The content of demands shapes government responsiveness: theory and evidence from Mumbai

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Abstract

What predicts government responsiveness to formal complaints in settings where demands are many and resources are scarce? Moving beyond research on accountability in general, I develop a theory of responsiveness based on the *content* of demands. Bureaucratic handlers are unlikely to address demands for the reallocation of resources between citizens because doing so may generate backlash. Within non-reallocating demands, they are more likely to respond to complaints aligned with their broader professional incentives. These patterns are important because communities with already poor services are more likely to make the reallocating demands that do not receive a response, and a lack of responsiveness discourages future complaint-making. I support the theory using qualitative interviews, data on the universe of digital complaints in Mumbai's water sector from 2016-2018, supervised learning for text classification, and a differences-in-differences design. The findings are important in explaining the persistence of suboptimal outcomes in service delivery in constrained settings.

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 (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 citizen feedback, such as online grievance redressal systems, participatory governance institutions, or bureaucratic offices for processing citizen complaints, can create a level playing field for disadvantaged citizens (eg. Blair, 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 general conditions under which politicians will be accountable to citizens (Cleary, 2007; 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). Broadly, this work research suggests that responsiveness varies with institutional rules for accountability along with characteristics of the complainants and the groups to which they belong.

Less is known, however, about how the content of a demand shapes responsiveness. Kramon and Posner (2013) show that patterns of distributive politics vary with the

service sector in question. Given that most formal complaints are frequently handled by appointed (rather than elected) officials, I further explore if patterns of *bureaucratic* responsiveness may vary depending on the outcome one studies and the implications of such patterns for service delivery.

I first develop a theory arguing that bureaucrats experience personal benefits and costs to responsiveness that vary with the type of demand, assuming that the handling office has the capacity and authority to respond at all. A complaint will incur personal costs for a handling officer if resolution involves reallocating resources from one citizen to another. Consider, for example, a complaint about insufficient hours of electricity in a system that cannot provide 24x7 access to all citizens and therefore rations supply. In the short term, supplies are fixed. Resolving such demands requires redistributing resources (eg. hours of service) from other citizens to the complainant, which may generate backlash from other citizens. This backlash might entail more complaints from another area or citizens complaining to politicians about bureaucrats (Slough, 2020). Resolving a complaint may be personally *beneficial* for a handling bureaucrat is if it is professionally incentivized. Solving certain problems or implementing programs, for example, may be related to the broader goals of the office or higher-level officials who shape decisions related to promotion and transfers. I therefore expect that non-reallocating demands are more likely to be addressed than reallocating demands. Within non-reallocating demands, I expect professionally incentivized demands to command priority.

I next argue that these patterns are 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. The distinction between reallocating and non-reallocating complaints is particularly important here. 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, I expect responsiveness to generate more complaint-making in the long-term 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 for the institutions in question. 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 complaint-making. Discouraged citizens may revert to relying on informal and less-transparent mechanisms for claim-making instead. The variation in responsiveness to different types of complaints and its effect 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 qualitative interviews with bureaucrats and an analysis of formal complaints lodged in Mumbai's water sector. While complaints here are usually made through political networks and other informal means (Anand, 2011; Björkman, 2015), 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.

Rates of resolution initially appear high, with over 90% of complaints marked as "Closed" in the portal. Yet closure rates alone are an uninformative measure of responsiveness, as handlers are incentivized to complete the process for as many complaints as possible; one must look at the written response to a complaint to learn if any meaningful action was taken. Using supervised machine learning techniques to classify the categories of complaints and text of responses reveals that not all complaints are actually met with government action. In fact, I see a distinct pattern of responsiveness that varies by complaint type–some types of complaints are consistently given a response suggesting action has been taken, and others are not.

I conducted interviews with the engineers who handle the water-based complaints to

shed light on why some types of complaints are more likely to be met with government action than others. Complaints about unauthorized use cannot be resolved without denying other citizens water, so addressing them is therefore avoided without input from other officials. Regarding water shortages, bureaucrats handling complaints can make small short-term alterations to water supply schedules to address water shortages within neighborhoods, but avoid doing so very often for fear of generating more complaints from the neighborhoods from where water is sourced. As such, these are examples of reallocating demands that are frequently ignored or given low levels of priority. Resolving complaints about leaks and contamination does not require reallocation of resources. Within this category, the engineers suggest that complaints about leaks are prioritized because of broader municipal goals to decrease water wastage in the city. Those about contamination are not seen as legitimate or high priority.

I next show that the incidence of complaints of different types varies with levels of service provision. For the remainder of the analysis, I focus on leaks and shortages as they are by far the most common complaints in the system and, therefore, salient to both citizens and officials. As the ward-level mean hours of daily water supply increases, the number of complaints about leaks increases while the number of complaints about shortages decreases. Levels of service provision are not correlated with complaint-making in general, but rather the *type* of complaints being made.

