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Improving payment for essential services

A field experiment in Nairobi, Kenya

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Improving payment for essential services – A field experiment in Nairobi, Kenya*

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Abstract

Utilities across the global require stable revenue streams to provide customers access to high quality energy, water, sanitation, and other essential services. This requires policy makers to set prices to cover costs, promote the efficient use of resources, and ensure services are affordable. It also requires that customers pay their bills. Historically, utilities have used disconnections, or the threat of disconnection, to compel customers to pay their bills on time. However, the increasing recognition of the human rights to water and sanitation by many governments and the COVID-19 pandemic have led some water utilities to discontinue or curtail disconnections. Reducing arrears and encouraging on-time bill payment is essential to get utilities in the Global South on the path to financial sustainability. This raises an important question for scholars and policy makers alike: if disconnection for essential services is viewed as socially or politically unacceptable, how can utilities encourage customers to pay their bills? In partnership with the water utility serving Nairobi, Kenya, we test the impact of a set of simple, low-cost reminders on customer bill payment using a pre-registered, randomized controlled trial of 50,000 residential customers. We use four measures of payment behavior: making any payment, paying the full current month's bill, total arrears accumulated over the six months when messages were sent, and the fraction of the cumulative 6-month bill paid. We find that SMS-based bill payment reminders were not effective at improving bill payment on average. Nudges alone seem unlikely to solve the problem of water debt.

Keywords: water, sanitation, information provision, field experiment, bill payment, Africa

JEL Codes: C93, D91, 013, Q25, Q56

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Improving payment for essential services – A field experiment in Nairobi, Kenya

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1. Introduction

Utilities require stable revenue streams to provide customers access to high quality energy, water, sanitation, and other essential services. In the water sector in the Global South, policy makers face a tripartite challenge of improving services for existing customers who often lack 24x7 service, expanding access to households that lack piped services, and ensuring that services are resilient to climate change. Financing this infrastructure transition requires policy makers to ensure prices are sufficient to cover the costs of service delivery and customers to pay their bills. Scholars and policy makers have paid considerable attention to the challenge of utility pricing. However, surprisingly little attention has been paid to customer bill payment and the challenge of customer arrears.

The magnitude of the global arrears problem is not known. However, utilities failed to collect 40 billion USD in outstanding water debt and nearly 100 billion USD in electricity debt annually (Theron-Ord, A., 2017; Liemberger and Wyatt, 2019). Evidence from individual utilities suggests that the problem may be larger and more widespread than previously thought. For example, Szabo and Ujhelyi (2015) indicated that in 2011 households owed municipal governments in South Africa approximately 4 billion USD. Similarly, Tonke (2024) observed that nearly 47% of water customers in Namibia had accumulated debt that was larger than their last three water bills. If the experience in these locales is indicative of customer payment behavior in other utilities in low- and middle-income countries, the arrears problem may represent an underappreciated threat to the financial sustainability of utilities across the globe.

Historically, utilities have used a credible threat of disconnection to compel customers to pay their bills on time. However, utilities may be reluctant to disconnect customers because it is politically unpopular or because it may encourage illegal connections or vandalism. The increasing recognition of the human rights to water and sanitation by many governments has led some utilities to further discontinue or even cease disconnections. The COVID-19 pandemic accelerated this trend as many utilities put temporary disconnection moratoria in place that many have struggled to rescind (Fincher et al., 2023; Amaechina et al., 2020). This raises an important question for scholars and policy makers alike: if disconnection for essential services is viewed as socially or politically unacceptable, how can utilities compel customers to pay their bills on time?

In partnership with the water provider in Nairobi (Kenya), we conducted a large-scale field experiment (N=~50,000) to test the impact of providing five simple, low-cost information treatments by SMS on residential customer bill payment behavior. The information treatments in our study -- co-designed with the water provider -- tested the efficacy of descriptive and injunctive norms, information about the capital intensity of water and sanitation service delivery, and an appeal to public health. Despite the potential appeal of low-cost, scalable interventions to improve bill payment, we find that our SMS-based bill payment reminders were not effective at improving bill payment on average.

This study makes several contributions to the literatures on customer payment behavior and utility bill payment. There is an extensive literature on the impact of information treatments on tax compliance and payment for other government services (Alm, 2019; Hallsworth, 2017; John and Blume, 2018; Chirico et al., 2016; Chorico et al., 2019; Antinyan and Asatryan, 2020). While much of the research in the tax compliance literature has been conducted in high-income countries, more recent attention has been paid to tax compliance in low- and middle-income countries (Santoro, 2024; Hoy et al., 2024; Mascagani and Nell, 2022). Our study adds to a small but growing literature on bill payment in the Global South.

This study also represents one of a small number of experimental studies that explicitly tests interventions to improve customer bill payment in the water sector. To our knowledge, there have been four experimental studies to date that examine customer bill payment in the water and sanitation sector, only two of which test interventions explicitly designed to improve bill payment (Szabo and Ujhelyi, 2015; Tonke, 2024; Rockenbach et al., 2023; Coville et al., 2023).

Additionally, unlike the experimental contexts in Rockenbach et al. (2023) and Tonke (2024), where customers had (pre-intervention) received paper bills by mail and paid them in person at utility offices, Nairobi has already made the transition to SMS-based billing and electronic bill payment (primarily via mobile money). This operational context more closely reflects the current situation in large cities in the Global South and where many are utilities headed. Thus, our study empirically tests an intervention many utilities are likely to consider implementing.

Finally, this study was co-developed and implemented in close partnership with the water service provider in Nairobi. As a result, our study is considerably larger than many studies in the literature

allowing us to assess the impact of an intervention at scale among the broader residential customer base. For example, previous work in Nairobi focused on bill payment among landlords in an informal settlement (Coville et al., 2023). It is rare for households in informal settlements – both in Nairobi and elsewhere – to have private connections to the piped water and sewer network. While providing an important site for testing approaches to improving customer bill payment, the experimental context in Coville et al. (2023) is not representative of Nairobi Water's broader customer base nor the customer base of many utilities in the Global South.

The remainder of the paper is structured as follows. Section 2 describes our study site and context, with sections 3 describing our intervention and experimental design. Section 4 details our estimation strategy and Section 5 presents our main results and describes several robustness checks reported in a Supplementary Information appendix. We conclude with a discussion of study limitations and implications for policy.

2. Empirical setting and context

This study was implemented in Nairobi, Kenya in partnership with Nairobi City Water and Sewerage Company (NCWSC). As the economic hub of East Africa, Nairobi is home to nearly 5 million people (KNBS, 2023), 60% percent of whom live in informal settlements (Coville et al, 2023). NCWSC provides water and sanitation services to over 200,000 residential customers, commercial customers, and industrial customers[1]. They also sell water through a network of staffed and automated (pre-paid) kiosks to households in informal settlements who typically lack a private, household connection to the piped water network.

