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

Tanu Kumar†

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Abstract

Formal institutions for claim-making can help marginalized citizens demand better basic services, but only if government is responsive. I argue that claims about infrastructure maintenance are more likely to get a response than demands for increased service provision. While maintenance-related claims either increase or at least do not worsen service provision for others, service-increase claims typically require reallocating resources between citizens and can generate even more claim-making. Variation in responsiveness to these two types of claims has implications for overall patterns of service delivery because the incidence of claim type may be correlated with a community's 1) existing levels of service provision and 2) past levels of responsiveness to its demands. I support this theory using a differences-in-differences design in the context of a water supply cut, supervised learning for text classification, and original data on the universe of digital claims in Mumbai's water sector from 2016-2018. The theory and findings imply that these institutions can be responsive and generate a virtuous cycle of claim-making, but mainly where levels of service provision are already high.

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†Postdoctoral Research Fellow, William and Mary. `tkumar@wm.edu`

1 Introduction

As part of the growth of information communication technology and e-governance initiatives, channels for citizens to lodge complaints, or claims, about public services have become ubiquitous in governments and public agencies around the globe (e.g. Burnett and Kogan, 2017; Chen et al., 2016; Dipoppa and Grossman, 2020; Distelhorst and Hou, 2017; Grossman et al., 2017, 2018, 2020; Sharan and Kumar, 2020). Prior research has shown that in democratic societies where scarce resources are often allocated through the logic of clientelism or distributive politics, particularly low- and middle-income countries (LMICs), formal institutions for civic participation can create a level playing field for disadvantaged citizens (e.g. 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). A prerequisite to the success of such institutions is that citizen claims are acknowledged, processed, and addressed. Under what conditions do formal mechanisms for claim-making yield a response from government officials?

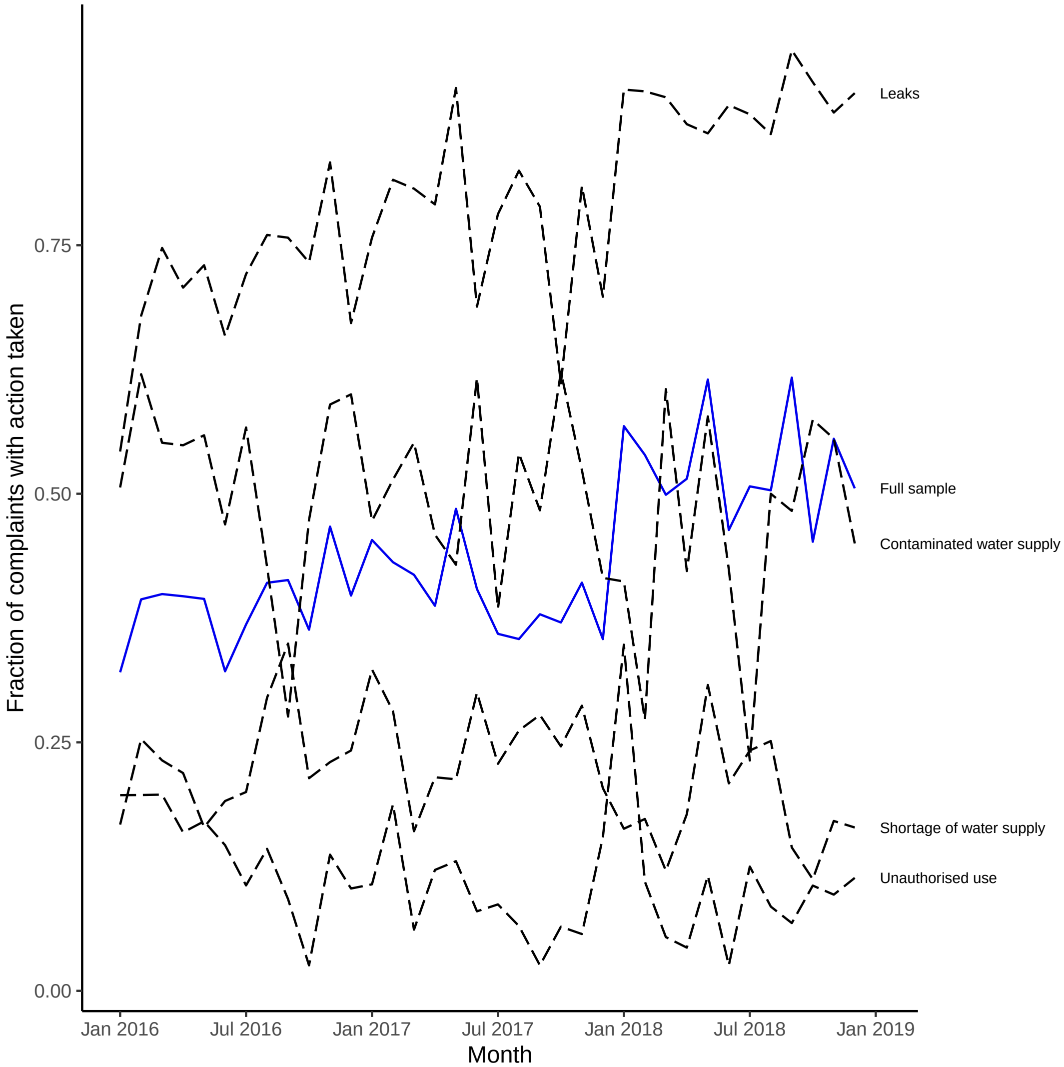
Most existing research on this question focuses on the effects of institutional-level variables, such as political competitiveness, degrees of decentralization, and variation in non-electoral political participation (Cleary, 2007; Faguet, 2014; Goldfrank, 2007; Wampler, 2007). This research has much in common with the literature on distributive politics which shows that characteristics at the constituency-level and below, such as ethnic composition, income, and partisan alignment can shape politicians and bureaucrats' incentives and therefore predict patterns of service delivery (see Golden and Min (2013) for a review). There is, however, an emerging recognition that patterns of responsiveness and service delivery may vary by service sector (Kramon and Posner, 2013).

