). Access to intermediaries and their effectiveness, therefore, are other variables predicting the allocation of public services. Auerbach (2016), for example, finds that areas with a higher number of political intermediaries per capita are more likely to have access to services such as street lighting in urban India.

Formal institutions allow citizens to approach officials with their problems directly. The late 20th century wave of decentralization across LMICs (see e.g Bardhan, 2002;

Rondinelli et al., 1983; Schneider, 1999) was accompanied by the rise of numerous formal non-electoral institutions for citizens to communicate with public officials, such participatory budgeting, local resource management, and grievance redressal systems. In recent years, the growth of e-governance initiatives has further led to the proliferation of online portals for citizens to make complaints about public services (eg. Chen et al., 2016; Dipoppa and Grossman, 2020; Distelhorst and Hou, 2017; Grossman et al., 2017, 2018, 2020; Sharan and Kumar, 2020). In India, these portals (commonly known as "grievance redressal systems") have been implemented at the central, state, and municipal levels. Public-private partnerships, such as Colab in Brazil and FixMyStreet in the United Kingdom (Dipoppa and Grossman, 2020), abound as well.

These institutions can provide a level-playing field for citizens to demand more resources in contexts where complaints are typically mediated through clientelistic networks. Grossman et al. (2014), for example, find that when citizens in Uganda are presented with the opportunity to send text messages to their representatives, a greater share of marginalized populations do so than use existing political communication channels. More generally, studies of participatory governance structures in general suggest that formal institutions for citizen participation increase the accountability and responsiveness of government by addressing problems of elite capture and the clientelistic distribution of public goods (eg. Blair 2000; Crook and Manor 1998; Díaz-Cayeros et al. 2014; Bardhan and Mookherjee 2000; Fujiwara and Wantchekon 2013; Mansuri and Rao 2012; Wampler 2010; Speer 2012). Similarly, another set of studies characterizes citizen participation as fundamental to creating deliberative democracy, thereby making outcomes more transparent and equitable (eg. Heller, 2001; Sanyal and Rao, 2018; Wampler, 2007; Weeks, 2000).

This increase in equity can only occur if bureaucrats and elected officials acknowledge, process, and respond to the citizens' input. The research on responsiveness typically conceptualizes politicians' and bureaucrats' behavior within a principal-agent framework, and assesses the factors that will hold politicians and bureaucrats account-

able to citizens. The research on politicians identifies variables such as degrees of decentralization (Goldfrank, 2007), rates of political competition,[2] election timing Dipoppa and Grossman (2020), and rates of non-electoral political participation and contention outside of the institution (Cleary, 2007; Wampler, 2008) as important predictors of responsiveness.

On the other hand, another body of research focuses on the accountability of the bureaucrats who actually handle complaints (see Grossman and Slough, 2021, for a review). The main mechanisms constraining bureaucrats' behavior are hiring and remuneration policies (Ashraf et al., 2020; Dal Bó et al., 2013; Duflo et al., 2015; Khan et al., 2019; Leaver et al., 2021), oversight by politicians (Callen et al., 2020; Dal Bó et al., 2021; Gulzar and Pasquale, 2017; Olken, 2007), and oversight by citizens (Björkman and Svensson, 2009; Kosack and Fung, 2014; Tsai, 2007). While these mechanisms are general to all types of bureaucratic performance, they can be applied to responsiveness to citizen complaints. Slough (2020), for example, suggests that variation in the ability of citizens to complain to politicians about bureaucrats affects bureaucratic responsiveness to citizen complaints.

I take a different approach by studying how responsiveness varies with the content of complaints. Studies of public economics have traditionally differentiated between private goods, club goods, public goods, and common-pool resources based on whether they are excludable and/or rival. Kramon and Posner (2013) also demonstrate that in countries in Africa, patterns of distributive politics vary with the sector (eg. education, water, electricity, and infant survival) that one studies. These prior theoretical frameworks suggest that the process and strategy for responding to different types of complaints will vary depending on what the complaints are about. The incentives for

[2]While a large body of literature has identified political competition as an important cause or prerequisite to public goods provision in general, there is less evidence that it generates greater responsiveness to civic participation (Cleary, 2007; Faguet, 2009).

responding will not vary across politicians or bureaucrats, but rather within the set of tasks that a single bureaucrat must accomplish.

Research on bureaucratic behavior has furthermore acknowledged that bureaucrats can have multiple types of tasks in their portfolios of responsibilities (see Besley et al., 2021, for a review) for a review. This literature finds that bureaucrats prioritize tasks in a way that aligns with their incentives (Holmstrom and Milgrom, 1991). Most of the empirical literature from LMICs has focused on how the design of incentives, such as teachers' compensation for test scores (Glewwe and Jacoby, 2004), affects performance. Such studies account for multiple tasks by comparing outcomes for incentivized and un-incentivized tasks (Khan et al., 2019). I build upon this literature by arguing that bureaucrats will prioritize tasks that are the lowest relative cost to complete.

3 Theory: complaint type and responsiveness

I argue that even within a sector or good type, responsiveness will vary with whether or not the demand entails the reallocation of existing resources from one citizen to another. To address a *reallocating* demand, such as the demand for more electricity or water, a handler must redirect some water or electricity from one citizen to another. If the supply of water or electricity is fixed, then increasing the service hours for one citizen requires decreasing the service hours or throughput (pressure or voltage in this case) for another set of citizens. In a demand for more health care, a doctor sent to one hospital must come from another one unless there is an excess supply of doctors available. Responding to *non-reallocating* demands, on the other hand, does not require the appropriation of resources already allocated to other citizens. Consider, for example, demands to fix downed electricity lines or burst water pipes. Addressing these requires some amount of resources or capacity but will not require resources already in use by another citizen. A rough proxy for whether a demand is reallocating or not is if it is about service infrastructure (typically non-reallocating) or the resources that flow

through this physical infrastructure (likely to be reallocating).

But in many cases, the distinction between reallocating and non-reallocating demands will be context specific. Consider, for example, a complaint about a broken bus. Whether this demand is reallocating or not depends on the method of addressing it and its consequences. If a small fix to a handrail is all that is required, the response will probably be non-reallocating, unless a handrail is taken from another bus to address the problem. If the bus needs to be replaced entirely, then the response might be reallocating, particularly if the overall number of buses in a system is fixed. The distinction between reallocating and non-reallocating demands, therefore, depends on the required response and the short-term binding constraint in the system of service delivery. In LMICs, this binding constraint is often resources and personnel rather than physical infrastructure, but this may vary by location and sector.

This distinction between reallocating and non-reallocating demands is relevant to handling bureaucrats for two reasons. First, the handler may not have the authority to respond to a reallocating complaint, in which case it is not "actionable" (Grossman et al., 2018). Even when a handler does have the authority to reallocate resources, doing so will impose costs in the form of backlash from citizens or, more simply, more complaints from another set of citizens. Both types of complaints require some level of some level of local capacity to resolve, and this local capacity is by no means guaranteed. But because reallocating demands are *even more* costly to address, I expect responsiveness to them to more rapidly decrease with increased complaint-making than responsiveness to non-reallocating complaints.