Meter reading in Nairobi is conducted by "marketing assistants" who read each meter monthly. The marketing assistants take a picture of the meter reading and manually enter it into a proprietary

[1] Utilities interact with customers through a meter. Thus, a residential "customer" in this context could be a free-standing single-family house (bungalow), a family in a multiple-family dwelling with a private meter, a multi-family dwelling with a shared meter (e.g., compound with a shared tap outside the home, compound with a shared meter, or apartment complex with a shared meter). Similarly, commercial customers could include stand-alone businesses with private meters or a business complex consisting of several businesses that share a meter.

phone application which uploads data to NCWSCs billing system. Customer service agents have access to the picture of the meter associated with each reading if a customer disputes their bill. In 2014, NCWSC transitioned completely to SMS-based billing. With the penetration of mobile money in Kenya customers have increasingly paid their water and sanitation bills via electronic – and largely phone-based – means. According to NCWSC, approximately 75% of customers pay their bills via mobile money. Thus, customers in Nairobi face little to no physical barriers or frictions to receiving or paying their bills.

At the beginning of our experiment, residential customers in Nairobi accounted for 89% of customer accounts, 47% of water sales, and 58% of total arrears. Approximately half (48%) of residential customers had unpaid balances (arrears) of over 100 KSH (~1 USD) on their accounts. Forty percent of residential customers had balances over 500 KSH (~5 USD). NCWSC has a formal disconnection policy for customers who are behind on their bills. According to NCWSC's official policy, bills are due seven days after the bill date and customers have a seven-day grace period to pay their bill. On the fifteenth day after the billing date, "disconnection of the services shall be carried out for overdue debts" (NCWSC, 2021). Like many utilities, however, this policy is not strictly enforced for a variety operational, financial, and political reasons.[2] In addition, NCWSC does not impose any late fees or penalties for overdue water bills.

3. Intervention, experimental design, and data

3.1 Intervention

This study tests the efficacy of relatively simple, low-cost reminders on improving customer bill payment among residential customers. We focus on residential customers alone because the payment behavior of commercial, industrial, and institutional customers is likely to be driven by different factors. The study was preregistered with the American Economic Association (AEA) RCT Registry (AEARCTR-0007477) and received approvals from the University of South Carolina Institutional Review Board (Pro00121799) and Kenya's National Council for Science and

[2] See Coville et al. (2023) for a detailed discussion of the variable enforcement of the disconnection policy in Nairobi.

Technology (Ref No. NACOSTU/P/13/8073/406). The intervention was co-developed in partnership with staff at NCWSC as an extension of a long-term collaboration related to water pricing, subsidy design and tariff reform. Previous collaborative work diagnosed customer arrears as an ongoing constraint to the long-term financial sustainability of the utility and an emerging priority for NCWSC.

The intervention in this study consisted of five information treatments (messages) sent to five treatment groups of approximately 10,000 customers monthly for six months (December 2022 to June 2023[3]) (Table 1). The content of the messages sent to each treatment group was developed in collaboration NCWSC staff to test behavioral mechanisms identified in the tax payment, utility bill payment, and willingness to pay literatures (Ben Zaied et al., 2020; Carillo et al., 2021; Hallsworth et al., 2017; Szabo and Ujhelyi, 2015; Fuente et al., 2023; Hamoudi et al., 2012; Jalan & Somanathan, 2008; Van Houtven et al., 2017; Kayaga et al., 2003; Kayaga et al., 2004; Sualihu et al., 2014; Vasquez, 2015; Vasquez and Alicia-Planas, 2017). The language in all messages was crafted to mirror the language used in official communication from the utility. The first and second treatment groups were sent messages to test the impact of descriptive and injunctive norms, respectively. The third treatment group were sent a message reminding customers that prompt bill payment provided revenue required to ensure service continuity, improve service quality and extend services to unserved households. This message was designed to remind customers of the relationship between prompt bill payment and the ability of the utility to provide high quality services. This "co-dependence" framing is related to, yet distinct from, the good will effect hypothesized in Szabo and Ujhelyi (2015).

Water and sanitation service delivery is capital intensive but much of the capital is invisible to the end users. Reservoirs and treatment plants are typically outside of public view and, unlike electricity, the vast network that carries water and wastewater through the city are buried underground. Fuente et al. (2023) recently found that providing customers information about the capital intensity of water and sanitation infrastructure increased their perception of a fair price to pay for water services by 30%. The message sent to the fourth treatment group replicated the co-dependence message described above and added information about the cost of a recent repair to

[3] Due to administrative issues, April messages were sent on May 1, 2023. Thus, one additional treatment was sent in June 2023 to complete the six-month treatment protocol.

the Sasumua pipeline that had recently been damaged in a landslide. This treatment was designed to provide customers a sense of the financial magnitude of the cost of infrastructure repair and, by extension, service delivery.

	Treatment	Rationale/mechanism
Treatment 1	"Dear valued customer: Most customers in Nairobi make a payment towards their water bill on time. Please pay your water bill before the due date."	Descriptive norm message
Treatment 2	"Dear valued customer: Most customers in Nairobi think it is important to pay their water bill on time. Please pay your water bill before the due date."	Injunctive norm message
Treatment 3	"Dear valued customer: NCWSC requires regular revenue to continue providing water services, improve service quality, and extend service to those who need it. Please pay your water bill before the due date."	Prompt payment=service quality
Treatment 4	"Dear valued customer: NCWSC requires regular revenue to continue providing water services, improve service quality, and extend service to those who need it. For example, the Company spent over KES 350 million to repair the damage to the Sasumua pipeline in May 2020. Please pay your water bill before the due date."	Prompt payment=service quality + financial information
Treatment 5	"Dear valued customer: Water, sanitation, and good hygiene are essential to public health. NCWSC requires regular revenue to continue providing water services, improve service quality, and extend service to those who need it. Please pay your water bill before the due date."	Public health appeal + Prompt payment=service quality
Control	n.a	n.a.

Table 1. Summary of messages sent to customers included in the intervention.

Finally, there is a robust evidence base linking high quality water and sanitation service delivery to improved public health outcomes (Wolf et al., 2018; Freeman et al., 2017). The fifth information treatment combines the co-dependence treatment described above with a reminder of the importance of water, sanitation and hygiene for health.

Customers in each treatment group were sent the same messages monthly for the duration of the treatment period of the study. Messages were sent to customers via the Mteja.io SMS platform using the sender code NRB_WATER. This sender code is nearly identical to the sender code used by Nairobi Water for official communication (NRBWATER). This sender code was purchased for the use in the study with expressed, written consent of NCWSC. In collaboration with NCWSC, the research team decided to send messages via an independent SMS system instead of the NCWSC SMS platform to 1) ensure randomization fidelity, 2) ensure control over message content and timing, and 3) reduce administrative burden on the utility.