I build upon this literature by investigating why there might 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 claims about different types of problems, such as leaks, shortages, and contamination.[1] I explain this variation by creating a stylized distinction between two primary functions that claims can serve. There are maintenance-related claims – those that generate important data about service and infrastructure problems – and service-increase claims – those that are essentially claims for more services or supply. Maintenance-related claims, such as claims about leaks and potholes, create data (Grossman et al., 2018) that helps handling officials improve service delivery for complainants without worsening service delivery for other citizens. Resolving them may even improve service delivery for others. In contrast, resolving service-increase claims, such as claims about water shortages or low electricity voltage, typically requires reallocating resources from one group of citizens to another. Addressing them is likely to generate more claims by other citizens. While the resolution of both types of claims is constrained by local capacity, addressing service-increase claims has broader distributional consequences which handling bureaucrats may be unable or unwilling to enact at scale. I thus expect that maintenance-demanding claims are more likely to be addressed than service-increase claims.

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 claim-type will vary with characteristics of where claim-makers live. First, the incidence of claim-type is likely to be correlated with existing levels of service provision. I expect most maintenance-related claims to originate in places where levels of service provision are already high, and for most service-increase claims to originate in places where levels of service provision are relatively lower. Second, this insight is important in light of an existing finding, namely that responsiveness generates more claim-making

[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 claims about water-related claims submitted to Mumbai's digital claims portal.



because citizens are more likely to make claims when and where they believe the will get a response (Kruks-Wisner, 2018b; Dipoppa and Grossman, 2020; Trucco, 2017; Goldfrank, 2002). The theory suggests the existence of two equilibria for claim-making and responsiveness. In one equilibrium, citizens have high levels of service delivery, make maintenance-related claims, and receive responses that encourage future claim-making. In the other, low-levels of service delivery are accompanied by service-increase claims that are less likely to receive responses and, therefore, less likely to encourage future making. The variation in responsiveness to different types of claims and the effect of this variation on citizens' expectations can therefore lead to enduring divergences in community levels of claim-making and service provision.

I empirically illustrate the argument through an analysis of formal claims lodged in Mumbai's water sector, where both leaks through the pipe infrastructure and shortages are endemic. In this context, I categorize claims about leaks as maintenance-related claims, and those about shortages as service-increase claims. While these claims can often be made through political networks and other informal means (Björkman, 2015; Anand Nikhil, 2011), citizens can also lodge formal claims with the city online, through an app, or on the phone. I scraped the universe of claims lodged from 2016-2018 through the website used for tracking these claims and developed a dataset of 21,384 unique claims about water. I then use supervised machine learning techniques to classify the text of the claims and responses to learn about trends in topics and the nature of responses by administrative ward and over time.

Using this data, I present three sets of empirical facts that support my theory. First, I show that not only do officials respond to claims about leaks at higher rates than they respond to claims about shortages, but an increase in the overall number of claims about shortages is met with a lower response rate while an an increase in the number of claims about leaks is not. This suggests that claims about shortages more quickly run up against capacity constraints than those about leaks. 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 claims about leaks increases while the number of claims about shortages decreases. This pattern indicates that the incidence of different types of claim-making 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 claims about shortages, but only where past responsiveness to claims has been relatively high. This pattern is further driven by high levels of responsiveness to claims about leaks rather than claims about shortages, thereby confirming that responsiveness indeed generates claim-making, but only with respect to claims 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 claims, which in turn vary in their likelihood of getting a response. This variation is further an important predictor of subsequent claim-making.

The theory and findings make at least three contributions to existing 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 claims made to a bureaucratic official. This is, to my knowledge, one of the first studies of the content of claims; the focus on intra-sector variation, moreover, underscores the idea that not only does service access vary among citizens, but so does the quality of services once access is granted (Kumar et al., 2022). Second, the study illustrates how in the short term, formal institutions for claim-making can primarily serve as tools for information collection for local governments, but 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 by those accountable to citizens, namely politicians. Finally, this study uses data and theory to bridge literature on claim-making and responsiveness, thereby illustrating how the behaviors of citizens and government officials shape each other over time.

2 Theory: claim type and responsiveness

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 growth of online portals for citizens to make claims about public services (e.g. Chen et al., 2016; Dipoppa and Grossman, 2020; Distelhorst and Hou, 2017; Grossman et al., 2017, 2018, 2020; Sharan and Kumar, 2020). These portals facilitate claim-making, or what Kruks-Wisner (2018a, 124) describes as "action...through which citizens pursue access to social...goods and [public] services." 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 serve two important functions. First, they can provide a level-playing field for citizens to demand more resources in contexts where claims 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 (e.g. 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 (e.g. Heller, 2001; Sanyal and Rao, 2018; Wampler, 2007; Weeks, 2000).