This proposed divergence in responsiveness is further important for two reasons. First, the types of demands that citizens make is likely correlated with underlying levels of service provision. An area with already high levels of service delivery and resource allocation is more likely to make non-reallocating complaints than one where service delivery is poor and resource allocation is low; this latter area is likely to make more reallocation demands than an area that is better off. For example, an area with

infrequent bus service is likely to make complaints for more frequent service, which may require decreased service on another route; a place that already receives many buses a day is more likely to make complaints about bus repair or operator behavior. The scope of problems shrinks as service delivery improves.

Second, this variation in responsiveness will have implications for future complaint making. Citizens are more likely to participate in civic life if they expect their actions to have some meaningful impact on governance or their lives. Kruks-Wisner (2018) finds that in rural India, citizens' prior experience with government shapes their propensity to make future complaints and what they believe they can ask for. As discussed, Dipoppa and Grossman (2020) similarly find that citizen reporting of street problems in England increases in pre-electoral periods, but mainly in areas where government responsiveness is already high. In one of the first experimental demonstrations of this phenomenon, Trucco (2017) finds that citizens in Buenos Aires are more likely to submit public complaints *after* they witness public maintenance work. Similarly, Goldfrank (2002) argues that a participatory governance program in Montevideo failed to generate engagement because citizens did not believe their input would have an impact on decision-making. More broadly still, Holland (2018) argues that poorer citizens do not vote for welfare because they do not believe that they will benefit from transfers. I argue, therefore, that high levels of responsiveness are likely to be correlated with even more complaint-making in the future.

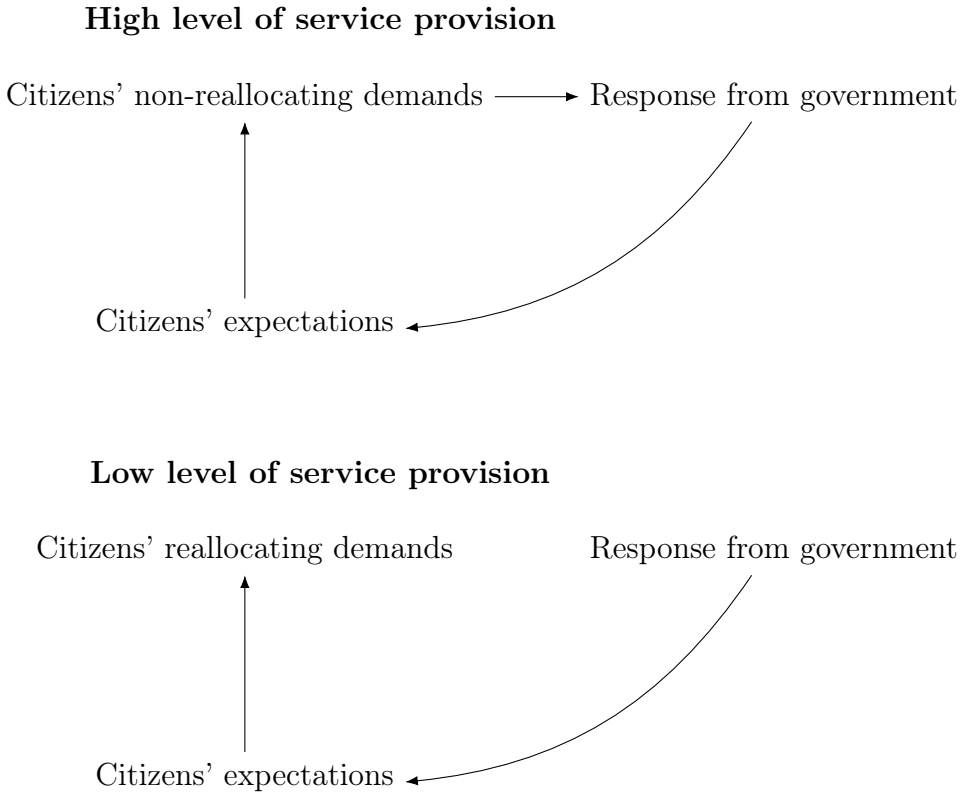
One of the main implications of this theory, then, is that complaint-making and responsiveness can exist in a self-fulfilling equilibrium that looks different based on existing levels of service provision as depicted in Figure 2. I expect the types of complaints citizens make to vary with existing levels of service provision. Responsiveness will, in turn, vary with the types of complaints being made. Responsiveness will, further, shape citizens' expectations and their future complaint-making. Formal institutions for lodging complaints can generate a virtuous cycle of complaint-making and responsiveness, but only where levels of service provision are already high. The theory suggests

the existence of high- and low-level equilibria based on the existing levels of service provision.

Bureaucrats are, of course, subject to political influence; indeed, this is explicitly the case in the literature on political oversight of bureaucrats (Callen et al., 2020; Dal Bó et al., 2021; Gulzar and Pasquale, 2017; Olken, 2007). This influence might heighten the dynamics presented in this theory. For example, communities with better services might also be better organized or have better access to processes of political mediation, thereby further increasing their likelihood of complaint-making or exerting external pressure to ensure that their complaints are resolved. It may also attenuate these dynamics, if communities are able to work to get their reallocating demands met. Responsiveness from this alternative channel may in turn affect citizens' expectations. This theory, however, is concerned strictly with bureaucrats' incentives when controlling for political mediation to assess how likely these institutions for direct democracy are to meet their aims of transparency and equity.

There are a few scope conditions for the argument. First, the theory applies only to institutions where government officials respond to citizen requests and complaints; it does not, importantly, apply to formal institutions for deliberative governance (see Sanyal and Rao, 2018, for example), wherein citizens address their own complaints as a group. Second, it applies to formal institutions where a non-elected official is responsible for handling complaints. As discussed in the vast literature on distributive politics, elected officials will face a different set of constraints and incentives when responding to complaints. Additionally, the theory is relevant to complaints made about a system of services itself, rather than requests to gain access to that system. Finally, it applies to settings where there are real constraints on service delivery wherein it is not possible to address every service-increase complaint or easily increase service supply levels overall. Where water supply is not extremely constrained, for example, a complaint about a water shortage is a non-reallocating complaint, as it is likely a symptom of a problem with physical infrastructure that can be resolved without redistributing the overall

Figure 2: Theorized relationships between expectations, complaints, and responsiveness and how they vary by demand type.



water supply. In a constrained system, however, water shortages are more likely to be due to inadequacy the overall water supply, and they will not be possible to resolve them without redistributing water.

4 Complaints and redressal in Mumbai's water sector

I illustrate the theory in Mumbai's water sector. Mumbai is India's financial, commercial, and entertainment capital, and a sprawling metropolitan area home to over 20

million residents. An estimated 12-13 million residents live under the direct purview of the Municipal Corporation of Greater Mumbai (MCGM), the city's governing body. Like other major cities in urbanizing countries, the city constantly faces insufficiency and inequity in the provision of many public services, such as water, electricity, and sanitation.

The water supply and infrastructure in particular face a great deal of pressure. While the city technically sources sufficient water from nearby lakes and dams to provide its citizens with adequate daily supply, different sources estimate that anywhere between 7-25% of this supply is lost through leaks and pipe bursts between the source and point of supply (Varshney, 2021b).[3] Water supply is also unequal: as is typical in cities with insufficient water, supply is rationed out to different areas in rotation for several hours at a time. Despite the launch of a 24x7 water supply project in 2014, the duration of supply across the city was only six hours in 2018, with 180 out of 273 zones receiving four or fewer hours of supply a day (PRAJA, 2020). The level supply also varies with communities' socio-demographic characteristics. In 2019, the MCGM found that non-slum areas received more than three times the daily volume water as slum areas, where over 50% of the city's population lived at the time.