3.2 Experimental design

This study focused on arrears and payment behavior of residential customers who pay their own water bills. Like many utilities, at the time of the study NCWSC did not have information on whether a meter served a single residence or multiple residences (either through a shared yard tap or a single meter serving a multi-unit apartment complex). Thus, the population for the study was limited to residential customers with an average consumption between zero and 500 cubic meters per month. The 500 cubic meter per month cut off was selected in consultation with NCWSC staff to plausibly exclude customers that share a meter. As a proxy for landlords who manage the accounts for multiple properties, customer accounts that shared a mobile phone number were excluded. The population for the study also excluded customers that had a credit on their account for 24 of the 36 months prior to the study. Finally, the population was limited to customers with average arrears less than KSH 53,000 (~USD 490 at the time of the study[4]), the 95th percentile of average arrears. Customers were then randomly assigned to one of five treatment groups or the control group consisting of approximately 10,000 customers each using the *randtreat* command in Stata/SE 17. The sample was stratified on deciles of average arrears and average water use over the 3 years prior to the study.

As pre-specified, we examine the impact of the intervention on four measures of customer payment behavior: the magnitude of customer arrears each month (*arrears*), whether or not a customer paid

[4] 1 USD = approximately 108 Ksh at the time of the study.

their the prior month's charges in full (*currontime*), whether a customer made any payment towards their previous bill (*anypay*), and the total amount paid over the six months divided by the total charges for those six months (*pctpaid*). We construct each of these outcome measures from information contained in NSCWC's billing records. The outcome *arrears* is defined as the balance brought forward from the previous month's bill. For practical purposes, we consider a customer's bill paid in full (*currontime*) if their payment was within KSH 10 of their previous bill. We also consider any payment made by a customer (*anypay*) as a payment over KSH 1.

4. Estimation strategy

Because of randomization, average treatment effects can be identified by examining the differences in means in the post-treatment period ($P_t = 1$, or December 2022 – June 2023) (Equation 1).

$$(1) \quad Y_{it} = \alpha + \gamma T_{i,l} + \beta X_{it} + \delta \omega_i + \tau_t + \epsilon_{it}; \quad \forall P_t = 1$$

We examine our four key bill payment outcomes (Y) for household *i* at month *t*. The measures for paying anything or paying the current bill in full are dichotomous but we use OLS models for consistency across outcome measures. $T_{i,l}$ is an indicator variable for each of the five treatment messages (l = 1..5) as well as a pooled treatment.

X_{it} controls for observable characteristics that may affect bill payment and evolve in the post-treatment period. As is typical, the utility does not observe the socioeconomic characteristics of account holders' households, and similar data from nationally representative survey is not available in Nairobi at a fine enough scale to allow us to geospatially match households to census regions or neighborhoods. We do not observe whether accounts serve more than one household, or whether accounts are managed by property owners on behalf of tenants. We do drop accounts where we suspected this was the case, however, as discussed above. In our case, X_{it} includes only water consumption, lagged by one month (since this affects the current month's bill). Although randomization should also ensure balance across pre-treatment variables, we also add a control for the average amount of water debt in the pre-treatment period (ω_i) in some models to increase precision. τ_t captures month fixed effects. $\epsilon_{i,t}$ is the idiosyncratic error term. Robust standard

errors are clustered at the account level to account for serial correlation in a household's payment behavior over time.

For three outcome measures[5], we also use a difference-in-difference (DiD) strategy that adds 12 months of pre-treatment data (Pt=0) and account-level fixed-effects (Equation 2). In this panel OLS model, controls for the average amount of water debt in the pre-treatment period (ω_i) are subsumed in the account-level fixed effects.

(2) $Y_{it} = \alpha + \gamma T_{i,l} \times P_t + \beta X_{it} + \tau_t + \epsilon_{it}; \quad \forall P_t = \{0,1\}$

We also estimate conditional average treatment effects (CATE) in the DiD model to examine heterogeneity in treatment (Equation 3). We interact the treatment effect with deciles (*D*) of account arrears (averaged over the 12 months of pre-treatment). Recall that randomization was conditioned on these same deciles, so our CATEs have a causal interpretation.

(3) $Y_{it} = \alpha + \theta_d \sum_{d=1}^{10} P_t \times D_d + \sum_{d=1}^{10} T_{i,l} \times P_t \times D_d + \beta X_{it} + \tau_t + \epsilon_{it}; \quad \forall P_t = \{0,1\}$

Our main results are intent-to-treat (ITT) and do not model whether text messages were undelivered to the recipient. Because we did not send SMS messages to the control group during the study period, we did not observe monthly deliverable status in the control group. We sent a message to all accounts in May 2024, after treatment had ended. Delivery status was unrelated to whether a household was assigned to the treatment or control group, as expected. We discuss treatment-on-the-treated (ToT) models as a robustness check below.

5. Results

5.1 Balance and Summary Statistics

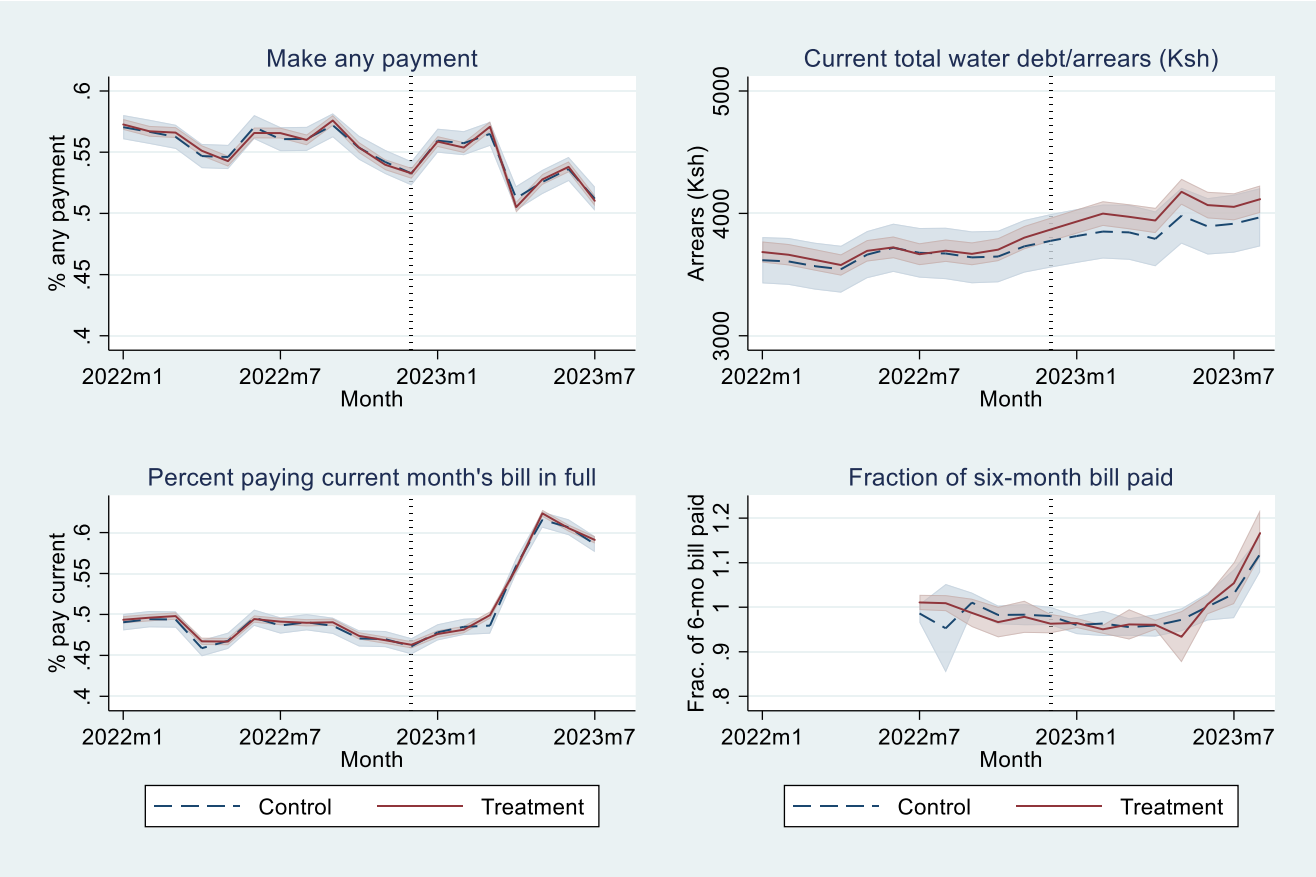
Randomization was successful. This is visually evident in the pre-treatment period in Figure 1, which pools all five SMS messages. It is also visually apparent for each of the five SMS treatments in Supplementary Information (SI) Figure A1. We confirmed this with a test of difference of means in the balance table (SI Table A1) and by regressing our outcome measures on treatment during