Finally, 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. 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 theoretically motivate and empirically demonstrate variation in bureaucratic responsiveness to dif-

ferent types of citizen complaints. This is, to my knowledge, one of the first studies of the content of complaints in either a formal or informal setting. I further develop a novel theory to explain intra-sector variation in service delivery and government responsiveness to complaints. 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. Bureaucratic handlers may only be able to focus on tackling minor complaints rather than addressing systemic issues of inadequate and inequitable resource allocation. 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). Researchers have found that the delivery of important public services such as water or electricity favors 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 and preferences. Citizens rely on them to communicate their needs, make demands, or solve problems (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 Rondinelli et al., 1983; Schneider, 1999) was accompanied by the rise of formal non-electoral institutions for citizens to communicate with public officials, such as 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 level the 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 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 (e.g. Blair, 2000; Kosec and Wantchekon, 2020; Mansuri and Rao, 2012; Grossman et al., 2014; Olken, 2010; Wampler, 2010; Speer, 2012).

This increase in equity can occur only if bureaucrats and elected officials acknowledge, process, and respond to the citizens' input. The research on responsiveness typically assesses the factors that will hold politicians and bureaucrats accountable to citizens. The research on politicians identifies variables such as degrees of decen-

tralization (Goldfrank, 2007), rates of political competition, 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 avenues for accountability and 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), 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). Broadly, existing research suggests that responsiveness varies with institutional rules and characteristics of the complainants themselves.

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. Not only will the incentives for responding vary across politicians or bureaucrats, but also within the set of tasks that a single bureaucrat must accomplish.

3 Theory: complaint type and responsiveness

The first and most important consideration for bureaucrats is short-term capacity to respond to a demand. The resolution of all demands requires some combination of material resources, personnel time, and authority to mobilize these resources. A demand may be placed with the wrong office or far exceed a given office's capacity, in

which case it is not "actionable" (Grossman et al., 2018).

For the demands that are plausibly actionable within an office, a bureaucrat must consider the tradeoffs involved involved in resolution. Resources expended on resolving one type of demand crowd out those available to resolve others. It is usually at this point in the process – choosing exactly how to allocate available resources – that more commonly studied external points of pressure like political mediation, mobilization, and corruption shape decision-making.

Yet resolving certain *types* of demands may be more *personally* beneficial in general. I highlight two dimensions of a demand that may affect bureaucrats' personal incentives to respond: whether they involve a reallocation of resources between different citizens and whether there are professional incentives to respond.

First, handlers are less likely to prioritize complaints that, while actionable, explicitly demand the reallocation of existing resources from one citizen to another. For example, the demand for more electricity or water is actionable if a handler redirects some water or electricity from one citizen to another. If the supply of water or electricity is fixed, 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 contrast, some other types of demands are non-reallocating in that resolution 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.[1]

A bureaucrat will avoid reallocating resources in the short term because doing so will impose personal costs in the form of backlash from citizens. Indeed, Slough (2020) suggests that variation in the ability of citizens to complain to politicians about bureaucrats, a mechanism for citizen oversight, affects bureaucratic responsiveness to citizen complaints. Backlash may also occur in the form of more complaints from

[1]The distinction between reallocating and non-reallocating demands depends on the required response and the short-term binding constraint in the system of service delivery.

another set of citizens, which will increase the bureaucrat's work load in the short term.

In the most extreme case of a demand for reallocation of resources from one citizen to another, bureaucrats are the least likely to respond to complaints directly about citizens. These cannot usually be resolved without directly affecting the citizens in question and, therefore, generating a large amount of backlash. Handlers are likely to proceed in such cases with caution, as resolution may be seen as overtly political. Indeed, Holland (2016) describes a bureaucratic process to detect land invasions in Bogotá, but reveals that it is eventually *mayors* who decide whether or not to sign the orders for eviction.

Within complaints that are actionable and do not involve substantial reallocation, handlers may have a distinct professional incentive to address those that meet the broader goals of their office. Higher-level officials to whom bureaucrats report may have prioritized certain issues. Tendler (1997, p. 1-27), for example, describes how a state-level government in a poor region in Brazil motivated or pressured local-level politicians and bureaucrats to prioritize work on a preventative health program. Certain types of complaints, furthermore, may be seen as more or less "legitimate" or within the scope of "existing rights as provided by law or policy" (Joshi and McCluskey, 2018, p. 7). Addressing demands that are seen as legitimate and fulfilling broader goals can impress politicians and those higher up in the bureaucracy. As such, I expect bureaucrats to prioritize demands given importance by the institution's development and planning goals and to deprioritize those that are not.

These patterns of responsiveness are 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 demands 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, 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. 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 is that complaint-making and responsiveness can exist in a self-fulfilling equilibrium that looks different based on existing levels of service provision. 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 and 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. Discouraged citizens may simply exit the arena for the complaint-making institution in question and resort to more traditional means, such as informal networks, for resolving their problems instead.

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 or attenuate the dynamics presented in the theory. 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, it applies only to institutions where government officials respond to citizen requests and complaints; it does not, importantly, apply to formal institutions for deliberative governance.[2] 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 binding constraints on service delivery.

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 supplies 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

[2]See, for example, Sanyal and Rao (2018), wherein citizens address their own complaints as a group.
[3]This figure is lower than usual estimates for non-revenue water in cities in LMICs because it does not

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 mean 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 of 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 of water as slum areas, where over 50% of the city's population lived at the time.