Citizens therefore complain frequently about leaks and shortages. Information about the location of leaks is valuable to the MCGM. In 2011, after a 15-day effort, city engineers found 653 leaks in the pipe system (Purohit, 2011). Citizen input can complement such efforts by providing additional information and reducing the burden on employees searching for leaks. My qualitative interviews revealed that self-interested citizens want to complain about leaks because they are worried about low water pressure or being billed for water they do not consume.

[3]This figure is lower than usual estimates for non-revenue water in cities in LMICs because it does not include unbilled supply. With the inclusion of unbilled supply, estimates for non-revenue water for cities in India can reach 50-90% (Bandari and Sadhukhan, 2021).

Complaints about water shortages also form a central component of political life in the city. Anand (2011) illustrates through careful ethnographic work how insufficient water shapes the lives of Mumbai citizens (particularly women, see p 97-126) and intermediaries – including engineers, informal fixers, and social workers – they approach to access more of it. Björkman (2015, 198-227) further illustrates how citizens' demands and politicians' promises for water have become a routine "spectacle" of Mumbai politics.

Citizens can also approach officials with their complaints directly through a formal process. They can lodge a complaint with MCGM through its online portal, a smartphone app, or through the phone (see Varshney (2021a) and Figure SI.1, top panel).[4] These complaints are then given a number with which citizens' can subsequently track the progress of the complaint. According to PRAJA, an NGO aiming to improve transparency and accountability in Indian cities, complaints about water are frequent; "Water supply" has been in the top 5 complaint categories every year since 2010, the year in which PRAJA first makes its reports available.

These complaints are then sent to a handler in the ward-level Hydraulic Engineering department, typically the Assistant Engineer for Water Works. I learned about the process of addressing complaints through a five unstructured interviews (conducted in January 2018) with the Assistant Engineer for Water Works in randomly sampled wards.[5] This employee is responsible for both maintaining a given municipal ward's water infrastructure and addressing citizen complaints. This individual triages the complaint and sends it to employees, sub-departments, or other agencies for addressal.

The process of resolution differs by complaint-type as illustrated by the resolution

[4]The website can be accessed at `http://www.mcgm.gov.in/`.

[5]Respondents were not compensated for their interviews. Their identities have been anonymized throughout the paper. Interviews were conducted in compliance with the American Political Science Association's Principles and Guidance for Human Subjects Research.

of leaks and shortages. According to an Assistant Engineer (ward name omitted for anonymity), when a complaint about a shortage comes in, the handler first determines whether the neighborhood of origin is operating at the designated supply schedule.[6] If so, the complainant is told that no resolution is possible. If for some reason the water schedule is not being followed, the water supply schedule can be reshuffled to provide one area with an extra hour or so of supply. An alternative solution is to send a tanker, or a water truck, to an area with low water supply. More often, if an area is receiving less water than usual for a known reason, that reason, such as "water in reservoir is low" is given in the response to the complainant. If multiple complaints are arising from a neighborhood for an unknown reason, an engineer will be sent to learn if there are problems with the infrastructure, but large infrastructural causes of water shortages, like water main bursts, are more likely to be submitted under a different category of complaint.

In most cases, there is no solution to a complaint about a shortage other than diverting water from one area of supply to another. Handling engineers often do not choose this option, as it simply "generates more complaints from other citizens." As reported by the Assistant Engineer, "this makes no sense. If my job is to get through as many of these grievances as possible, why would I do something that makes other people complain? In some cases the MCGM can send a tanker, but not for every problem."

When a complaint about a leak comes in, on the other hand, an employee is sent to investigate the source of the leak. If one is found, that leak is patched or the relevant section of the pipe is replaced. If a leak is not found, the complainant is alerted to the fact. Each individual complaint about a leak from the same neighborhood receives some investigation as multiple different leaks within a neighborhood are possible. The

[6]The engineer contacts the local valvemen, or those responsible for opening and closing valves to pressure an area of the network, to do so. For more on valvemen in the Indian context, see Hyun et al. (2018).

modal response to a complaint about a leak, however, is to quickly repair or replace a section of pipe, which is an action that does generally does not affect service delivery for other citizens beyond the area being served by the faulty pipe. As reported by the Assistant Engineer, "sometimes fixing a leak can take time, but it doesn't affect other people [who don't live in the area]."

These descriptions, overall, suggest that the resolution of complaints about leaks and shortages follows two distinct patterns. The resolution of complaint about a leak typically does not worsen service delivery for others outside of the relevant valve area. A shortage complaint, on the other hand, is a request for more water, particularly more supply hours. The main resolution of a shortage complaint, is to allocate more supply hours to the complaint's area of distribution. This can only be done by reallocating supply hours or water volume (and, therefore water pressure) from another area. Another option is to send a water tanker which, given a fixed supply of tankers is itself a reshuffling of existing supply. In this context, I therefore define complaints about leaks as non-reallocating demands and those about shortages as reallocating demands.

5 Data

I illustrate my theory about these two types of demand using original data on the content of complaints and responses to complaints in Mumbai. I collected data on complaints concerning water supply made to the MCGM from the citizen complaint portal which collects and tracks the formal complaints made over the phone, online, or through a smartphone application. I inputted every possible permutation of the details requested (eg. municipal ward, complaint-type, and date, Figure SI.1, bottom panel) to collect individual-level data for every complaint lodged from 2016-2018. This process generated information on 21,384 complaints in the "Water supply" complaint-type.

Each complaint ticket includes the original complaint text in Hindi, Marathi, or English. I used basic text-analysis and supervised machine learning processes to classify

these complaints into topic categories. I translated the text using Google Translate, tokenized the sentences and phrases into words, removed special characters, removed stopwords, and stemmed any remaining words.[7] About 68% of these complaints had been classified into categories by the handling officer. Using a "bag of words" approach, I fit least absolute shrinkage and selection operator (LASSO) models to a 70% training sample of the already categorized sample to select the words or features most predictive of each complaint topic as defined by the handler.[8] I selected the words with non-zero coefficients from each of the LASSO models to fit a random forests model on the training sample of the classified data.[9] This model predicted complaint categories in the remaining 30% test dataset with 86% accuracy. The words used in the final model can be seen in Table SI.1. The overall incidence of the most frequently occurring categories in each month for which I collected data can be seen in Figure 3, Panel A. Complaints about leaks and shortages make up the vast majority of topics covered.