[5] The fourth measure – the percent of the total water charges incurred over six months that were paid over the same six months – is by construction an aggregate measure that cannot be analyzed at a monthly scale in a difference-in-difference framework.

the 12 months before treatment and with monthly fixed effects, either pooling treatments (SI Table A2) or by SMS treatment arm (SI Table A3).

During the six months prior to treatment, customers used an average of 17-18 cubic meters of water per month (Table A1). This average is skewed by a right tail of larger water users; median water use is 9 m^3. Only half of customers pay their "current" bill: the amount covering the prior month's charges but not including balances or debts/arrears. Forty-three percent make no payment at all. The average customer owes a debt to the NCWSC of approximately 3650 Ksh (~US$34), though this is again driven by accounts with large debts. The median debt is negligible (9 Ksh), and in fact approximately one quarter of customers have a credit on their accounts. This is also apparent in our fourth outcome measure: the percent of the total bill for six months paid during those six months. Calculated over the six months before treatment, this measure is very close to 100%, on average. In summary, although a significant fraction of customers owe large water debts to the utility, the average customer is choosing to either periodically overpay their bill and then skip payments while the credit is run down, or skip paying their bills for several months until the overdue amount reaches a high enough level that they decide to pay. We return to this point below in discussing the policy implications of our experimental results.

Figure 1. Bill payment outcome measures January 2022 to July 2023



Notes: Vertical dotted line indicates the first month that SMS messages were sent. 95% confidence intervals shown for the control group (blue) and pooled treatment (red). 1 US $~108 Ksh during this time.

5.2 Intent-to-treat results

Pooling the five SMS treatments, we find no statistically significant effect on two payment behaviors: paying any amount or paying the current month's bill (Table 2, Panels A and B). In each panel of Table 2, Models 1 and 2 present the results from the model using only data from the post-treatment period (Equation 1) without (Model 1) and with controls for pre-treatment average arrears and lagged water consumption (Model 2). Average treatment effects (intent-to-treat) are therefore the coefficient for "Any SMS". Model 3 shows results from the panel OLS difference-in-difference model without and with lagged consumption as a control, where average treatment effects are "AnySMS*post".

We do, however, find a perverse impact on total arrears (Table 2, Panel C): receiving any SMS increases total arrears by Ksh 104, or 5% of the average arrears in the control group. This average treatment effect is, however, only statistically significant at the 90% level in three models. It is significant at the 95% in the DiD model with controls for consumption. Using the logarithm of arrears as our outcome measure, we see similar results (SI Table A4): receiving an SMS increased arrears 5-7% in Models 1 and 2 using post-treatment data only, and 3.5 - 3.8% in Models 3 and 4 that use a DiD approach with the full set of pretreatment data.

We also find no impact of receiving any SMS on the percentage of their total bill over the six months of treatment that customers paid. A simple t-test of difference in means in the post-treatment period shows no significant difference (1.03 in the control group vs. 1.05 in the treatment group, t=-0.43). An OLS model with a control for the percentage paid over the 6 months prior to treatment also shows no statistically significant treatment effect of the pooled treatment (SI Table A5).

Panel A: Dependent variable = Making any payment that month

	(1)	(2)	(3)	(4)
Any SMS	-0.00049	0.00011	0.00075	0.00055
	(-0.13)	(0.03)	(0.20)	(0.15)
Pre-trt arrears(Ksh)		-0.000012***		
		(-47.93)		
L.Consumption (m3)		0.00010		0.000042
		(1.09)		(1.14)
Any SMS*post			-0.0012	-0.00092
			(-0.48)	(-0.37)
post			-0.060***	-0.027***
			(-18.96)	(-8.59)
Constant	0.55***	0.60***	0.57***	0.56***
	(144.20)	(142.75)	(154.97)	(150.13)
Observations	355,065	354,864	1,120,622	1,059,737
R-sq	0.0021	0.057		
R-sq overall			0.0016	0.0026
Month FEs	Yes	Yes	Yes	Yes
DiD, Account FEs	No	No	Yes	Yes