Complaints about water 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 the 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.

5 Data

I collected data on complaints concerning water supply made to the MCGM from the online citizen complaint portal which collects and tracks formal complaints. I inputted every possible permutation of the details requested (eg. municipal ward,

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).

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

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 observation also 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. Figure 1 shows the number of complaints and rate of ticket closure by month from 2016-2018. Overall, the total ticket closure rate is high at 93.4%. The generally high rate of closure reflects the engineer's incentives to resolve as many cases as possible. A backlog of open cases reflects poorly on the office as a whole.

I next explore how these patterns vary with the content of the complaints. 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.[5] 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.[6] 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.[7] 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.

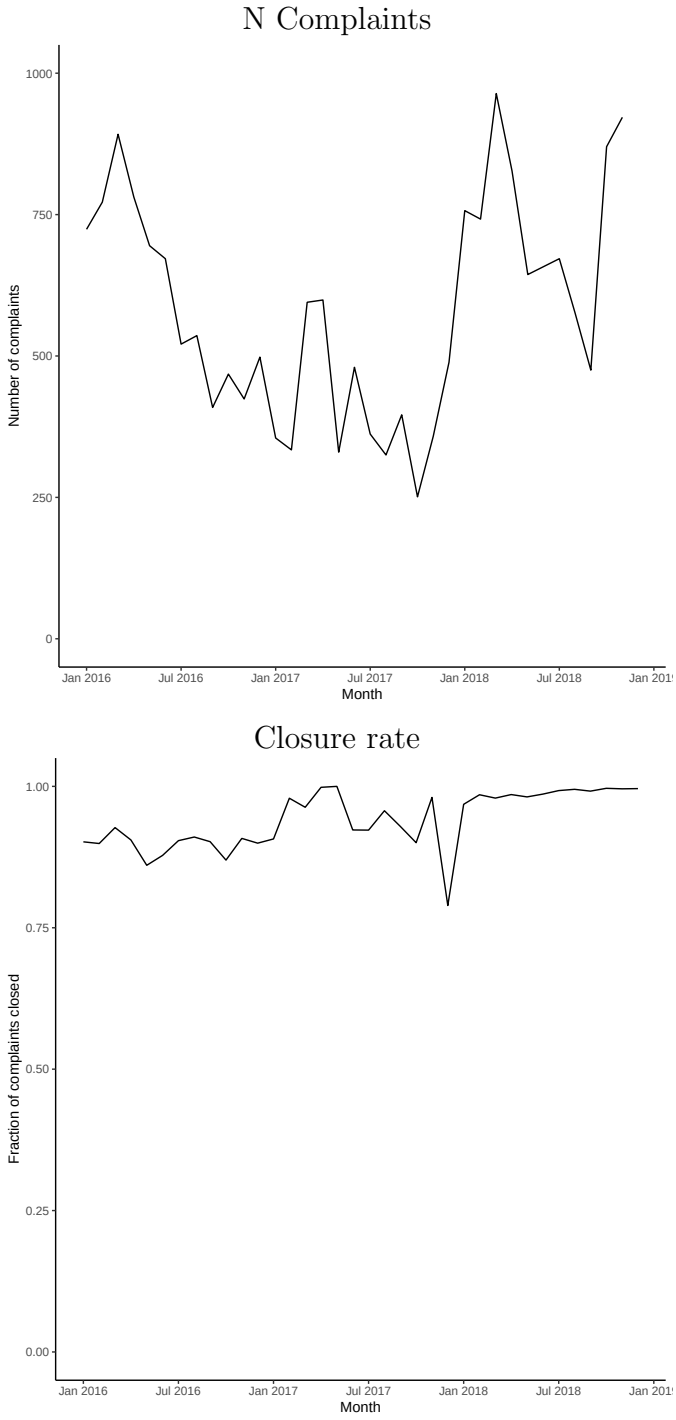
The overall incidence of the most frequently occurring categories in each month for

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

[6] 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."

[7] 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.