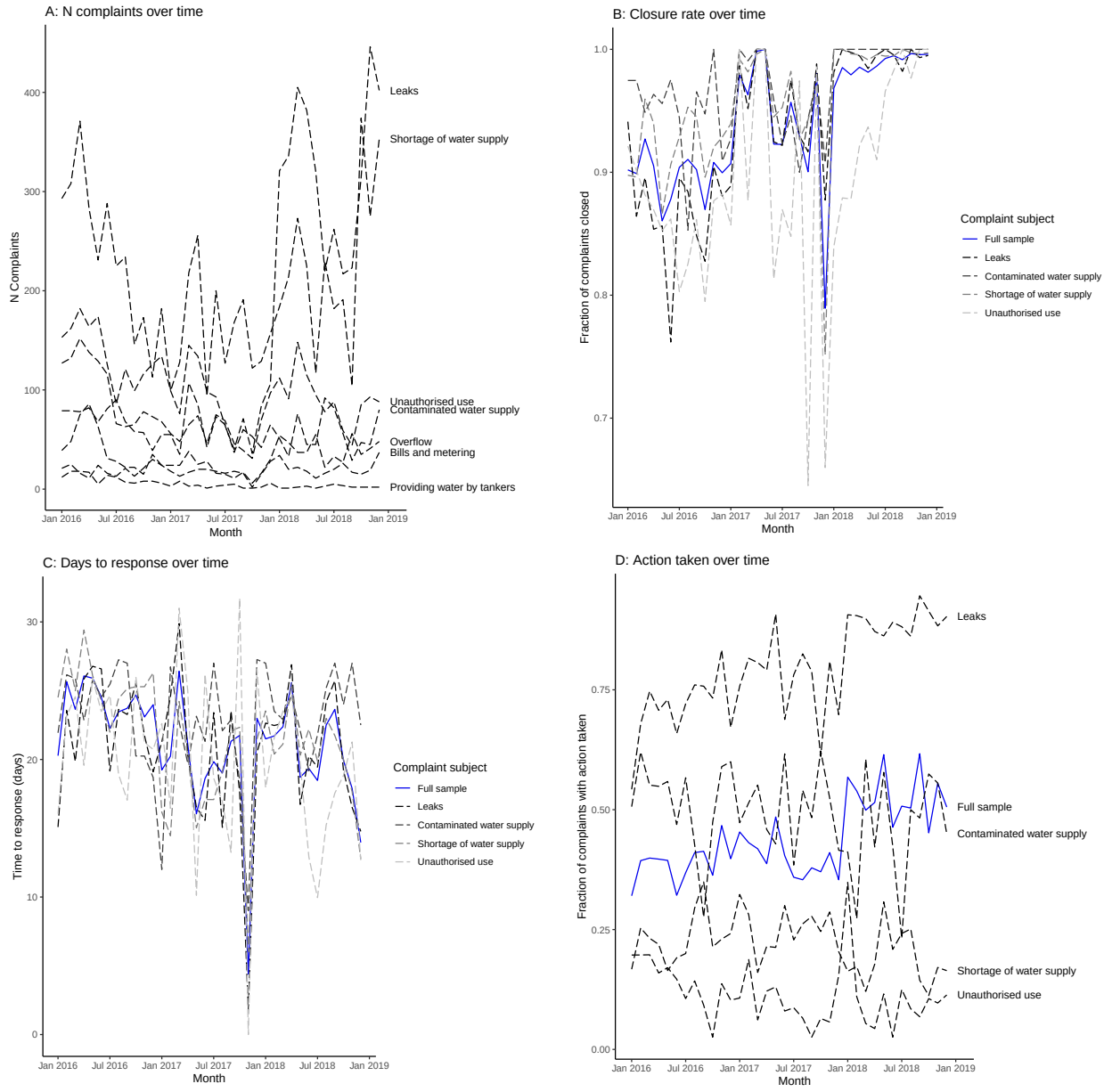
The data also include measures of responsiveness to these different complaints. First, each observation contains information on its status, with the majority (93%) marked as "Closed," and others marked as "Registered," "In process," "Re-assigned," "Incomplete information," or with no status information. The rate of complaint closure over time and by category can be seen in Figure 3, Panel B. Second, about 25% of the observations include PDF documents tracking the dates on which complaints were resolved, allowing me to measure the number of days between a complaint being lodged and its final

[7] I validated the translations by manually confirming the translation of 100 randomly selected rows.

[8] I selected λ for each model using k-fold cross validation. I chose to collapse two predefined categories, "Leaks in water lines" and "Leakage near meter" into the umbrella category of "Leaks."

[9] Random forests provided a higher accuracy rate than k-nearest neighbors, gradient boosting, and naive Bayes, other popular algorithms for multi-class classification. The number of trees and number of variables available for splitting at each node (eg. "mtry") were determined using holdout cross validation.

Figure 3: N complaints, complaint closure rate, time to response, and rate of meaningful action taken by complaint type for most common complaint categories in Mumbai's water sector, 2016-2018.



resolution. Monthly means for the available sample are shown in Figure 3, Panel C. Because this variable is only available for such a small subset of the data, I omit it from subsequent analyses. Note, however, that the mean time to response is about 21 days across the full sample, and the maximum time to response is 72 days.

Finally, observations that are marked as "Closed" include response text from the final handling officer. This response text reveals that several "Closed" complaints are not actually resolved. For example, many complaints receive "False complaint" as a response, and several complaints about water shortages receive "Water in reservoir is low" as a response. I used the text of the responses to classify the text of these responses. A team first coded 3% of the responses as "Action taken," "False complaint," "Incorrect or missing information," "Referred to other department," or "No action taken" for some other reason. Each observation was coded twice by independent coders, and I made the final judgement on any discrepancies. I then used the coded observations to build a model to predict the categories of the remaining 97% of the sample using the same process of text cleaning, feature selection using LASSO, and classification with random forests as used for the complaint text (final model features shown in Table SI.1). The final model predicted response categories in the test dataset with 92.5% accuracy. The rates of responses denoting "Action taken" over time and by complaint type are shown in Figure 3, Panel D. Complaints marked as "Action taken" are usually (99.6%) marked as "Closed", but the reverse is not true, as just 47% of complaints marked as "Closed" are classified as "Action taken." Categorization as "Action taken" is my main measure for responsiveness throughout the paper.

The subsequent analyses in this paper aggregates complaints to the ward-day level. Table 1 shows summary statistics for all of the outcomes of interest at the ward-day level for the three years that the dataset covers.

5.1 Multiple complaints

Sometimes, multiple complaints will come in about the same problem. To be able to detect whether two complaints are about the same problem, one must be able to match local addresses and landmarks provided by citizens to a map of the piped water network. As in other cities (see Kumar et al., 2022, for a discussion of this issue in Bangalore),

Table 1: Summary statistics for main outcomes of interest. Unit of analysis is the ward-day, Mumbai 2016-2018.

Variable	*Min.*	*Max.*	*Mean*	*SD*
Complaints (all types)	0	23	0.81	1.38
Complaints (shortages)	0	22	0.28	0.81
Complaints (leaks)	0	12	0.25	0.63
Closure rate (all types)	0	1	0.95	0.20
Closure rate (shortages)	0	1	0.96	0.20
Closure rate (leaks)	0	1	0.96	0.20
Action taken rate (all types)	0	1	0.45	0.44
Action taken rate (shortages)	0	1	0.22	0.39
Action taken rate (leaks)	0	1	0.82	0.64

this map of the piped water network does not exist in a centralized location. Handlers must rely on coordinated efforts between engineers and valvemen to locate problems. As highlighted in the discussion of the process for the resolution of leaks, even those with knowledge about the layout of pipe infrastructure will have to investigate individual complaints to learn whether two are about the same problem.

As a result, it is not feasible for me to restrict the dataset to unique problems only. Nor would doing so necessarily shed light on some of my main quantities of interest, namely the incidence of complaint-making independent of the rate of underlying problems. Wherever relevant, I discuss how I expect repeat complaints about the same problem to influence my results and interpretation.