Panel B: Dependent variable = Paying current bill in full

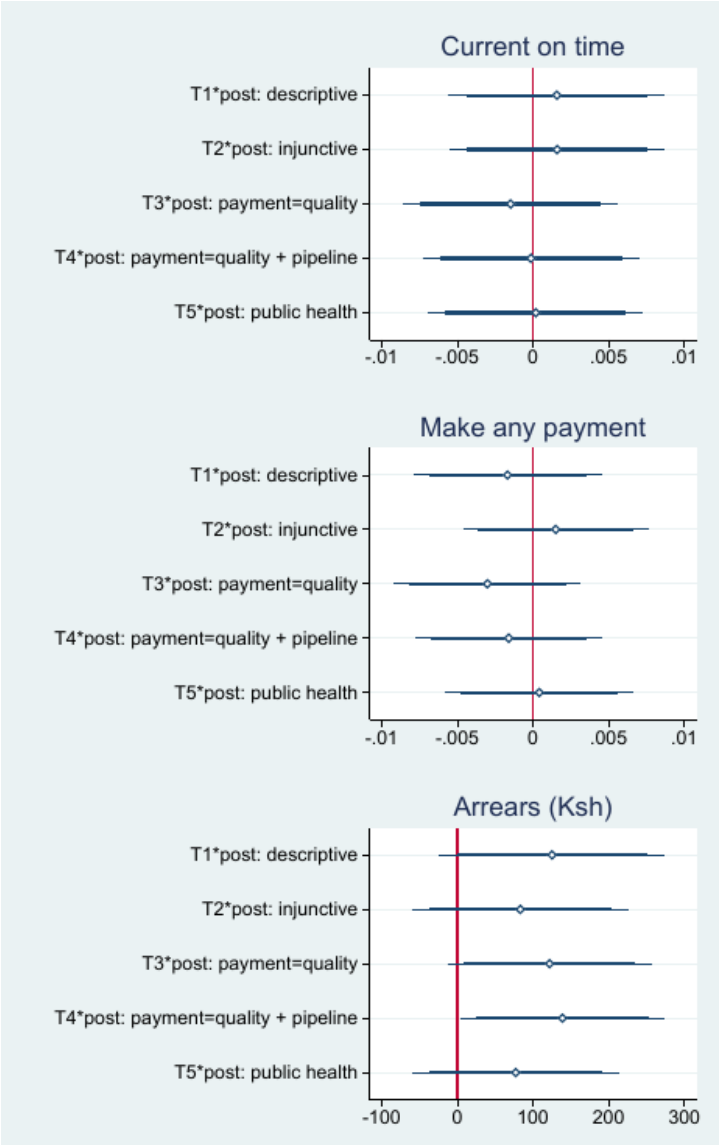
	(1)	(2)	(3)	(4)
Any SMS	0.0030	0.0033	0.0022	0.0021
	(0.99)	(1.12)	(0.70)	(0.65)
Pre-trt arrears(Ksh)		-0.0000054***		
		(-33.70)		
L.Consumption (m3)		0.000022		0.000036
		(0.93)		(1.13)
Any SMS*post			0.00018	0.00040
			(0.06)	(0.14)
post			0.097***	0.094***
			(27.04)	(26.13)
Constant	0.48***	0.50***	0.49***	0.49***
	(146.79)	(149.95)	(145.45)	(143.20)
Observations	355,065	354,864	1,120,622	1,059,737
R-sq	0.011	0.022		
R-sq overall			0.0091	0.010
Month FEs	Yes	Yes	Yes	Yes
DiD, Account FEs	No	No	Yes	Yes

Panel C: Dependent variable = Total water debt/arrears (Ksh)

	(1)	(2)	(3)	(4)
Any SMS	155.2	109.4*	48.1	44.3
	(1.24)	(1.88)	(0.45)	(0.41)
Pre-trt arrears(Ksh)		1.05***		
		(70.94)		
L.Consumption (m3)		0.92		1.16
		(1.13)		(1.13)
Any SMS*post			104.0*	108.7**
			(1.87)	(2.01)
post			304.0***	296.3***
			(5.30)	(5.18)
Constant	3844.8***	17.5	3608.4***	3584.2***
	(33.91)	(0.23)	(37.27)	(35.86)
Observations	355,065	354,864	1,120,622	1,059,737
R-sq	0.000063	0.72		
R-sq overall			0.00024	0.00036
Month FEs	Yes	Yes	Yes	Yes
DiD, Account FEs	No	No	Yes	Yes

Table 2. Average treatment effects (ITT), pooling treatments

Figure 2. Average treatment effects (ITT) (Jan 2022 – July 2023): by SMS message



Notes: 90% confidence intervals (thin lines) and 95% confidence intervals (thick lines) displayed

Figure 2 displays the estimated average treatment effect of each of the five separate messages, using the DiD specification with a control for lagged consumption (Equation 2)[6]. None of the treatment messages had a statistically significant impact on paying anything or paying in full. The

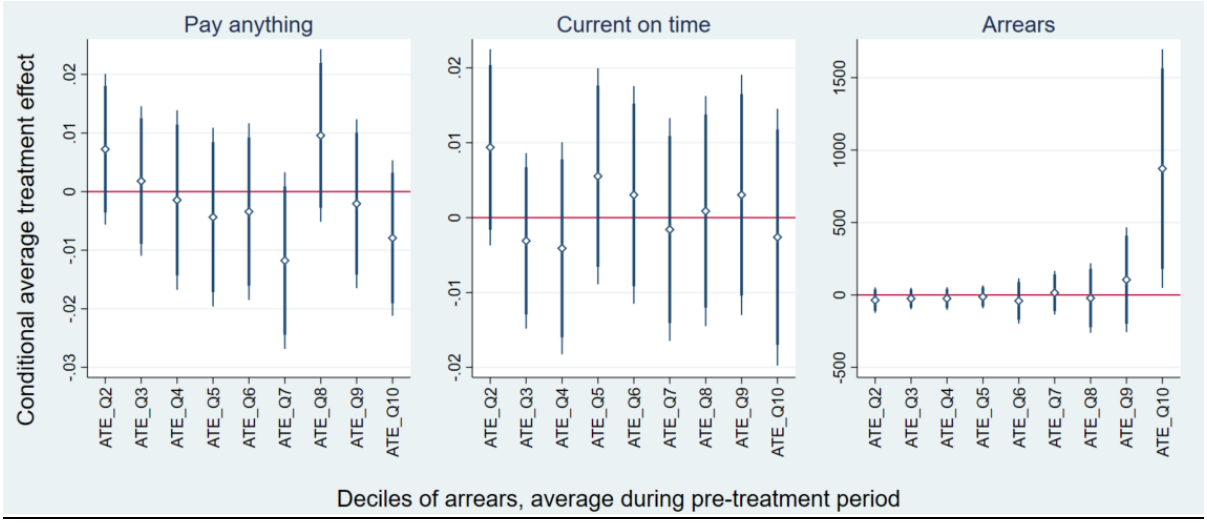
[6] Full model results are shown in SI Table A6.

positive and significant ATE in the pooled results for arrears (Table 2) are driven by treatments 1 (descriptive norm), 3 (service quality) and 4 (service quality + financial information), though the effects are similar in each. Only the third message (service quality) has a detectable effect on the percentage of the six-month bill paid: it also has a perverse effect of reducing the percentage paid by 10.6% (SI Table A7). We also find no detectable pattern in average treatment effects by month of treatment (SI Table A8 and A9).

5.3 Treatment heterogeneity

We explore treatment heterogeneity by decile of average pre-treatment water debt. Note that the first two deciles had negative water debts (i.e., account credits) in the pre-treatment period. Treatment effects are not visible from the paths of the four outcome variables diverging after treatment (SI Figures A2-A5) Figure 3 plots the 90% and 95% confidence intervals of the conditional average treatment effects. (Full model results are given in SI Table A10). We find no treatment heterogeneity for paying anything or paying on time (Figure 3). We do, however, find that the positive and significant effect of treatment on arrears is driven by the top decile – the accounts with the largest water debts at baseline.

Figure 3. Conditional average treatment effects of receiving any letter on three outcomes, by decile of pretreatment water debt/arrears.