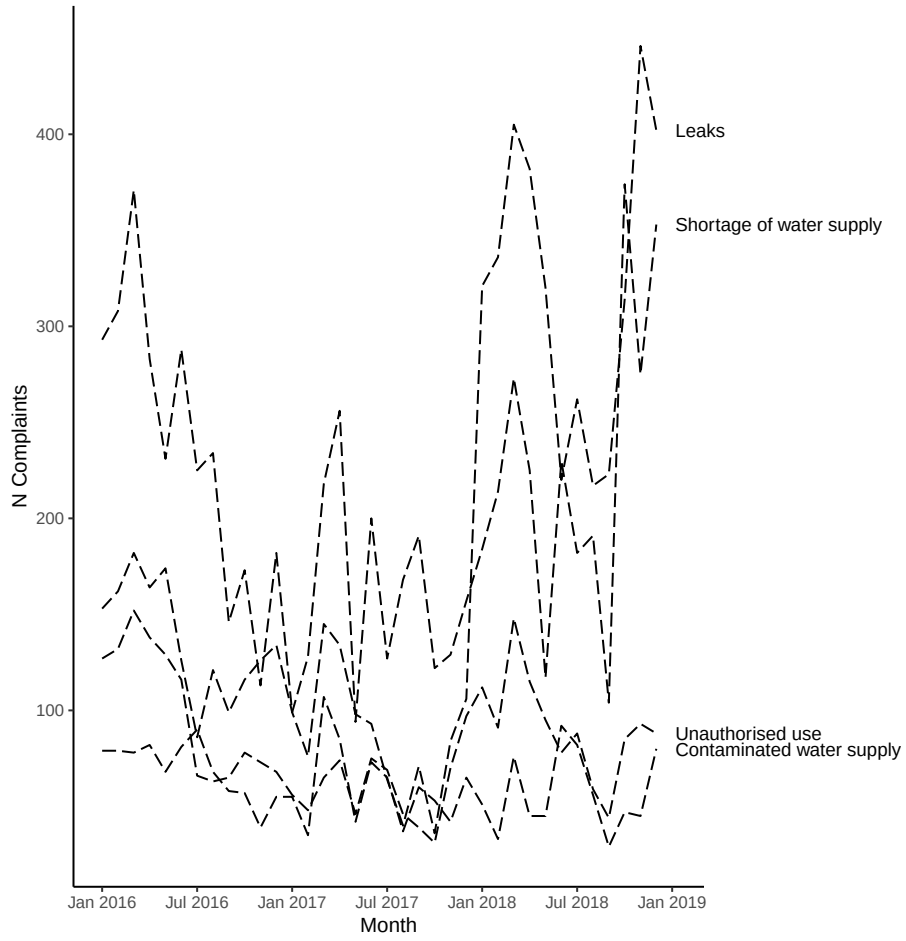
Figure 1: Overall complaint (top) and closure rate (bottom) in Mumbai's water sector, 2016-2018.



which I collected data can be seen in Figure 2. Complaints about leaks and shortages make up the vast majority of topics covered.

At first glance, it still appears that bureaucrats resolve most complaints. The rate

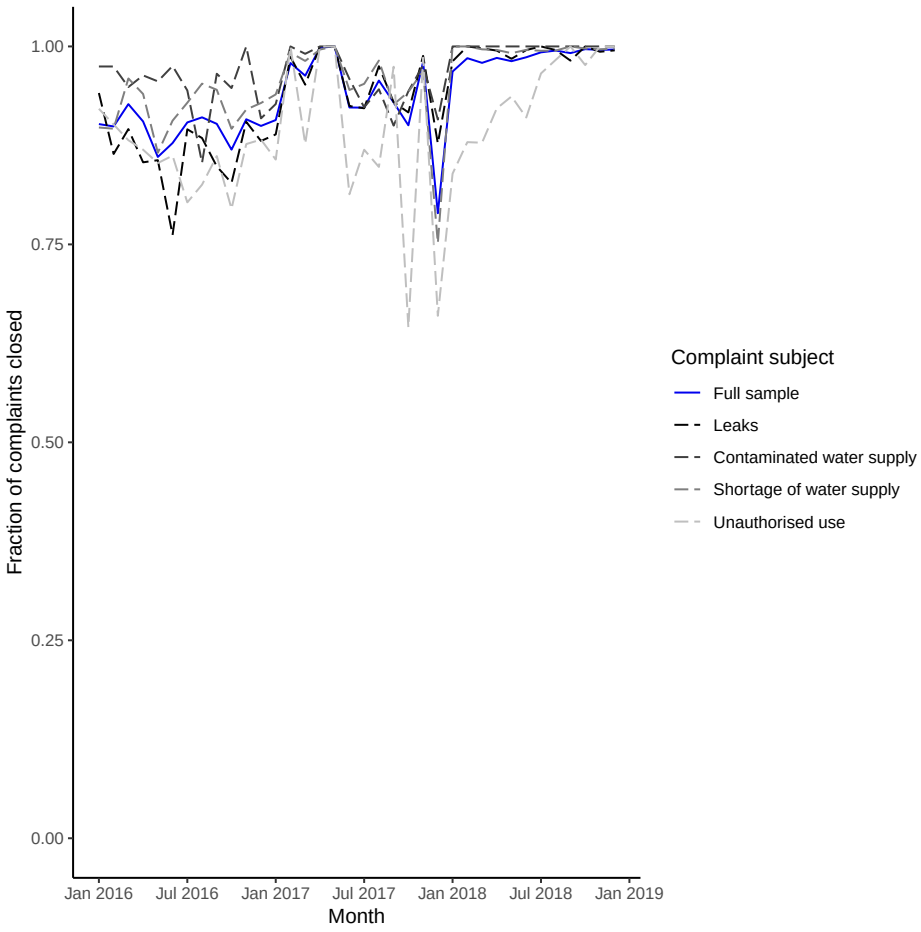
Figure 2: N complaints for most common complaint categories in Mumbai's water sector, 2016-2018.



of complaint closure over time and by category can be seen in Figure 3, with minimal variation across complaint type.