6 Responsiveness to different types of complaints

I first show simple patterns of responsiveness to different types of complaints within the water sector. Figure 3 shows that non-reallocating demands, or those related to leaks, get responses at much higher rates than reallocating demands, or those related to shortages. Action is taken for almost 83% of complaints about leaks. In contrast, action

is taken for only 21% of complaints about shortages. To demonstrate that differences in rates of responsiveness are shaped by capacity constraints, I estimate the following equation, where t indexes days and w indexes wards:

$$responsiveness_{t,w} = \beta_0 + \beta_1 complaints_{t,w} + \overrightarrow{\eta} month_m + \overrightarrow{\gamma} year_y + \overrightarrow{\delta} \alpha_w + \epsilon_{t,w} \quad (1)$$

The main outcome, $responsiveness_{t,w}$, is the percentage of complaints registered on a given day that I classify as "action taken." Only days on which at least one complaint is registered are included, as the outcome is otherwise undefined. The N for the leaks and shortages models is thus lower than for the model including all complaints because ward-days in which there were no complaints about leaks or shortages are dropped. The main predictor of interest, $complaints_{t,w}$ measures the number of complaints that a ward receives on a given day. In other words, the equation is estimating how a ward office changes its levels of responsiveness as its caseload increases.

As the comparison of interest is being made *within* a ward over time, the equation also includes ward-level fixed-effects (α_w) to account for any unobservable differences across wards when they are pooled together. These unobservable differences might include community-level avenues for political mediation and influence that operate outside of the formal complaint system.

Year fixed-effects ($year_y$) account for long-term unobserved trends affecting responsiveness, while the month fixed-effects ($month_m$) capture seasonal trends. The model allows for variation over days within wards. In this and subsequent analyses, standard errors are clustered at the ward level to account for correlations of unobserved variables within wards over time.

The main results are presented in Table 2. I see a divergence in responsiveness by complaint type. Across all water-related complaints, there is a negative relationship between the number of complaints registered on a single day and the rate of action

taken. This relationship appears to be driven by complaints about shortages. For every additional complaint about shortages registered on a given day, the rate at which these complaints receive a meaningful response decreases by about 0.9%. This is consistent with the assumption of fixed capacity and complaints that are costly to address. There is no measurable relationship between the number of complaints about leaks that come in on a certain day and the rate of resolution, suggesting that this type of complaint runs up against fixed capacity at a lower rate, or incurs lower costs of resolution.

Table 2: Correlation between rates of responsiveness and complaint-making.

	Rate of action taken for closed complaints:[1]		
	All water complaints	Leaks	Shortages
N complaints	-0.007^{**}		
	(0.003)		
N complaints (leaks)		0.001	
		(0.007)	
N complaints (shortages)			-0.009^{***}
			(0.002)
Constant	0.120^{***}	0.429^{***}	0.085^{*}
	(0.041)	(0.069)	(0.045)
Observations	10,821	4,575	4,850
R^2	0.092	0.152	0.069
Adjusted R^2	0.089	0.145	0.061

*p<0.1; **p<0.05; ***p<0.01 Observations are at the day-ward level. All regressions include ward, year, month of the year fixed-effects, and standard errors clustered at the ward level.
[1] Rate at which complaints that receive some response or acknowledgement have responses indicating that the handling officer has taken some meaningful action.

These patterns are surprising given how multiple complaints for a given area are handled for each complaint type. Recall that even when multiple complaints about leaks come in from a single area, it is not clear (without some inspection) whether the complaints are about the same problem. Multiple pipe sections within a neighborhood can leak. A complaint about a shortage, on the other hand, is relevant to an entire section of the water network that is pressurized at a time. Multiple complaints about shortages from the same area are likely to be able to same problem. In other words, the unit of resolution for a complaint about a leak is a section of pipe (of which there

are infinitely many), and the citizen-provided information on where a leak is occurring rarely has sufficient detail to identify the relevant section of pipe without further investigation. The unit of resolution for a complaint about a shortage is a valve area or small neighborhood, which can be identified using a general address, so long as the handler has (or can reach someone with) knowledge of the rough boundaries of different segments of the water network.

As a result, each additional shortage-related complaint incurs a lower variable cost to address because a) there is some likelihood that it is related to a complaint already in the system and b) it is known to handlers without substantial additional investigation whether or not this is the case. Nevertheless, the resolution of shortages decreases as caseload increases, but the same is not true for leaks. Complaints about leaks continue to prompt action even when the caseload is high, suggesting that handlers do not face substantial net capacity constraints in addressing them. This daily-level trend may account for the overall divergence in rates of resolving complaints about leaks versus shortages as seen in Figure 1.

7 Divergence in the types of complaints that are made

Next, I show that the incidence of different types of complaints varies with existing levels of service provision. I test whether the ward-level daily complaint rate varies with fixed ward-level service provision levels. Here, I use the mean daily hours of water supply as the indicator of service provision levels because supply hours best approximate the total volume of water households receive from the public utility. This data is from PRAJA (2020) and covers the year 2018.

I estimate the following equation, where t indexes days and w indexes wards:

$$complaints_{t,w} = \beta_0 + \beta_1 hours_w + \overrightarrow{\eta} day_t + \epsilon_{t,w} \quad (2)$$

Here, $complaints_{t,w}$ is the number of complaints registered on a given day divided by the total number of individuals living in the ward. The main predictor of interest, $hours_w$ is the measure of mean daily hours of water supply. All models include day fixed-effects (day_t) to account for any events or trends affecting complaint levels over time. In other words, comparisons are being made across wards, so I control for unobserved time-related characteristics of each observation. The model allows for variation across wards, and standard errors are clustered at the ward level. Because the data on mean daily supply hours is from the beginning of 2018, I include observations from 2018 only.

Note that I do not contend that an increase in mean supply hours causes more or less complaints. It is likely that both supply hours and the incidence of complaint-making are correlated with some other variables, particularly ward-level socio-economic characteristics, that drive the relationship. Wealthier, more literate, and better organized communities are likely to be more active in complaint-making. It is also possible that this relationship is driven by a variation in the incidence of real problems with underlying levels of service provision. This exercise simply shows that different types of complaints tend to come from different types of places and that levels of service provision are an important differentiating factor, as levels of service provision is the relevant variable in the theory outlined in Figure 2. For this reason, I do not include any control variables aside from the day fixed-effects.

The results can be seen in Table 3. First, there is no measurable relationship between the ward-level daily complaint rate per capita for all water-related and the mean daily supply hours. This suggests that areas with different levels of service delivery are unlikely to exhibit variation in complaint-making *in general*. This null relationship masks two correlations going in opposite directions. Wards that experience one more hour of service generate 0.001 more complaints about leaks per person and 0.00003

fewer complaints about shortages per person per day. I therefore see a divergence in the types of complaints that are made as levels of service provision increase.

Table 3: Correlation between number of complaints per capita and mean daily supply hours (2018).

	Dependent variable:		
	All water complaints[1]	Leaks	Shortages
Mean daily supply hours	0.0002	0.001***	−0.0003**
	(0.0003)	(0.0001)	(0.0001)
Constant	0.008*	−0.0004	0.003**
	(0.004)	(0.002)	(0.001)
Observations	8,760	8,760	8,760
R^2	0.070	0.086	0.072
Adjusted R^2	0.030	0.046	0.032

*p<0.1; **p<0.05; ***p<0.01
Observations are at the day-ward level for 2018. All regressions include a dummy for each day, and standard errors clustered at the ward level.
[1] Number of complaints per day divided by the number of individuals in the ward.