Beyond deepening democracy, these institutions can improve public service delivery by crowdsourcing important information about service and maintenance problems (Grossman et al., 2018; Post et al., 2018). Kumar et al. (2022) show, for example, that officials managing Bangalore's non-automated water distribution system do not have accurate information about the frequency with which different neighborhoods receive piped water supply. Citizen claims about infrequent supply could address this information shortfall. Similarly, several studies of grievance redressal systems focus on claims about potholes (e.g. Burnett and Kogan, 2017; Gorgulu et al., 2020). These claims are a cost-effective way for local governments to learn about where these potholes are. In this vein, Lee and Choi (2020) and Schneider (1999) argue that a key function of participatory governance systems is to provide valuable information to local government, thereby making current levels of public service delivery more "legible" (Scott, 2008) to officials.

Neither of these functions is fulfilled if bureaucrats and elected officials do not acknowledge, process, and respond to the citizens' input. One body of research finds variation in responsiveness across political institutions, and identifies variables such as degrees of decentralization (Goldfrank, 2007), rates of political competition,[2] and rates of non-electoral political participation and contention outside of the institution (Cleary, 2007; Wampler, 2008) as important predictors of responsiveness. Within institutions, particularly when bureaucrats are handling citizens' claims and input, Slough (2020) suggests that variation in the ability of citizens to complain about bureaucrats affects bureaucratic responsiveness. Dipoppa and Grossman (2020), on the other hand, highlight the importance of election timing. What these explanations (and most research in political economy) have in common is the idea that resources, including time and band-

[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).

width, are scarce and local officials will allocate these resources to respond to citizens in a way that aligns with their interests.

If resources are indeed scarce, then responsiveness likely also varies with the *content* of citizen's claims. The idea that strategies for allocating different public services will vary is not new. The field of public economics has 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 (e.g. education, water, electricity, and infant survival) that one studies.

Existing 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). This literature, most often operating through a lens of principal-agent relationships, typically 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 typically 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.

In particular, I argue that even within a sector or good type, responsiveness will vary with the function of the claim, or whether it is primarily a *service-increase* claim or a *maintenance-related* claim. Examples of each by sector can be seen in Table 1. Maintenance-related claims alert officials to service problems, particularly infrastructure or personnel-related issues, that they may not otherwise be able to detect and prompt direct action by the government. Resolving these claims can help improve service delivery for other citizens or at least is unlikely to worsen service delivery for other citizens within the same system. It is unlikely that fixing a downed electricity line will reduce the quantity or quality of service delivery for any households on the system.

Claims for more services, on the other hand, are demands to increase the supply of resources flowing through the system to a citizen or group. Important to note is that these service increase claims are not demands for the extension of a system, such as claims for more pipe, power line, or route coverage. Instead, they are requests that the flow of services received through existing infrastructure are augmented. Demands for service extension fall, by definition, outside the scope of the system to which a formal complaint mechanisms pertains.

Within a service system with fixed resources, resolving service increase claims necessarily requires reducing services for one set of citizens to the benefit of another. A doctor sent to one hospital must come from another one, and similarly, extra water supply for one area means less for another. As a result, service-increase claims incur greater potential costs on handlers in the form of backlash from citizens or, more simply, more claims from another set of citizens. Because they are relatively costly to address, I expect responsiveness to service-increase claims to more rapidly decrease with increased claim-making than responsiveness to maintenance-related claims.

Table 1: Examples of different types of claims by sector.

	Water	*Electricity*	*Transit*	*Healthcare*
Service-increase claims	More supply hours	Higher voltage, more supply hours	More buses and more frequent service on a given line	More supplies, beds, and staffing
Maintenance-related claims	Leaks, contamination	Downed lines, temporary outages	Unsafe infrastructure, operator behavior	Malpractice, doctor absenteeism

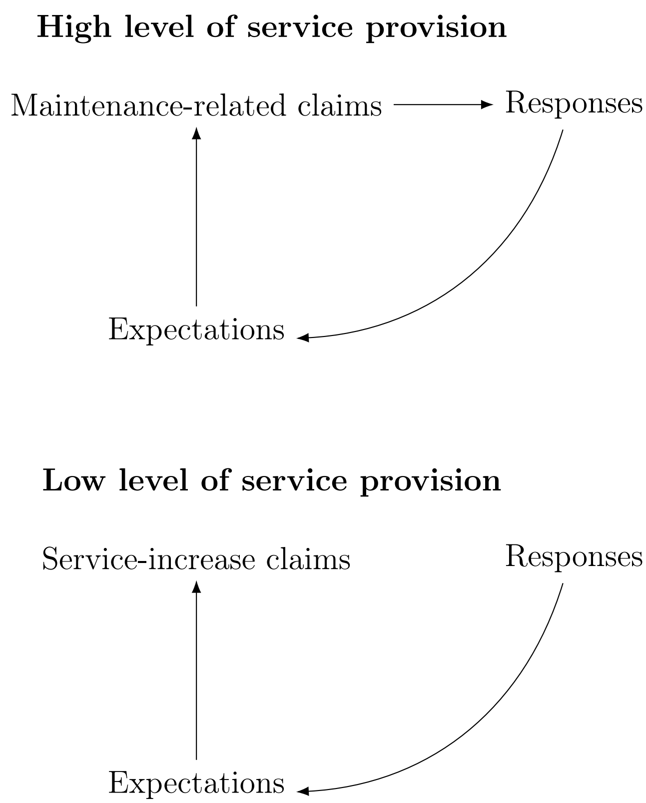
This proposed divergence in responsiveness is important for two reasons. First, the types of demands that citizens make is likely to be correlated with underlying levels of service provision. An area with already high levels of service delivery and resource allocation is more likely to make maintenance-related claims than one where service delivery is poor and resource allocation is low; this latter area is likely to make more service-increase claims than an area that is better off. For example, an area with infrequent bus service is likely to make claims for more frequent service; a place that already receives many buses a day is more likely to make claims about bus repair or operator behavior. This proposition is based in part on the idea that one's needs change as one becomes more fortunate (Maslow 1943). More simply, the scope of problems shrinks as service delivery improves.