Notes: 90% confidence intervals (thin lines) and 95% confidence intervals (thick lines) displayed

5.4 Treatment on the treated

The above analysis does not account for whether the messages were successfully delivered to customers. The bulk SMS service we used to send the information treatments to customers reports whether messages were successfully delivered or not. Messages may not reach users because a number has been disconnected, a network/delivery failure or because a user has a number registered on a "do not contact" list[7]. Overall, 62% of customers in the treatment groups had all the messages delivered during the treatment period. Nine percent had no messages successfully delivered and 29% has some messages delivered but not all. Recalling that we sent messages using the same contact information as used by NCWSC for bill and that NCWSC's billing is completely

[7] Referred to as "UserinBlackList". This occurs if the user has opted out of receiving messages either from the particular sender ID or by blocking all messages when they dial the opt out code.

paperless[8], it is unsurprising that we find that accounts where the SMS bounced had worse payment behaviors during the pre-treatment period (SI Tables A11, A12 and A13).

This should not, however, affect the interpretation of our intent-to-treat (ITT) experimental results unless by chance the SMS delivery rates differed between the treatment and control groups. Because we sent no messages to the control group during the experiment and do not have access to the SMS delivery status that NCWSC achieved with their monthly billing in the pretreatment period, we cannot directly observe this. In May 2024, however, we pinged all the accounts in the experiment, including the control group. Overall, 63.02% of messages to control group accounts were successfully delivered (n=9,327), compared to 63.71% of all messages to treatment group accounts (n=46,166). This difference is not statistically significant (t = -1.26), and we are confident that differences in SMS delivery status did not contaminate our ITT results above.

We approximate a treatment-on-the-treated analysis by re-estimating the difference-in-difference models above (Eq 2) but dropping all data from accounts where the SMS was undelivered in May 2024. This drops 37.0% of observations in the control group and 36.3% of observations in the treatment group. We find no average treatment effects of the pooled messages on our preferred DiD specification (Eq 2), and the perverse effect on arrears is no longer statistically significant (SI Table A14). The pattern of results by individual treatment message (SI Table A15) is also similar with one exception: the third message (payment=quality) had a small but statistically significant negative impact on whether the accountholder made any payment[9]. The pattern of treatment heterogeneity is similar except that we no longer observe the perverse effect on arrears among those in the top decile of pre-treatment arrears (SI Figure A6).

[8] Over 95% of customers receive bills via SMS. The remainder receive bills by email.

[9] A t-test of mean differences in the percentage of the six-month bill during the treatment period also shows no effect of pooled treatment after dropping accounts that did not receive the test SMS message in May 2024 (t =-0.65).

6. Discussion and Conclusion

Ensuring customers pay their bills on time and in full is an essential component to getting utilities in the Global South on the path to financial sustainability. This revenue provides the critical foundation to financing the infrastructure transition that will be required to ensure universal access to high-quality, reliable water, sanitation and energy services. While the magnitude of the global utility bill payment and arrears challenges are not known, there is emerging evidence that the Global South may be experiencing a quiet crisis in utility bill payment. This problem may be especially acute in the water and sanitation sector where pre-paid technologies have not yet proven to be technologically or financially feasible and there are stronger beliefs about the government's responsibility to provide access to water and sanitation services for all.

Our study tests a potentially low-cost method of improving customer bill payment that may be attractive to many utilities as they increasingly transition to electronic billing and payments. Our results suggest that, overall, sending messages to customers to encourage bill payment was not effective at improving bill payment behavior in Nairobi. The average treatment effect on paying anything or paying their current bill were not statistically different from zero, despite relatively large sample sizes. We also do not observe significant differences among the five different messages. Descriptive norms, injunctive norms, appeals to public health, and appeals to service quality were all equally ineffective at improving payment behavior on average. This may suggest that customers are inattentive to the content of text messages due to message saturation or that text messages are simply not an effective means of improving customer bill payment (Bahety et al., 2021).

We do, however, find that total arrears accumulated over the prior six months was slightly higher among those who received a text message than those who did not. This result was driven by those in our sample with the highest pre-treatment arrears. It is possible that the messages reminded these customers how far in debt they were and made them "give up" making any payments, or inadvertently reinforced their "self-concept" as a non-payer (Rockenbach et al. 2023). It may have also reminded them that despite their large water debts they were still receiving service and that the threat of disconnection was very weak. Due to ethical concerns, we did not include an information treatment focused on this threat. Despite the decreasing political appetite for

disconnections globally, it may be that the threat of disconnection is the strongest policy tool at utilities' disposal for encouraging this group of customers to pay their bills. This is an empirical question that requires further study.

In addition to our main experimental results, our study provides two additional policy relevant insights. First, our treatment on the treated analysis highlights that customers who do not reliably receive messages, or receive messages at all, were less likely to pay their bills and had higher arrears pre-treatment. While not surprising, this underscores the importance of utilities maintaining accurate administrative records and alternative means of contacting customers as the trend towards electronic billing and payment accelerates globally.

Second, we find that while customer payment behavior may appear to be problematic at a single point in time, on net most customers generally pay their bills over time. Some customers maintain credits on their accounts, some accumulate debts and make periodic payments, and some make fixed payments each month carrying credits some time and debts others. Others, however, are chronically in debt. Additional work is needed to better understand customer bill payment behavior in a dynamic context and which behaviors are the greatest threats to the financial health of utilities.

A stable revenue stream is the foundation for sustainable utility finance. To deliver on the global ambition of providing safe and affordable water and sanitation services for all, policy makers and utilities will need to implement a range of measures to ensure customers pay their bills. There has been limited research to date on what works, where, and under what circumstances in promoting customer bill payment. More research implemented in close partnership with utilities is needed to better understand the myriad reasons customers may not pay their utility bills on time and policy interventions to encourage – and enable – them to do so.

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Supplementary Tables and Figures for ”Improving payment for essential services...”

Authors omitted for blind review[1]

[1]*N/A*

September 2024

1 Balance in the pre-treatment period

Table A1: Outcome measures during pre-treatment period (Jan - November 2022): pooling treatment

	(1)	(2)	(3)
Variable	Control	Any SMS treatment	Difference
Consumption (m3)	17.44	17.73	0.29
	(31.80)	(43.02)	(0.351)
Water debt/arrears (Ksh)	3644.80	3681.87	37.07
	(10124.84)	(10138.20)	(0.727)
Paid current bill due	0.48	0.48	0.00
	(0.50)	(0.50)	(0.479)
Made any payment	0.56	0.56	0.00
	(0.50)	(0.50)	(0.837)
Percent of 6-mo bill paid	0.98	0.99	0.01
	(2.45)	(3.25)	(0.672)
Observations	107,770	539,186	646,956

Notes: Standard errors clustered at the account level.