8 Responsiveness and subsequent complaint-making

Finally, I argue that citizens' complaint-making is shaped by past levels of responsiveness. Here, it is not informative to simply show a correlation between past responsiveness and present levels of complaint-making. This is because I have demonstrated that rates of responsiveness and complaint-making are correlated. Any relationship between past responsiveness and subsequent complaint-making could simply be the result of the autocorrelation of complaint-making within a ward over time.

Instead, I examine how a differentially experienced shock to the water supply affects complaint-making, and how this effect varies with previous responsiveness. From March 25th to April 8th 2017, roughly half of the wards in the MCGM experienced a 10% reduction in supply hours as a new valve was installed in the Bhandup water supply

tunnel.[10] I use a difference-in-differences design[11] to estimate the effect of this water supply cut on complaint-making:

$$complaints_{t,w} = \beta_0 + \beta_1 short_w + \beta_2 post_t + \beta_3 post_t \times short_w + \overrightarrow{\eta} day_t + \epsilon_{t,w} \quad (3)$$

Here, $complaints_{t,w}$ is the number of complaints registered on a given day in a ward, and $short_w$ is an indicator for whether or not a ward was affected by the shortage. Note here that my quantity of interest is explicitly multiple or repeat complaints about the same problem. I include daily observations across all wards for the duration of the shortage (15 days) and the 15 days preceding the shortage, and $post_t$ is an indicator for whether an observation takes place during the shortage of interest. I also include day-level fixed effects (day_t) to account for unobserved daily factors affecting complaint-making, and all standard errors are clustered at the ward level. I estimate Equation 3 separately for wards that are at the time highly responsive (above the median rate of ward-level "Action taken" over the previous six months) and not highly responsive (at or below the median rate of ward-level "Action taken" over the previous six months). A triple interaction effect is presented in Table SI.2. Among the wards affected by the shortage, there are 9 and 8 affected wards that are unresponsive and responsive, respectively.

The coefficient of interest is β_3. As is typical in a difference-in-differences design, the coefficient measures the interaction effect $post_t \times short_w$ to assess the difference

[10] The affected wards were A, C, D, GS, GN, L, N, S, HE, HW, KE, KW, PS, PN, RS, RC, and RN. For more information, see Pinto (2017) .

[11] This is a simple two-period difference-in-differences design with no variation in treatment timing, and therefore not subject to emerging concerns about the specification of difference-in-differences as raised by Goodman-Bacon (2021) and others.

between pre- and post-shortage complaint levels across affected and unaffected wards. Under certain assumptions, this coefficient can be interpreted as the causal effect of the shortage on complaint-making. In particular, I assume that affected and unaffected wards do not exhibit different trends in complaint-making prior to the shortage. I validate the assumption in three ways. First, I consider the reason for the shortage and whether this would affect the prior trends in complaint-making. In Mumbai, a large underground valve is usually replaced because it does not fully close. Fixing it increases the overall pressure in the water system. Because of the age of the water system, a handler reported that this valve had likely had this problem for several years. As a result, I expect differences in the overall *levels* of complaints made in affected wards and unaffected wards prior to the shortage, but it is unlikely that there would be recent differences in trends in complaint-making across affected and unaffected wards. Moreover, we might expect long-term trend differences across these two wards, but not in the short-term. I next visually verify this claim by plotting the mean number of complaints for affected and unaffected wards for the two months prior to the shortage (Figure 4) and see no evidence of different trends in complaint-making prior to the shortage. Finally, I estimate differences-in-difference models for 5 time periods prior to the shortage as placebo tests (Figure 5) and find no evidence for differences in trends prior to the shortage.

The main results can be seen in Table 4 and Figure 5. Most simply, the shortage adds about 0.47 shortage-related complaints per day, almost twice the daily rate of complaint-making about shortages from 2016-2018 (Figure 3), to affected wards relative to unaffected wards. Yet this effect is only visible in wards that have been relatively responsive to complaints over the past six months. There is a smaller effect for complaints about leaks, but given the nature of the intervention, the main effect of interest is on complaints about shortages. The triple interaction (Table SI.2) similarly show that that the supply cut generates complaint-making about shortages at significantly higher rates in wards that are highly responsive than in wards that are not.

Figure 4: Daily means for complaint-making before and during the 2017 water supply cut (shaded area) for wards with high (left panel) and low (right panel) rates of responsiveness.

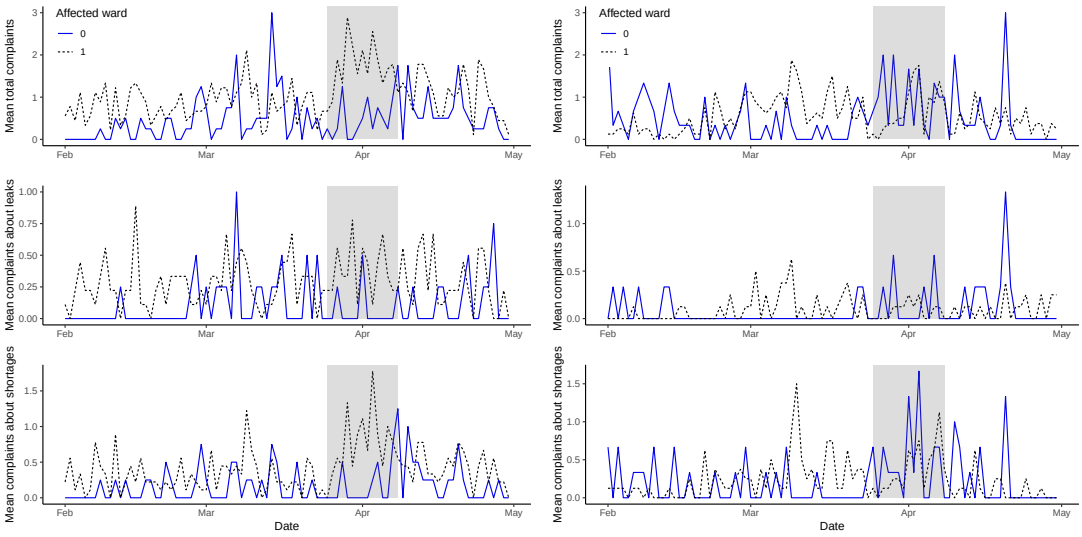
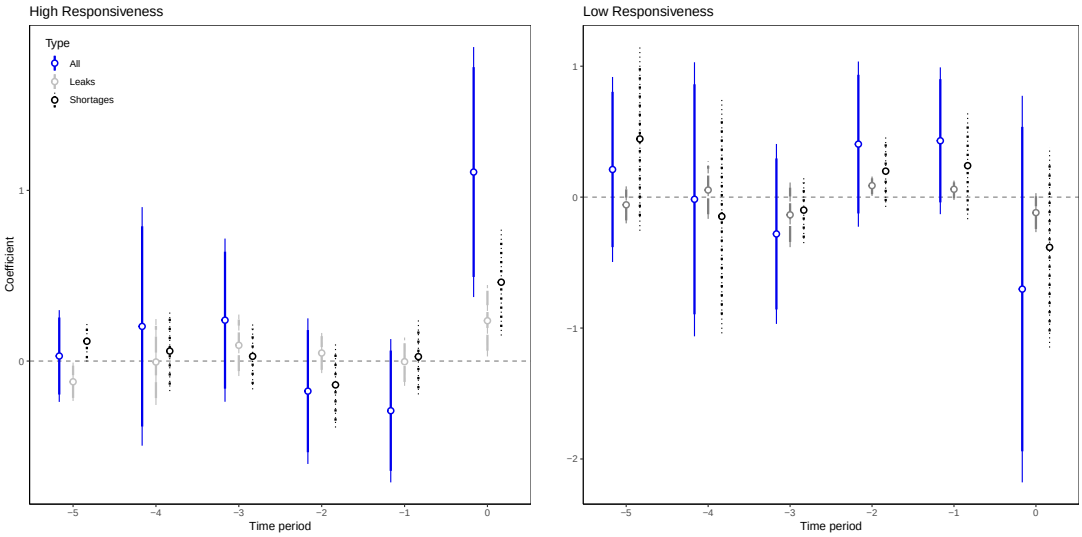


Figure 5: Difference-in-difference estimates for wards with high (left panel) and low (right panel) rates of responsiveness for the time periods leading up to the March 2017 supply cut period.