Second, this variation in responsiveness will have implications for future claim making. An emerging body of research finds that 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 (2018b) finds that in rural India, citizens' prior experience with government shapes their propensity to make future claims 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 claims *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 claim-making in the future.

One of the main implications of this theory, then, is that claim-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 claims citizens make to vary with existing levels of service provision. Responsiveness will, in turn, vary with the types of claims being made. Responsiveness will, further, shape citizens' expectations and their future claim-making. Formal institutions for lodging claims can generate a virtuous cycle of claim-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.

There are a few scope conditions for this argument. First, the theory applies only to institutions where government officials respond to citizen requests and claims; it does not, importantly, apply to formal institutions for deliberative governance (see e.g. Sanyal and Rao (2018)), wherein citizens address their own claims as a group. Second, it applies to formal institutions where a non-elected official is responsible for handling claims. As discussed in the vast literature on distributive politics, elected officials will face a different set of constraints and incentives when responding to claims. Additionally, the theory is relevant to claims 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 claim or easily increase service supply levels overall. In a wealthy context, for example, a claim about a water shortage is a maintenance-related claim, as it alerts officials anomalies in the water supply system. In a constrained system, however, water shortages will be routine, and it will not be possible to resolve every instance.

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



3 Claims and redressal in Mumbai's water sector

I assess the validity of this 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). 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. 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. 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).

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.

Claims 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. Bjorkman (2015, 198-227) further illustrates how citizens' demands and politicians' promises for water have become a routine "spectacle" of Mumbai politics.

While Bjorkman (2015) and Anand (2011) describe the informal and political processes through which citizens make claims about water, it is possible to do so through a formal process as well. Citizens can lodge a claim with MCGM through its online portal, a smartphone app, or through the phone (see Varshney (2021a) and Figure SI.1, top panel).[3] These claims are then given a number with which citizens' can subsequently track the progress of the claim. According to PRAJA, an NGO aiming to improve transparency and accountability in Indian cities, claims about water are frequent; "Water supply" has been in the top 5 claim categories every year since 2010, the year in which PRAJA first makes its reports available.

These claims are then sent to a handler in the ward-level Hydraulic Engineering department, typically the Assistant Engineer for Water Works. This employee is responsible for both maintaining a given municipal ward's water infrastructure and addressing citizen claims. This individual triages the claim and sends it to employees, sub-departments, or other agencies for addressal.

The process of resolution differs by claim-type as illustrated by the resolution of leaks and shortages. According to an Assistant Engineer (ward name omitted for anonymity), when a claim about a shortage comes in, the handler first determines whether the neighborhood of origin is operating at the designated supply schedule.[4] If so, the complainant is typically told that no resolution is possible. If for some reason the water

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

[4] 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).

schedule is not being followed, the water supply schedule may 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 typically, 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 claims are arising from a neighborhood for an unknown reason, an engineer may be sent to learn if there are problems with the infrastructure, but large infrastructural causes of water shortages, typically water main bursts, are more likely to be submitted under a different category of claim.

In most cases, there is no solution to a claim about a shortage other than diverting water from one area of supply to another. Handling engineers typically 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 claim about a leak comes in, on the other hand, an employee is typically sent to investigate the source of the leak. If one is found, that leak is typically 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 claim about a leak from the same neighborhood receives some investigation as multiple different leaks within a neighborhood are possible. The modal response to a claim 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 other people [who don't live in the area] don't get upset when you do it."

These descriptions, overall, suggest that the resolution of claims about leaks and shortages follows two distinct patterns. A claim about a leak provides actionable data (Grossman et al., 2018) for the government, and resolution typically does not worsen service delivery for others outside of the relevant valve area. A shortage claim, on the other hand, is typically a request for more water, particularly more supply hours. The main resolution of a shortage claim, is to allocate more supply hours to the claim-maker'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 claims about leaks as maintenance-related claims and those about shortages as service-increase claims.

4 Data

I collected data on claims concerning water supply made to the MCGM from citizen claim portal which collects and tracks the formal claims. I inputted every possible permutation of the details requested (e.g. municipal ward, claim-type, and date, Figure SI.1, bottom panel) to collect individual-level data for every claim lodged from 2016-2018. This process generated information on 21,384 claims in the "Water supply" claim-type.

Each claim ticket includes the original claim text in Hindi, Marathi, or English. I used basic text-analysis and supervised machine learning processes to classify these claims 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. About 68% of these claims 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 claim topic as defined by the handler.[5] I selected the words with non-zero coefficients

[5] 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."