Table A2: Falsification test for balance: OLS regression of any treatment on outcomes during pre-treatment period (Jan - November 2022)

	(1)	(2)	(3)	(4)
	Current on time	Arrears (Ksh)	Pay anything	Percent 6 mo bill paid
Any SMS	0.0022	41.7	0.00070	-0.017
	(0.0032)	(106.7)	(0.0037)	(0.015)
Constant	0.49***	3638.5***	0.57***	0.98***
	(0.0034)	(97.4)	(0.0037)	(0.010)
Observations	706,275	706,275	706,275	58,411
Month FEs	Yes	Yes	Yes	Yes

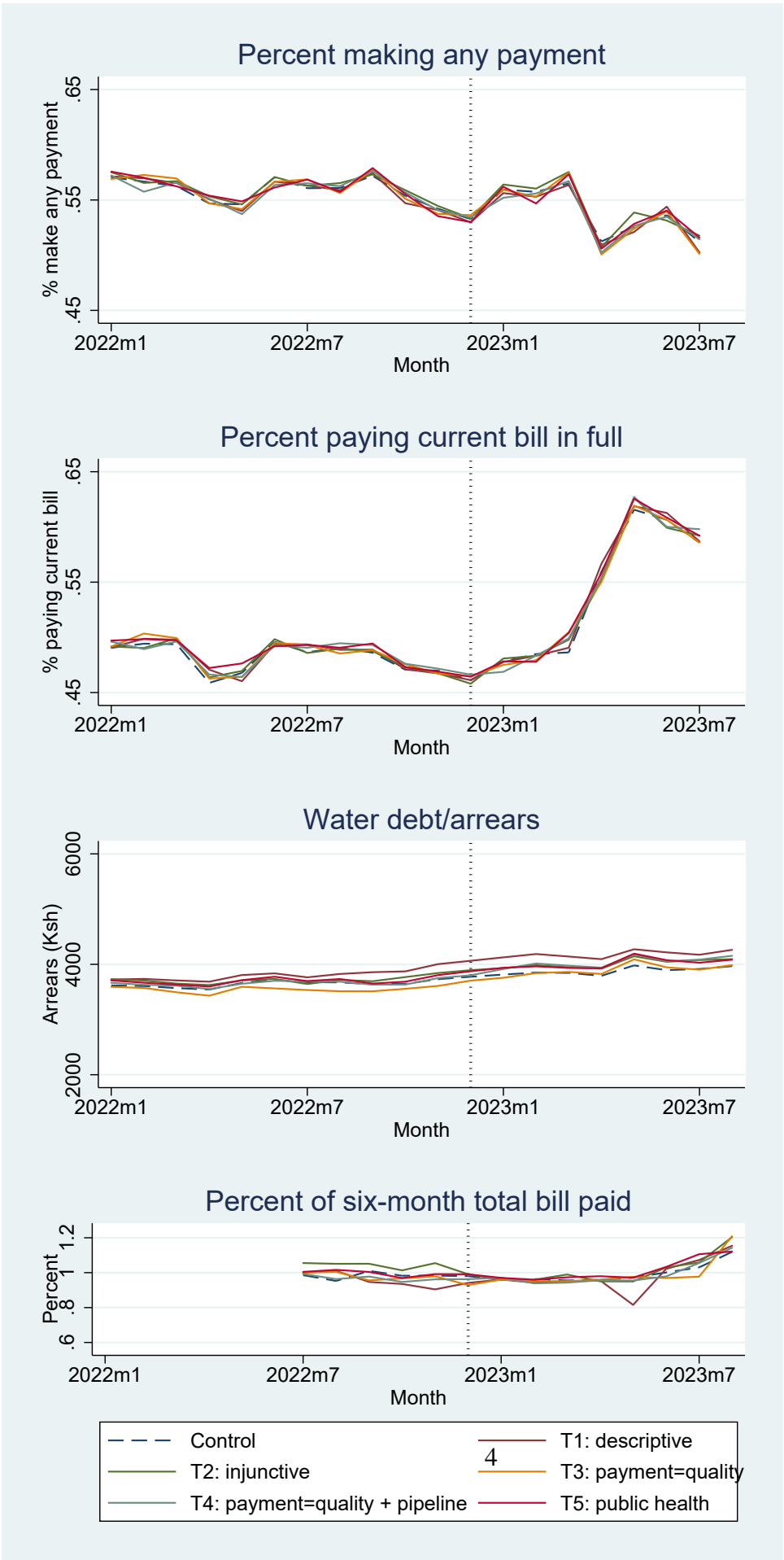
Notes: Robust standard errors clustered at the account level

Table A3: Falsification test for balance: OLS regression of treatment on outcomes during pre-treatment period (Jan - November 2022), by SMS treatment

	(1) Current on time	(2) Arrears (Ksh)	(3) Pay anything	(4) Percent 6 mo bill paid
T1: descriptive	0.0014	168.8	-0.00063	-0.039
	(0.0041)	(140.8)	(0.0047)	(0.037)
T2: injunctive	0.00072	71.1	0.0026	0.011
	(0.0041)	(137.5)	(0.0047)	(0.016)
T3: payment=quality	0.0021	-99.1	0.00066	-0.051
	(0.0041)	(134.1)	(0.0047)	(0.040)
T4: payment=quality + pipeline	0.0026	11.5	-0.00014	-0.017
	(0.0041)	(136.0)	(0.0047)	(0.014)
T5: public health	0.0043	56.5	0.0010	0.011
	(0.0041)	(138.5)	(0.0047)	(0.015)
Constant	0.49***	3638.5***	0.57***	0.98***
	(0.0034)	(97.4)	(0.0037)	(0.010)
Observations	706,275	706,275	706,275	58,411
Month FEs	Yes	Yes	Yes	Yes

Notes: Robust standard errors clustered at the account level

Figure A1: Bill payment outcome measures, by treatment message



2 Additional model specifications

Table A4: Average treatment effects (ITT), pooling treatments, dependent variable = **log(arrears)**

	(1)	(2)	(3)	(4)
Any SMS	0.070*	0.054*	0.0089	0.012
	(1.87)	(1.72)	(0.27)	(0.37)
Pre-trt arrears(Ksh)		0.00013***		
		(100.16)		
L.Consumption (m3)		-0.0018***		0.0011***
		(-3.18)		(3.64)
Any SMS*post			0.038*	0.035*
			(1.92)	(1.78)
post			0.042*	0.094***
			(1.77)	(3.94)
Constant	6.90***	6.12***	6.14***	6.07***
	(193.42)	(186.53)	(195.16)	(187.87)
Observations	195,943	195,815	626,801	592,954
R-sq	0.00029	0.22		
R-sq overall			0.00040	0.000049
Month FEs	Yes	Yes	Yes	Yes
DiD, Account FEs	No	No	Yes	Yes

Notes: = 90%, **=95%, ***=99%.*

Table A5: Average treatment effects (ITT), pooling treatments, dependent variable = **Percent of 6-mo bill paid**

	(1) Percent 6-mo bill paid
Any SMS	0.0000
	(0.00)
Percent 6-mo paid pre-trt	0.0123
	(1.37)
Constant	1.0391***
	(20.50)
Observations	57,992
R-sq	0.000032
Month FEs	No
DiD, Account FEs	No

Notes: = 90%, **=95%, ***=99%.*

Table A6: Difference-in-difference (Jan 2022 - July 2023): By information treatment