Time period 0 refers to March 10-April 8 2017, with the supply cut period occurring after March 25. Time period -1 refers to February 19-March 5 2017, with a placebo supply cut period occurring after March 19. Other time periods similarly look at five 30 day intervals occurring 20, 40, 60, 80, and 100 days prior to the actual supply cut as to examine parallel trends for 100 days total.

I next show that these patterns are driven by prior responsiveness to complaints about leaks, rather than complaints about shortages. I separately estimate Equation 3 for wards that are above the median rate of "Action taken" for complaints about either shortages or leaks in Table 5. I find no measurable effect of the water shortage in wards that are relatively responsive to complaints about shortages, yet I find that it generates 0.324 more leak-related and 0.338 more shortage-related complaints per day in wards that are highly responsive to complaints about leakages. These results suggest that the effects in Table 4–indeed, the effects on complaint-making about *shortages*–are driven by wards that are relatively responsive to complaints about leaks.

Why do we not see an effect on complaint-making in wards where responsiveness to complaints about shortages is relatively high? Theoretically, the mechanism here–that responsiveness is sending signals to citizens about either its capacity or willingness to respond (Hern, 2017; Hunter and Sugiyama, 2014)–should apply regardless of the topic of complaints to which governments are responsive. The rates of responsiveness to complaints about shortages, however, are much lower than rates of responsiveness to complaints about leaks (Figure SI.2). The median rate of responsiveness to complaints about shortages hovers around 25%, while it is closer to 80% for complaints about leaks. In other words, even the wards that are relatively more responsive to complaints about shortages are not responding to these complaints at a high rate. And the correlation between the different types of responsiveness is low; over time, the correlation between responsiveness to leaks and responsiveness to shortages is 0.09 and not statistically significant (standard error of 0.05).[12]. This suggests that we do not see an effect on complaint-making in wards where responsiveness to complaints about shortages is relatively high because this response rate is still low in absolute terms and therefore unlikely to be correlated with high expectations for responsiveness.

[12]This correlation was measured through a regression of daily responsiveness to leaks on responsiveness to shortages with daily fixed effects and standard errors clustered at the ward level

Table 4: Difference-in-differences estimates for wards with high (top panel) and low (bottom panel) rates of responsiveness.

	High rates of previous responsiveness[1]		
	All water complaints	Leaks	Shortages
Supply cut period	0.253	−0.041	0.435
	(0.698)	(0.114)	(0.444)
Affected ward	0.508**	0.080	0.027
	(0.206)	(0.118)	(0.114)
Supply cut period × Affected ward	−0.560	0.186*	0.473***
	(0.378)	(0.105)	(0.183)
Constant	0.702*	0.030	0.065
	(0.369)	(0.126)	(0.113)
Observations	348	348	348
R^2	0.112	0.092	0.156
Adjusted R^2	0.028	0.006	0.076

	Low rates of previous responsiveness[4]		
	All water complaints	Leaks	Shortages
Supply cut period	0.253	−0.041	−0.079
	(0.784)	(0.136)	(0.426)
Affected ward	0.508***	0.071*	0.317***
	(0.165)	(0.041)	(0.108)
Supply cut period × Affected ward	−0.560	−0.057	−0.340
	(0.742)	(0.086)	(0.385)
Constant	0.702**	0.113	0.345
	(0.353)	(0.110)	(0.260)
Observations	348	348	348
R^2	0.112	0.056	0.118
Adjusted R^2	0.028	−0.034	0.035

*p<0.1; **p<0.05; ***p<0.01

Observations are at the ward-day level, including all days between March 11-April 8 2017. All regressions include day fixed-effects, ward fixed-effects, and standard errors clustered at the ward level.

[1] Includes all wards above the median value for "Action taken" over the previous six months.

[2] Indicator for whether an observation takes place during the waterupply cut period (March 25-April 8, 2017)

[3] Indicator for whether a ward was affected by the water supply cut.

[4] Includes all wards below the median value for "Action taken" over the previous six months.

Table 5: Difference-in-differences estimates for wards with high rates of responsiveness to complaints about leaks (top) and shortages (bottom).

	Highly responsive to complaints about shortages [1]		
	All water complaints	Leaks	Shortages
Supply cut period	−0.660	−0.137	−0.104
	(0.635)	(0.143)	(0.349)
Affected ward	0.349	0.067	0.210*
	(0.223)	(0.092)	(0.123)
Supply cut period × Affected ward	0.889	0.233	0.337
	(0.632)	(0.145)	(0.313)
Constant	0.963**	0.127	0.211
	(0.461)	(0.140)	(0.245)
Observations	340	340	340
R^2	0.231	0.110	0.218
Adjusted R^2	0.156	0.023	0.142

	Highly responsive to complaints about leaks [4]		
	All water complaints	Leaks	Shortages
Supply cut period period	−0.185	−0.024	0.152
	(0.605)	(0.130)	(0.456)
Affected ward	−0.116	0.003	0.042
	(0.191)	(0.125)	(0.084)
Supply cut period period × Affected ward	1.131	0.324**	0.338*
	(0.408)	(0.127)	(0.197)
Constant	0.630***	0.089	0.152
	(0.184)	(0.127)	(0.095)
Observations	319	319	319
R^2	0.153	0.099	0.137
Adjusted R^2	0.065	0.006	0.047

*p<0.1; **p<0.05; ***p<0.01

Observations are at the ward-day level, including all days between March 11-April 8 2017. All regressions include day fixed-effects, ward fixed-effects, and standard errors clustered at the ward level.

[1] Includes all wards above the median value for rates "Action taken" for complaints about shortages over the previous six months.

[2] Indicator for whether an observation takes place during the water supply cut period (March 25-April 8, 2017)

[3] Indicator for whether a ward was affected by the water supply cut.

[4] Includes all wards above the median value for rates "Action taken" for complaints about leaks over the previous six months.

Overall, I find that a cut in the water supply increases complaint-making about shortages, but only where past responsiveness to complaint-making is already high. This suggests that over time, responsiveness can moderate citizens' expectations and their use of formal institutions for complaint making, even in the context of a clear service problem. The theorized mechanism behind this pattern is that citizens' expectations about receiving a response must be sufficiently high for them to expend the effort required to make a complaint. I further show that this pattern is driven by prior responsiveness to complaints about leaks, even though shortages (and not leaks) are the service problem in question. This is likely because measure of past responsiveness used is a relative one, and even wards with relatively high rates of responsiveness exhibit low levels of responsiveness in absolute terms. Overall, the findings suggest that divergence in responsiveness to complaints of different types can moderate the use of of formal institutions for complaint-making in the future, and that patterns of responsiveness to one type of complaint can moderate complaint-making about another.