Yet not all observations that are marked as "Closed" are actually accompanied by meaningful action or resolution. Each "Closed" observations includes 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 as "Action taken," "False complaint," "Incorrect or missing information," "Referred to other department," or "No action taken" for some other reason. A team first coded 3% of the responses as "Action taken," "False complaint," "Incorrect

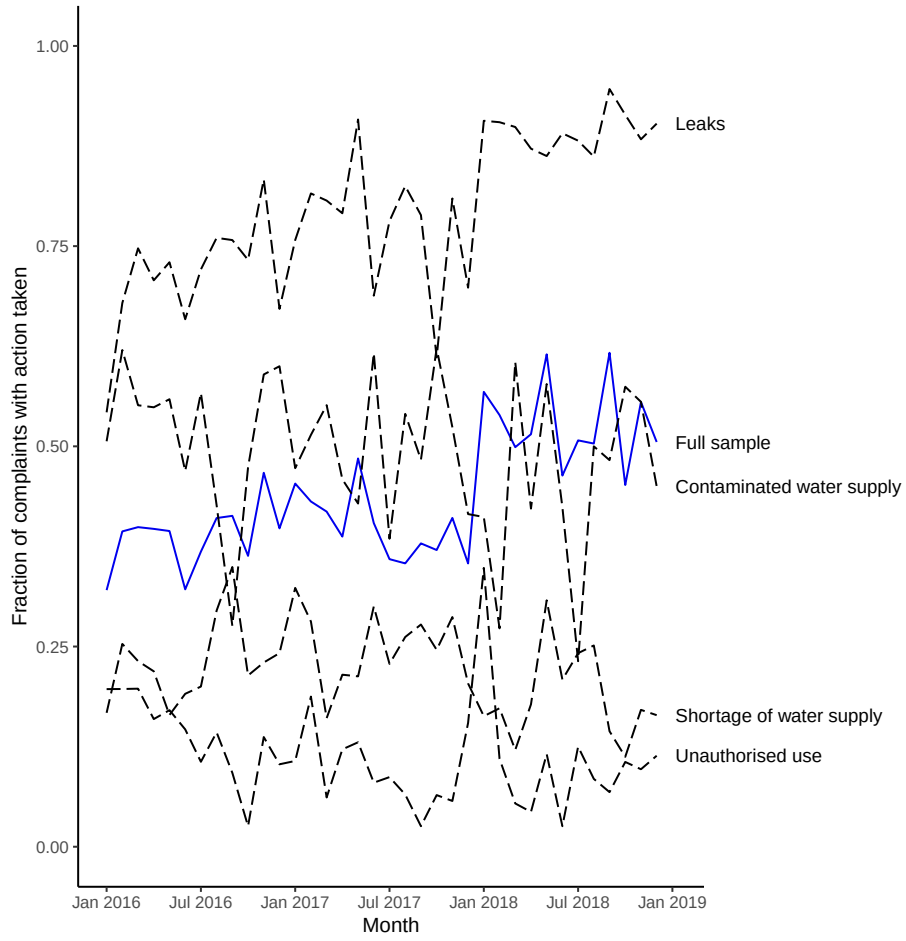
Figure 3: Complaint closure rate for most common complaint categories in Mumbai's water sector, 2016-2018.



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 4. 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"

Figure 4: Rate of meaningful action taken by complaint type for most common complaint categories in Mumbai's water sector, 2016-2018.



are classified as "Action taken." Categorization as "Action taken" is my main measure for responsiveness throughout the paper.

6 Responsiveness to different types of complaints

This categorization reveals a distinct pattern to responsiveness that varies by type. Figure 4 shows that action is taken for almost 83% of complaints about leaks, and 49% of complaints about contaminated water, 21% of complaints about shortages, and only 12% of complaints about unauthorized use. Table SI.2 estimates the correlation between the complaint type and the likelihood of its response being categorized as "Action taken" when controlling for day and ward characteristics and finds similar

patterns.

What accounts for this clear variation in responsiveness to different types of demands in the water sector? I explore these dynamics through qualitative interviews with those who handle the complaints in the ward-level Hydraulic Engineering department, typically the Assistant Engineer for Water Works. I learned about the process of addressing complaints through five unstructured interviews (conducted in January 2018) with the Assistant Engineer for Water Works in randomly sampled wards. This employee is responsible for both maintaining a given municipal ward's water infrastructure and addressing citizen complaints. He triages the complaint and sends it to employees, sub-departments, or other agencies for addressal.

The interviews illustrate the reasons for patterns of responsiveness in handlers' own words. Complaints about unauthorized use, such as instances in which a pipe is being tapped by an individual or settlement, are low priority. These complaints are very clearly about other citizens, and the engineers hesitate to address them. "I don't know what the arrangement is with the leader or people there. It is best that the corporators [ward-level representatives], police, or courts deal with such issues," one engineer hastily replied when I brought up the issue. These complaints therefore receive the lowest levels of responsiveness.