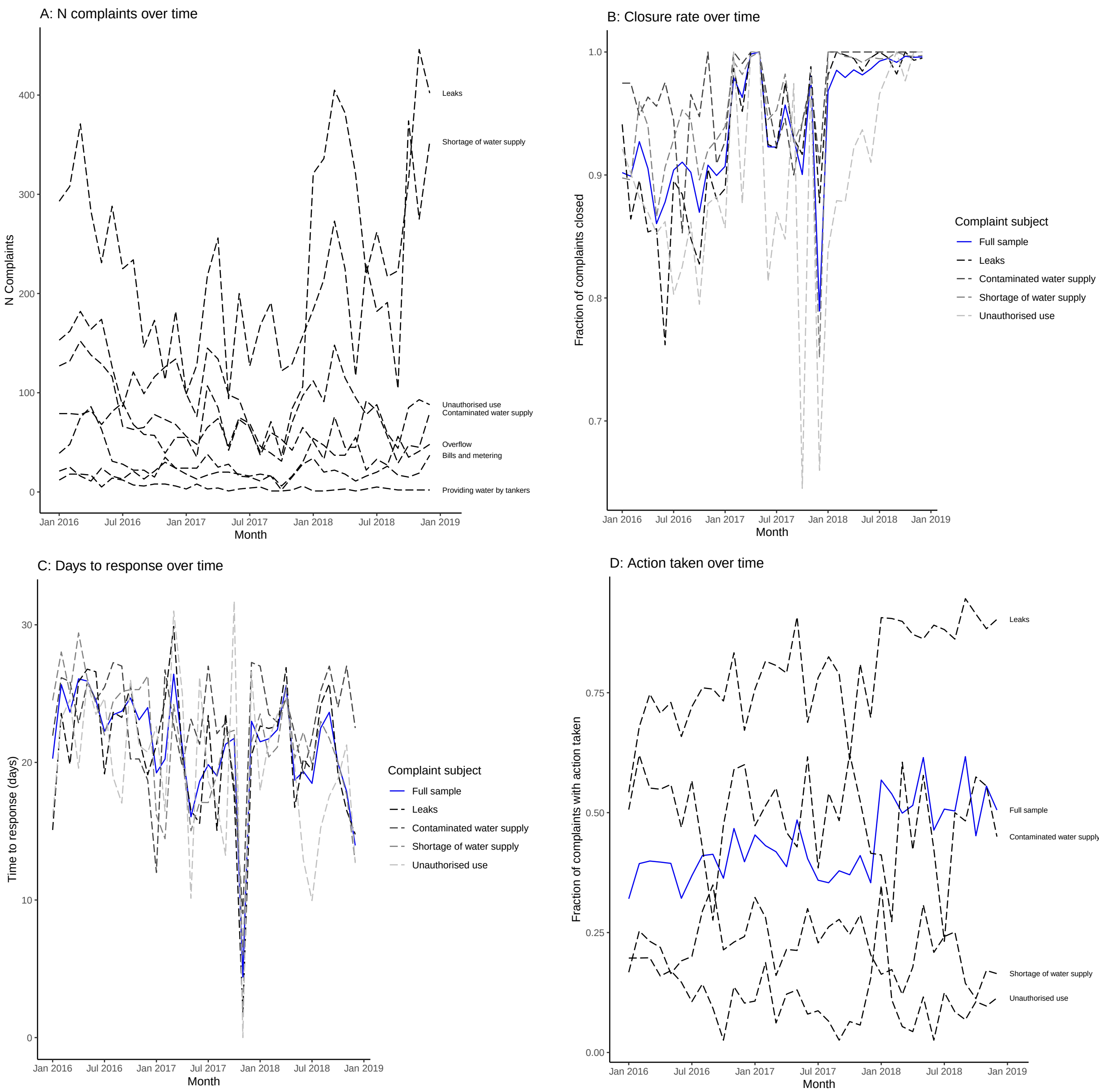
from each of the LASSO models to fit a random forests model on the training sample of the classified data.[6] This model predicted claim categories in the remaining 30% test dataset with 86% accuracy. The words used in the final model can be seen in Table SI.1. The overall incidence of the most frequently occurring categories in each month for which I collected data can be seen in Figure 3, Panel A. Claims about leaks and shortages make up the vast majority of topics covered.

The data also include measures of responsiveness to these different claims. 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 claim 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 claims were resolved, allowing me to measure the number of days between a claim being lodged and its final 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" claims are not actually resolved. For example, many claims receive "False complaint" as a response, and several claims 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

[6] 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 (e.g. "mtry") were determined using holdout cross validation.

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



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 claim 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 claim type are shown in Figure 3, Panel D. Claims marked as "Action taken" are typically (99.6%) marked as "Closed", but the reverse is not true, as just 47% of claims 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 use aggregate claims to the ward-day level. Table 2 shows summary statistics for all of the outcomes of interest at the ward-day level for the three years that the dataset covers.

Table 2: Summary statistics for main outcomes of interest. Unit of analysis is the ward-day, Mumbai 2016-2018.

Variable	*Min.*	*Max.*	*Mean*	*SD*
Claims (all types)	0	23	0.81	1.38
Claims (shortages)	0	22	0.28	0.81
Claims (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

4.1 Multiple claims

Sometimes, multiple claims will come in about the same problem. To be able to detect whether two claims 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), 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 may have to investigate individual claims 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 claim-making independent of the rate of underlying problems there are. Wherever relevant, I discuss how I expect repeat claims about the same problem to influence my results and interpretation thereof.