9 Conclusion

This paper has developed a theory to explain how the content of formally lodged complaints shapes variation in responsiveness to them, a phenomenon that is not yet fully understood. It has clarified the difference, from a handling officer's perspective, between complaints that make reallocating and non-reallocating demands. It further argues that non-reallocating complaints are more likely to get a response, as they are less likely to generate more complaint-making in the future. The distinction therefore contributes to an emerging literature on bureaucratic constraints (eg. Dasgupta and Kapur, 2020) to demonstrate how they affect service delivery and interactions with citizens. It also highlights how the quality of services can vary and be manipulated by government actors within a single service sector (Kumar et al., 2022). Together, these insights indicate the potential for further research on how bureaucrats working within a service sector

allocate time and resources to different tasks and aspects of service delivery.

From a policy perspective, the distinction demonstrates both the potential and limitations of formal complaint-making institutions to improve the equity of service delivery in LMICs. I argue and show that the types of complaints that a neighborhood makes are correlated with existing levels of service delivery and prior levels of responsiveness. In particular, I update the existing finding that responsiveness generates more complaint-making (Kruks-Wisner, 2018; Dipoppa and Grossman, 2020; Trucco, 2017; Goldfrank, 2002) by demonstrating that it does so mainly for non-reallocating demands arguably because responsiveness to reallocating demands is so low in absolute measures. These patterns suggest that formal institutions can generate a virtuous cycle of complaint-making and responsiveness, but primarily with respect to non-reallocating complaints and where levels of service provision are already high.

From a citizens' perspective, the intermediaries (Auerbach, 2016; Jha et al., 2007; Krishna, 2011) and community organizations (Auerbach, 2017; Cooperman, 2019; Spater and Wibbels, 2021) described by existing literature on service delivery in LMICs may be more effective institutions for demands for reallocating existing resources. Redistribution, after all, is a fundamentally political process. Intermediaries might also exert pressure on bureaucrats to help citizens receive responses, thereby undermining the aims of formal institutions for transparent and direct complaint-making.

In this way, the paper synthesizes and builds upon research on ICT institutions for complaint-making that have found them to be minimally effective in in increasing political accountability (eg. Grossman et al., 2018, 2020) and identifies important conditions under which they would fulfill their promise to improve equity in service outcomes (World Bank, 2004). In the short term, these institutions serve the primary (and important) function of crowd-sourcing information about service problems for local officials. As described by Grossman et al. (2018), these institutions can serve as "hotlines" alerting the government about urgent problems. In the long-term, formal institutions for complaint-making might increase equity in service delivery if information about the

distribution and incidence of reallocating demands reaches those with the power and incentives to redistribute or expand the total resources available to a system. In short, these institutions are no substitute for accountable politicians.

Finally, the theory bridges the literatures on citizen-initiated complaint-making and bureaucratic responsiveness. I support the theory using original data on the universe of complaints about water placed with Mumbai's online grievance redressal system from 2016-2018. This is, to my knowledge, among the first studies of service delivery that includes data on both complaints and responses. This allows me to demonstrate how responsiveness varies with the total number of complaints, thereby highlighting the capacity constraints in responding to reallocating demands, or those about water shortages in this case. I further am able to show patterns over time, which allows the use of fixed-effect models and a difference-in-differences design to show how responsiveness is mediated by important prior conditions, namely past responsiveness and existing levels of service delivery. Indeed, research on how citizens' expectations shapes their behavior (eg. Kruks-Wisner, 2018; Auerbach and Kruks-Wisner, 2020) has relied on cross-sectional patterns to develop and support the theory upon which this paper builds. The data and theory here are further able to illustrate dynamic interactions between citizens and local officials and how their actions shape each other over time.

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Appendices

Figure SI.1: MCGM's website and complaint-tracking portal.

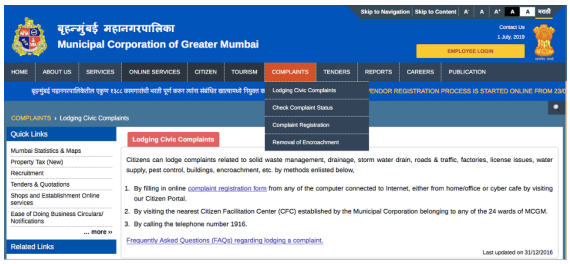

Table SI.1: Words used in predictive models for response and complaint categories.

Outcome	*Predictive words (stemmed)*
Complaints	booster, pump, use, day, suppli, leakag, shortag, complaint, connect, get, road, unauthor, tap, illeg, taken, leak, kurla, start, contamin, last, water, line, low, pressur, sinc, bill, overflow, tank, broken, wast, instal, meter, not, bad, provid, near, even, problem, smell, two, come, short, main, receiv, issu, less, past, burst, dirti, tanker, pipelin, pipe, flow
Responses	pleas, mobil, bill, provid, address, suppli, due, found, inspect, unauthor, repair, contact, joint, aqueduct, consent, inner, site, leakag, fals, henc, must, fact, contamin, cut, regular, action, connect, damag, entir, not, offic, smooth, complaint, disconnect, detect, water, declar, short, meter, request, done, hous, servic, check, low, email, usual

Table SI.2: Triple difference estimates of the effects of the supply cut conditional on rates of responsiveness.

	Dependent variable:		
	All water complaints	Leaks	Shortages
	(1)	(2)	(3)
Supply cut period[1]	0.460	0.058	0.360
	(0.720)	(0.099)	(0.406)
Affected ward[2]	0.508***	0.071*	0.317***
	(0.159)	(0.039)	(0.103)
Highly responsive[3]	0.476***	0.131	0.113**
	(0.171)	(0.088)	(0.046)
Supply cut period × Affected ward	−0.560	−0.057	−0.340
	(0.713)	(0.083)	(0.370)
Supply cut period × Highly responsive	−0.876***	−0.198***	−0.363
	(0.728)	(0.066)	(0.364)
Affected ward × Highly responsive	−0.463	0.009	−0.291*
	(0.254)	(0.120)	(0.151)
Supply cut period × Affected ward × Highly responsive	1.623	0.243**	0.813**
	(0.788)	(0.121)	(0.405)
Constant	0.515*	0.006	0.149
	(0.267)	(0.079)	(0.143)
Observations	696	696	696
R^2	0.125	0.063	0.114
Adjusted R^2	0.080	0.015	0.068

*p<0.1; **p<0.05; ***p<0.01

Observations are at the ward-day level, including all days between March 11-April 8 2017. All regressions include day fixed-effects, ward fixed-effects, and standard errors clustered at the ward level.

[1] Indicator for whether an observation takes place during the water supply cut period (March 25-April 8, 2017)

[2] Indicator for whether a ward was affected by the water supply cut.

[3] Indicator for whether a ward is above the median value for rates "Action taken" for complaints about leaks over the previous six months.

Figure SI.2: Distribution of mean rates of action taken in response to different types of leaks MCGM wards, October 2016-March 2017