On the other hand, engineers do have some latitude to respond to complaints about shortages without immediately harming another citizen. "We don't like to do it, but we can sometimes reshuffle the timings of the water supply to give one area more water and another one a little less. We can only do this sometimes and if the need is very great, though, otherwise people get upset." Notably, these short-term solutions do not have large budget outlays, but are instead costly because of the likelihood of citizens' complaints. Another option is to send a water tanker which, given a fixed supply of tankers is itself a reshuffling of existing supply.

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." 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.

Next, consider complaints about contamination. According to an Assistant Engineer (ward name omitted for anonymity), the department may work to see whether there is a sewage leak or some debris in the reservoir, but this is rarely the case, he says. "People will have a bad smell in the neighborhood and blame it on the water. There's usually nothing wrong," he explains. Whether or not this is true, the attitude indicates that such complaints are rarely prioritized or taken seriously. This is partly because, as another engineer explains, households can boil or filter the water to clean it. Their first priority is ensuring that households actually have the water. Within the MCGM's set of constraints, complaints about contamination are deprioritized.

Most important are complaints about leaks. The MCGM has been operating under a steady campaign to resolve leaks and decrease non-revenue water, or water that is generated in the system but does not reach the end user. In 2011, after a 15-day effort, city engineers found 653 leaks in the pipe system (Purohit, 2011). Citizens' complaints are key to supporting such initiatives to map, maintain, and upgrade leaky pipes, and resolving leaks is therefore central to the engineers' job description. As such, the local context incentivizes prioritizing these complaints, even if they incur monetary costs. In fact, there is a sanctioned budget that is easily accessible to address problems of leaks. The modal response to a complaint about a leak, therefore, is to quickly repair or replace a section of pipe. As reported by the Assistant Engineer, "sometimes fixing a leak can take time, but the office has the support to do it and it doesn't affect other

people [who don't live in the area]."

These observations and interviews suggest that within the context of Mumbai, complaints about contamination and leaks do not require denying other citizens water, and can therefore be categorized as non-reallocating demands. Complaints about shortages or the unauthorized use of water, on the other hand, can be categorized as reallocating demands because their resolution explicitly entails removing or redirecting another citizen's water supply. Within non-reallocating complaints, those about leaks are most relevant to the handlers' broader mission to reduce non-revenue water. Within reallocating complaints, handlers can feasibly respond to those about shortages; responding to complaints about unauthorized use is politically risky. Overall, complaints about leaks and shortages are the most prevalent in the system and the most likely in their respective categories of non-reallocating and reallocating demands to get a response.

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. For the remainder of the analysis, I focus on leaks and shortages as they are by far the most commonly placed complaints. I test whether the ward-level daily complaint rate varies with fixed ward-level service provision levels.[8] 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:

$$complaints_{t,w} = \beta_0 + \beta_1 hours_w + \overrightarrow{\eta} day_t + \epsilon_{t,w} \tag{1}$$

Here, $complaints_{t,w}$ is the number of complaints registered on a given day divided

[8]Table SI.3 shows summary statistics for the outcomes of interest at the ward-day level for the three years that the dataset covers.

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 or real problems about service delivery, that drive the relationship. 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. For this reason, I do not include any control variables aside from the day fixed-effects.

The results can be seen in Table 1. 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.

These trends are further mirrored in the analysis of how ward-level characteristics are correlated with complaint-making using data from the 2010 census (Table SI.4). The use of the complaint-making system in the water sector does not increase with the ward's population of Scheduled Caste, literature, or regularly employed individuals. Yet as literacy increases, complaint-making about leaks increases while complaint-

making about shortages decreases. Similar trends can be seen with respect to the regular employment rate. These patterns suggest that a divergence in complaint-making and, therefore, responsiveness, has implications for equity in service delivery across socio-demographic boundaries as well.

Table 1: 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. 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.[9] I use a difference-in-differences design[10] to estimate the effect of this water supply cut on complaint-making:

[9]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) .

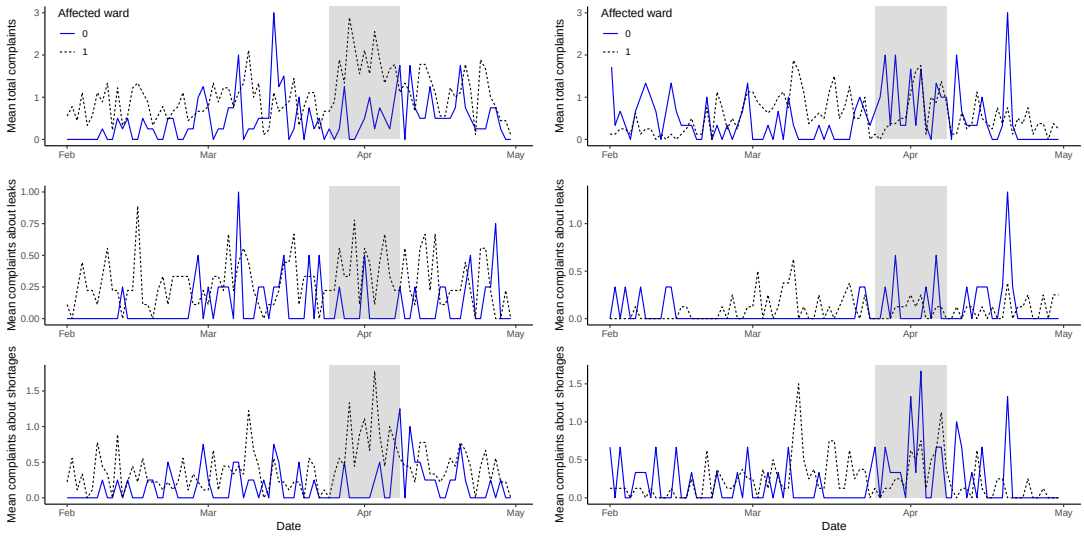
[10]This is a simple two-period difference-in-differences design with no variation in treatment timing, and therefore not subject to emerging concerns about the specification of staggered difference-in-differences as raised by Goodman-Bacon (2021) and others.