5 Responsiveness to different types of claims

I first show simple patterns of responsiveness to different types of claims within the water sector. Figure 3 shows that maintenance-related claims get responses at much higher rates than service-increase claims. Action is taken for almost 83% of claims about leaks. In contrast, action is taken for only 21% of claims 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:

$$responsiveness_{t,w} = \beta_0 + \beta_1 claims_{t,w} + \overrightarrow{\eta}\, month_m + \overrightarrow{\gamma}\, year_y + \overrightarrow{\delta}\, \alpha_w + \epsilon_{t,w} \tag{1}$$

The main outcome, $responsiveness_{t,w}$, is the percentage of claims registered on a given day that I classify as "action taken." Only days on which at least one claim 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 claims because ward-days in which there were no claims about leaks or shortages are dropped. The main predictor of interest, $claims_{t,w}$ measures the number of claims 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. 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 3. I see a divergence in responsiveness by claim type. Across all water-related claims, there is a negative relationship between the number of claims registered on a single day and the rate of action taken. This relationship appears to be driven by claims about shortages, or scarcity-related claims. For every additional claim about shortages registered on a given day, the rate at which these claims receive a meaningful response decreases by about 0.9%. This is consistent with an assumption of fixed capacity and claims that are costly to address. There is no measurable relationship between the number of claims about leaks (maintenance-related claims) that come in on a certain day and the rate of resolution, suggesting that this type of claim runs up against fixed capacity at a lower rate, or incurs lower costs of resolution.

Table 3: Correlation between rates of responsiveness and claim-making.

	Rate of action taken for closed claims:[1]		
	All water claims	Leaks	Shortages
N claims	-0.007^{**}		
	(0.003)		
N claims (leaks)		0.001	
		(0.007)	
N claims (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 claims 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 claims for a given area are handled for each claim type. Recall that even when multiple claims about leaks come in from a single area, it is not clear (without some inspection) whether the claims are about the same problem. Multiple pipe sections within a neighborhood can leak. A claim about a shortage, on the other hand, is relevant to an entire section of the water network that is pressurized at a time. Multiple claims about shortages from the same area are likely to be able to same problem. In other words, the unit of resolution for a claim 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 claim 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 claim incurs a lower variable cost to address because a) there is some likelihood that it is related to a claim 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. Claims 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 claims about leaks versus shortages as seen in Figure 1.

6 Divergence in the types of claims that are made

Next, I show that the incidence of different types of claims varies with existing levels of service provision. I test whether the ward-level daily claim 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:

$$claims_{t,w} = \beta_0 + \beta_1 hours_w + \vec{\eta}\, day_t + \epsilon_{t,w} \tag{2}$$

Here, $claims_{t,w}$ is the number of claims 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 to account for any events or trends affecting claim 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. 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 this relationship is that an increase in mean supply hours causes more or less claims. It is likely that both supply hours and the incidence of claim-making are correlated with some other variables, particularly ward-level socio-economic characteristics, that drive the relationship. It is also possible that this relationship is driven by a divergence in the incidence of real problems by underlying levels of service provision. This exercise simply shows that different types of claims 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 4. First, there is no measurable relationship between the ward-level daily claim 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 claim-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 claims about leaks per person and 0.00003 fewer claims about shortages per person per day. I therefore see a divergence in the types of claims that are made as levels of service provision increase.

Table 4: Correlation between number of claims per capita and mean daily supply hours (2018).

	Dependent variable:		
	All water claims[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 claims per day divided by the number of individuals in the ward.

7 Responsiveness and subsequent claim-making

Finally, I argue that citizens' claim-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 claim-making. This is because I have demonstrated that rates of responsiveness and claim-making are correlated. Any relationship between past responsiveness and subsequent claim-making could simply be the result of the autocorrelation of claim-making within a ward over time.

Instead, I examine how a differentially experienced shock to the water supply affects claim-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.[7] I use a difference-in-differences design[8] to estimate the effect of this water supply cut on

[7] 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) .

[8] 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

claim-making:

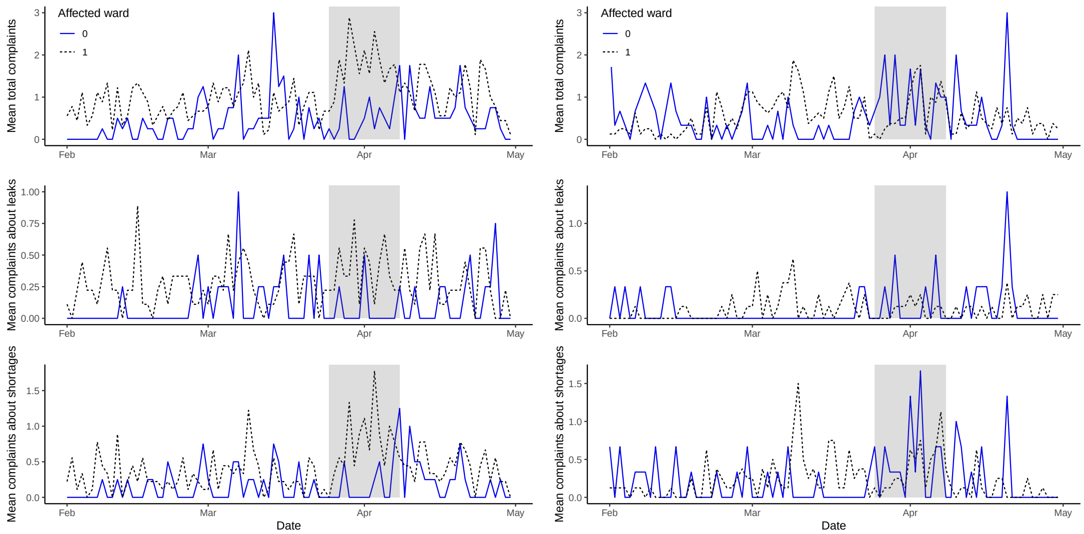
$$claims_{t,w} = \beta_0 + \beta_1 short_w + \beta_2 post_t + \beta_3 post_t \times short_w + \vec{\eta}\, day_t + \epsilon_{t,w} \qquad (3)$$