$$complaints_{t,w} = \beta_0 + \beta_1 short_w + \beta_2 post_t + \beta_3 post_t \times short_w + \overrightarrow{\eta} day_t + \epsilon_{t,w} \quad (2)$$

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. 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 2 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). This subgroup effect is conducted conditional on a *pretreatment* variable as it is measured prior to the intervention. A triple interaction effect is presented in Table SI.5. 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, which measures the interaction effect $post_t \times short_w$ to assess the difference 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

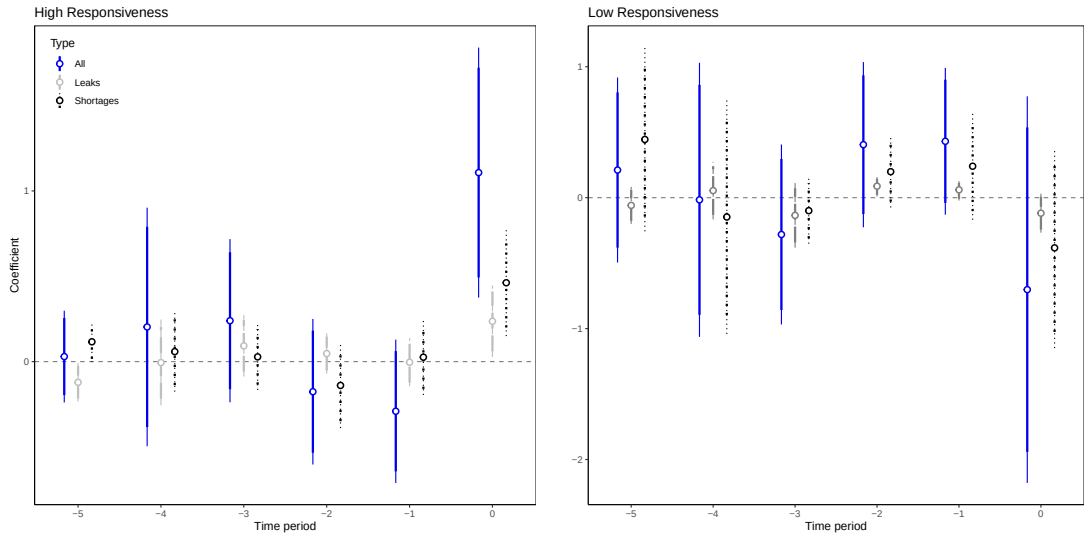
Figure 5: Daily means for complaint-making before and during the 2017 water supply cut (shaded area) for wards with high (left panel) and low (right panel) rates of responsiveness.



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 5) 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 6) and find no evidence for differences in trends prior to the shortage.

The main results can be seen in Table 2 and Figure 6. 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 1), 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.5) similarly shows that that the supply cut generates complaint-making about shortages at significantly

Figure 6: 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.

higher rates in wards that are highly responsive than in wards that are not.

I next show that these patterns are driven by prior responsiveness to complaints about leaks, rather than complaints about shortages. I separately estimate Equation 2 for wards that are above the median rate of "Action taken" for complaints about either shortages or leaks in Table 3. 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 2–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

Table 2: 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 3: Difference-in-differences estimates for wards with high rates of responsiveness to complaints about shortages (top) and leaks (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	−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 × 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.

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).[11] 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.

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 findings indicate that divergence in responsiveness to complaints of different types can moderate the use 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 is, to my knowledge, one of the first explorations of how government responsiveness varies with the content of demands. I have further developed a theory to explain this variation that builds on an understanding of bureaucrats' personal incentives and constraints. The argument contributes to an emerging literature on bureaucratic con-

[11]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

straints (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 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) 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 demands and where levels of service provision are already high.

From a citizen's perspective, the intermediaries 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 formal 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), they 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 increase capacity and 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. 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. 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

SI.1 Tables and Figures

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

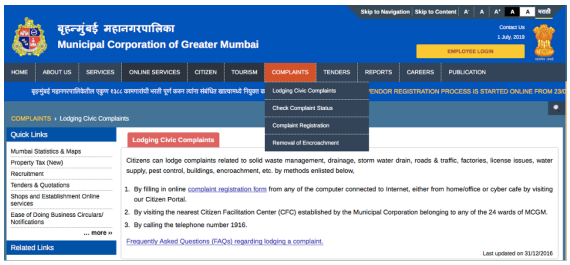

Figure SI.2: Distribution of mean rates of action taken in response to different types of complaints MCGM wards, October 2016-March 2017

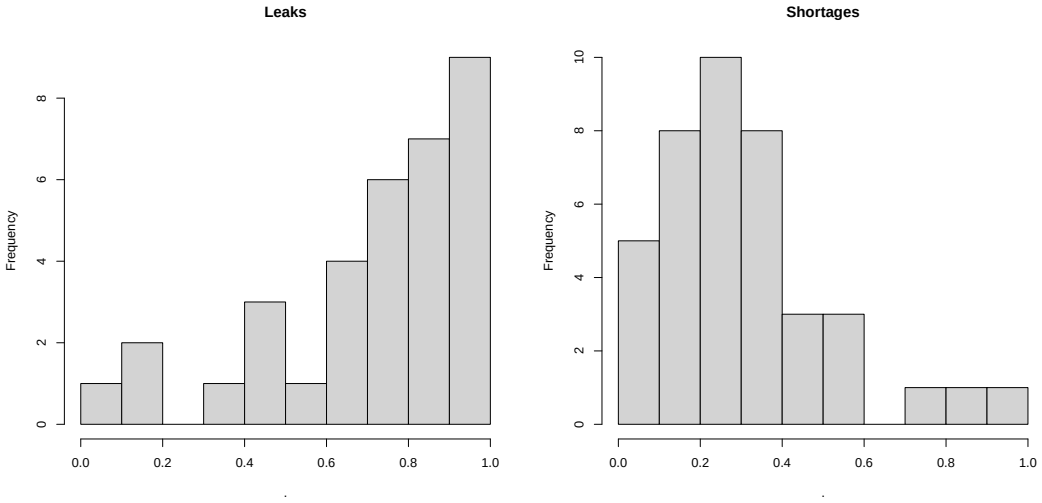

Table SI.1: Words used in predictive models for response and complaint categories.

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: Correlation between complaint category and likelihood of having a response indicating meaningful action is taken. Unit of analysis is the complaint, Mumbai 2016-2018.

	Action taken			
	(1)	(2)	(3)	(4)
Contamination (reference)	0.493^{***}	0.501^{***}	0.495^{***}	0.503^{***}
	(0.047)	(0.043)	(0.038)	(0.036)
Leaks	0.335^{***}	0.320^{***}	0.331^{***}	0.314^{***}
	(0.049)	(0.049)	(0.048)	(0.048)
Shortages	-0.281^{***}	-0.284^{***}	-0.287^{***}	-0.291^{***}
	(0.042)	(0.039)	(0.042)	(0.040)
Unauthorized use	-0.369^{***}	-0.376^{***}	-0.355^{***}	-0.365^{***}
	(0.053)	(0.048)	(0.055)	(0.050)
Date dummies?	No	Yes	No	Yes
Ward dummies?	No	No	Yes	Yes
Observations	19,248	19,248	19,248	19,248
R^2	0.355	0.403	0.377	0.423
Adjusted R^2	0.354	0.367	0.376	0.388

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

All models include standard errors clustered at the ward level.

Table SI.3: 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 (unauthorized use)	0	9	0.11	0.41
Complaints (contamination)	0	10	0.08	0.36
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 (unauthorized use)	0	1	0.91	0.28
Closure rate (contamination)	0	1	0.97	0.18
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 (unauthorized use)	0	1	0.12	0.32
Action taken rate (contamination)	0	1	0.50	0.49
Action taken rate (shortages)	0	1	0.22	0.39
Action taken rate (leaks)	0	1	0.82	0.64

Table SI.4: Correlation between number of complaints per capita and ward characteristics (based on 2010 Census)

	Complaint type:				
	All Water Complaints	Leaks	Shortages	Unauthorized Use	Contamination
	(1)	(2)	(3)	(4)	(5)
% Scheduled caste	0.005	0.025**	−0.024	−0.010	0.008
	(0.046)	(0.011)	(0.024)	(0.011)	(0.009)
% Literate	−0.054	0.036**	−0.071**	−0.012	−0.010
	(0.046)	(0.017)	(0.028)	(0.011)	(0.008)
% Main worker[1]	0.060	−0.035*	0.059**	0.030***	0.011
	(0.048)	(0.019)	(0.026)	(0.012)	(0.013)
Constant	0.030	−0.017	0.039	0.0004	0.006
	(0.035)	(0.010)	(0.025)	(0.008)	(0.008)
Observations	26,304	26,304	26,304	26,304	26,304
R^2	0.090	0.106	0.075	0.055	0.053
Adjusted R^2	0.050	0.067	0.035	0.014	0.011
Residual Std. Error (df = 25205)	0.028	0.011	0.018	0.010	0.009

*p<0.1; **p<0.05; ***p<0.01
Observations are at the day-ward level for 2016-2018. All regressions include a dummy for each day, and standard errors clustered at the ward level.
Individuals who were employed for the major part of the past year.

Table SI.5: 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.