Here, $claims_{t,w}$ is the number of claims 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 claims 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 to account for unobserved daily factors affecting claim-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 between pre- and post-shortage claim levels across affected and unaffected wards. Under certain assumptions, this coefficient can be interpreted as the causal effect of the shortage on claim-making. In particular, I assume that affected and unaffected wards do not exhibit different trends in claim-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 claim-making. In Mumbai, a large underground valve is typically replaced because it does not fully close. Fixing it increases the overall pressure in

Goodman-Bacon (2021) and others.

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



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, we may expect differences in the overall *levels* of claims made in affected wards and unaffected wards prior to the shortage, but it is unlikely that there would be recent differences in trends in claim-making across affected and unaffected wards. I next visually verify this claim by plotting the mean number of claims for affected and unaffected wards for the two months prior to the shortage (Figure 4) and see no evidence of different trends in claim-making prior to the shortage. Finally, I estimate differences-in-difference models for 5 time periods prior to the shortage as placebo tests (Figure SI.2) and find no evidence for differences in trends prior to the shortage.

The main results can be seen in Table 5 and Figure SI.2. Most simply, the shortage adds about 0.47 shortage-related claims per day to affected wards relative to unaffected wards, but this effect is only visible in wards that have been relatively responsive to claims over the past six months. There is a smaller effect for claims about leaks, but given the nature of the intervention, the main effect of interest is on claims about shortages. The triple interaction (Table SI.2) similarly show that that the supply cut generates claim-making about shortages at significantly 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 claims about leaks, rather than claims about shortages. I separately estimate Equation 3 for wards that are above the median rate of "Action taken" for claims about shortages and and wards that are above the median rate of responsiveness to claims about leaks in Table 6. I find no measurable effect of the water shortage in wards that are relatively responsive to claims about shortages, yet I find that it generates 0.324 more leak-related and 0.338 more shortage-related claims per day in wards that are highly responsive to claims about leakages. These results suggest that the effects in Table 5–indeed, the effects on claim-making about *shortages*–are driven by wards that are relatively responsive to claims about leaks.

Table 5: 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 claims	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 claims	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.

Why do we not see an effect on claim-making in wards where responsiveness to claims 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 claims to which governments are responsive. The rates of responsiveness to claims about shortages, however, are much lower than rates of responsiveness to claims about leaks (Figure SI.3). The median rate of responsiveness to claims about shortages hovers around 25%, while it is closer to 80% for claims about leaks. In other words, even the wards that are relatively more responsive to claims about shortages are not responding to these claims 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).[9]. This suggests that we do not see an effect on claim-making in wards where responsiveness to claims 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 claim-making about shortages, but only where past responsiveness to claim-making is already high. This suggests that over time, responsiveness can moderate citizens' expectations and their use of formal institutions for claim 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 claim. I further show that this pattern is driven by prior responsiveness to claims 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 may exhibit low levels of responsiveness

[9]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

in absolute terms. Overall, the findings suggest that divergence in responsiveness to claims of different types can moderate the use of of formal institutions for claim-making in the future, and that patterns of responsiveness to one type of claim can moderate claim-making about another.

Table 6: Difference-in-differences estimates for wards with high rates of responsiveness to claims about leaks (top) and shortages (bottom).

	Highly responsive to claims about shortages [1]		
	All water claims	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 claims about leaks [4]		
	All water claims	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 claims 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 claims about leaks over the previous six months.

8 Conclusion

This paper has developed a theory to explain variation in responsiveness to claims for service delivery made through formal channels, a phenomenon that is not yet fully understood. It has clarified the difference, from a handling officer's perspective, between maintenance-related and service-increase claims. It further argues that maintenance-related claims are more likely to get a response, as they are less likely to generate more claim-making in the future. The distinction therefore contributes to an emerging literature on bureaucratic constraints (e.g. 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 new 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 claim-making institutions to improve the equity of service delivery in LMICs. I argue and show that the types of claims that a neighborhood makes are correlated with existing levels of service delivery and prior levels of responsiveness. In particular, I update existing the existing finding that responsiveness generates more claim-making (Kruks-Wisner, 2018b; Dipoppa and Grossman, 2020; Trucco, 2017; Goldfrank, 2002) by demonstrating that it does so mainly for maintenance-related claims arguably because responsiveness to service-increase claims is so low in absolute measures. These patterns suggest that formal institutions can generate a virtuous cycle of claim-making and responsiveness, but primarily with respect to maintenance-related claims and where levels of service provision are already high. In the short term, then, 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 this way, the paper synthesizes and builds upon existing research on ICT institutions for claim-making that have found them to be minimally effective in in increasing political accountability (e.g. Grossman et al., 2018, 2020) and identifies important conditions under which they would fulfill their promise to improve equity in service outcomes (World Bank, 2003). Importantly, in the case studied here, claims are handled by bureaucrats whose *other* tasks are also related to infrastructure maintenance, thereby incentivizing them to be more responsive to maintenance-related claims. In the long-term, formal institutions for claim-making might increase equity in service delivery if information about the distribution and incidence of service-increase claims reaches those with the power and incentives to reallocate resources 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 claim-making and bureaucratic responsiveness. I support the theory using original data on the universe of claims 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 claims and responses. This allows me to demonstrate how responsiveness varies with the total number of claims, thereby highlighting the capacity constraints in responding to service-increase claims, 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 (e.g. Kruks-Wisner, 2018b; 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 claim-tracking portal.

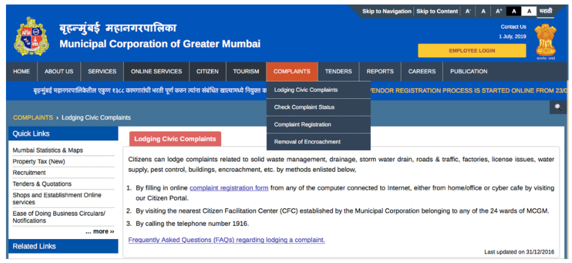
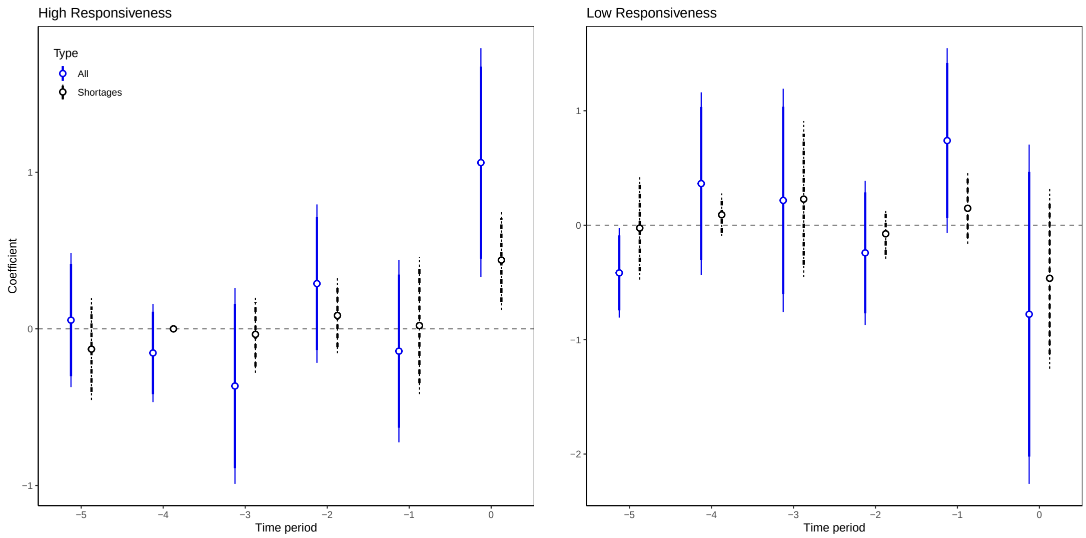


Table SI.1: Words used in predictive models for response and claim categories.

Outcome	*Predictive words (stemmed)*
Claims	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

Figure SI.2: 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 thesupply cut period occurring after March 25. Time period -1 refers to February 1-March 9 2017, with a placebosupply cut period occurring after February 23. Other time periods similarly look at 30 day intervals occurring prior to the actualsupply cut.

Figure SI.3: Distribution of mean rates of action taken in response to different types of leaks MCGM wards, October 2016-March 2017

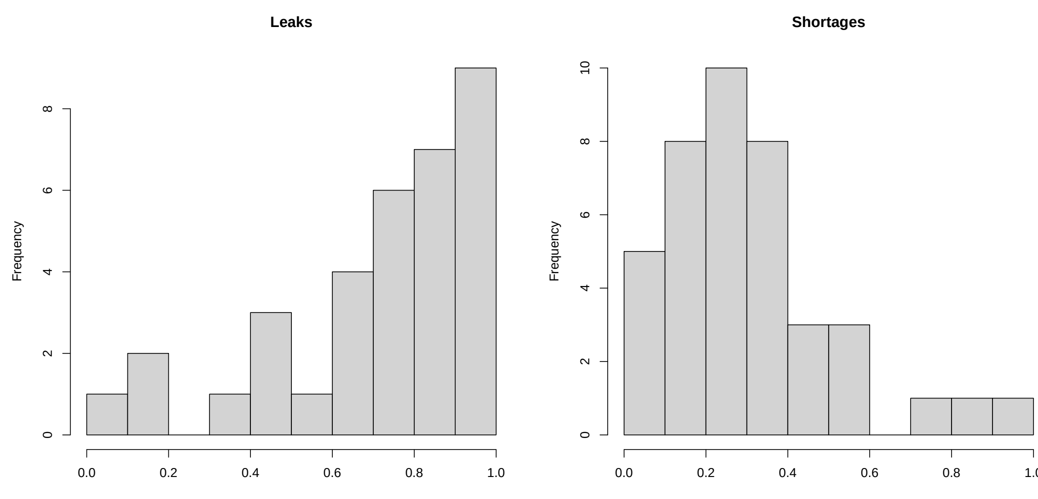


Table SI.2: Triple difference estimates of the effects of the supply cut conditional on rates of responsiveness.

	Dependent variable:		
	All water claims	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 claims about leaks over the previous six months.