	(1)	(2)	(3)
	Made any payment	Paid current bill due	Water debt/arrears (Ksh)
T1*post: descriptive	-0.0018	0.0015	119.8731
	(-0.58)	(0.42)	(1.57)
T2*post: injunctive	0.0015	0.0017	83.2357
	(0.47)	(0.47)	(1.13)
T3*post: payment=quality	-0.0030	-0.0014	121.1970*
	(-0.95)	(-0.39)	(1.74)
T4*post: payment=quality + pipeline	-0.0016	-0.0000	142.8292**
	(-0.50)	(-0.01)	(2.04)
T5*post: public health	0.0004	0.0002	76.3044
	(0.12)	(0.05)	(1.09)
post	-0.0270***	0.0945***	296.3351***
	(-8.59)	(26.13)	(5.18)
T1: descriptive	-0.0007	0.0015	179.8762
	(-0.16)	(0.36)	(1.27)
T2: injunctive	0.0025	0.0006	66.2045
	(0.52)	(0.14)	(0.48)
T3: payment=quality	0.0006	0.0021	-93.3065
	(0.13)	(0.50)	(-0.69)
T4: payment=quality + pipeline	-0.0002	0.0024	11.6659
	(-0.05)	(0.57)	(0.09)
T5: public health	0.0006	0.0040	56.9283
	(0.13)	(0.96)	(0.41)
L.Consumption (m3)	0.0000	0.0000	1.1587
	(1.14)	(1.13)	(1.13)
Observations	1,059,737	1,059,737	1,059,737
R-sq overall	0.0026	0.010	0.00042
Month FEs	Yes	Yes	Yes
DiD, Account FEs	Yes	Yes	Yes

Notes: = 90%, **=95%, ***=99%.*

Table A7: Average treatment effects (ITT), by information treatment, dependent variable = **Percent of 6-mo bill paid**

	(1) Percent 6-mo bill paid	(2) Percent 6-mo bill paid	(3) Percent 6-mo bill paid	(4) Percent 6-mo bill paid	(5) Percent 6-mo bill paid
T1: descriptive	0.0294				
	(0.54)				
Percent of 6-mo bill paid	0.0123	0.0123	0.0122	0.0123	0.0122
	(1.37)	(1.37)	(1.36)	(1.37)	(1.36)
T2: injunctive		0.0041			
		(0.08)			
T3: payment=quality			-0.1069*		
			(-1.96)		
T4: payment=quality + pipeline				0.0026	
				(0.05)	
T5: public health					0.0708
					(1.30)
Constant	1.0342***	1.0385***	1.0571***	1.0387***	1.0274***
	(43.16)	(43.40)	(44.10)	(43.36)	(42.92)
Observations	57,992	57,992	57,992	57,992	57,992
R-sq	0.000037	0.000032	0.000098	0.000032	0.000061
Month FEs	No	No	No	No	No
DiD, Account FEs	No	No	No	No	No

Notes: = 90%, **=95%, ***=99%.*

3 Time-varying treatment effects

Table A8: Time-varying treatment effects, pooling all treatments, post-treatment period only

	(1) Pay anything	(2) Current on time	(3) Arrears (Ksh)
Any SMS=1 × Month=757	-0.0030	-0.0032	98.0*
	(-0.57)	(-0.59)	(1.82)
Any SMS=1 × Month=758	0.0065	0.013**	83.5
	(1.24)	(2.44)	(1.40)
Any SMS=1 × Month=759	-0.0066	-0.0029	106.5*
	(-1.23)	(-0.52)	(1.77)
Any SMS=1 × Month=760	0.0026	0.0081	151.6**
	(0.48)	(1.51)	(2.33)
Any SMS=1 × Month=761	0.0023	-0.00072	124.2*
	(0.42)	(-0.13)	(1.80)
Any SMS=1 × Month=762	-0.0012	0.0055	92.6
	(-0.22)	(1.02)	(1.25)
Pre-trt arrears(Ksh)	-0.000012***	-0.0000054***	1.05***
	(-47.93)	(-33.70)	(70.94)
L.Consumption (m3)	0.00010	0.000022	0.92
	(1.09)	(0.93)	(1.13)
Observations	354,864	354,864	354,864
R-sq	0.057	0.022	0.72
Month FEs	Yes	Yes	Yes
DiD, Account FEs	No	No	No

Notes: = 90%, **=95%, ***=99%.*

Table A9: Time-varying treatment: Difference-in-difference (Jan 2022 - January 2023): time-varying treatment effects, pooling all treatments

	(1) Pay anything	(2) Current on time	(3) Arrears (Ksh)
Any SMS=1 × Month=745	-0.0027	-0.0038	-160.1
	(-0.43)	(-0.51)	(-0.01)
Any SMS=1 × Month=746	0	-0.0010	-155.8
	(.)	(-0.13)	(-0.01)
Any SMS=1 × Month=747	0.0011	0.0033	-186.7
	(0.18)	(0.46)	(-0.02)
Any SMS=1 × Month=748	-0.0071	-0.0066	-183.3
	(-1.19)	(-0.90)	(-0.02)
Any SMS=1 × Month=749	-0.0091	-0.0073	-193.2
	(-1.54)	(-0.99)	(-0.02)
Any SMS=1 × Month=750	0.0011	-0.00077	-227.5
	(0.19)	(-0.11)	(-0.02)
Any SMS=1 × Month=751	-0.0049	-0.0063	-195.4
	(-0.82)	(-0.85)	(-0.02)
Any SMS=1 × Month=752	-0.000012	-0.0018	-191.3
	(-0.00)	(-0.25)	(-0.02)
Any SMS=1 × Month=753	-0.0035	-0.0022	-160.7
	(-0.58)	(-0.30)	(-0.02)
Any SMS=1 × Month=754	-0.0058	-0.0067	-152.6
	(-0.96)	(-0.92)	(-0.02)
Any SMS=1 × Month=755	-0.0033	-0.0034	-134.4
	(-0.54)	(-0.46)	(-0.01)
Any SMS=1 × Month=756	-0.0041	-0.0072	-102.6
	(-0.67)	(-1.00)	(-0.01)
Any SMS=1 × Month=757	-0.0071	-0.0088	-73.4
	(-1.14)	(-1.22)	(-0.01)
Any SMS=1 × Month=758	0.0024	0.0077	-89.6
	(0.38)	(1.07)	(-0.01)
Any SMS=1 × Month=759	-0.011*	-0.0084	-65.6
	(-1.71)	(-1.29)	(-0.01)
Any SMS=1 × Month=760	-0.0015	0.0025	-18.3
	(-0.24)	(0.39)	(-0.00)
Any SMS=1 × Month=761	-0.0018	-0.0062	-46.4
	(-0.29)	(-0.91)	(-0.00)
Any SMS=1 × Month=762	-0.0054	0	-78.0
	(-0.85)	(.)	(-0.01)
Any SMS=1 × Month=763	0		0
	(.)		(.)
L.Consumption (m3)	0.000042	0.000036	1.16
	(1.14)	(1.13)	(1.13)
Observations	1,059,737	1,059,737	1,059,737
R-sq overall	0.0026	0.010	0.00037
Month FEs	Yes	Yes	Yes
DiD, Account FEs	Yes	Yes	Yes

Notes: Treatment begins in month 757

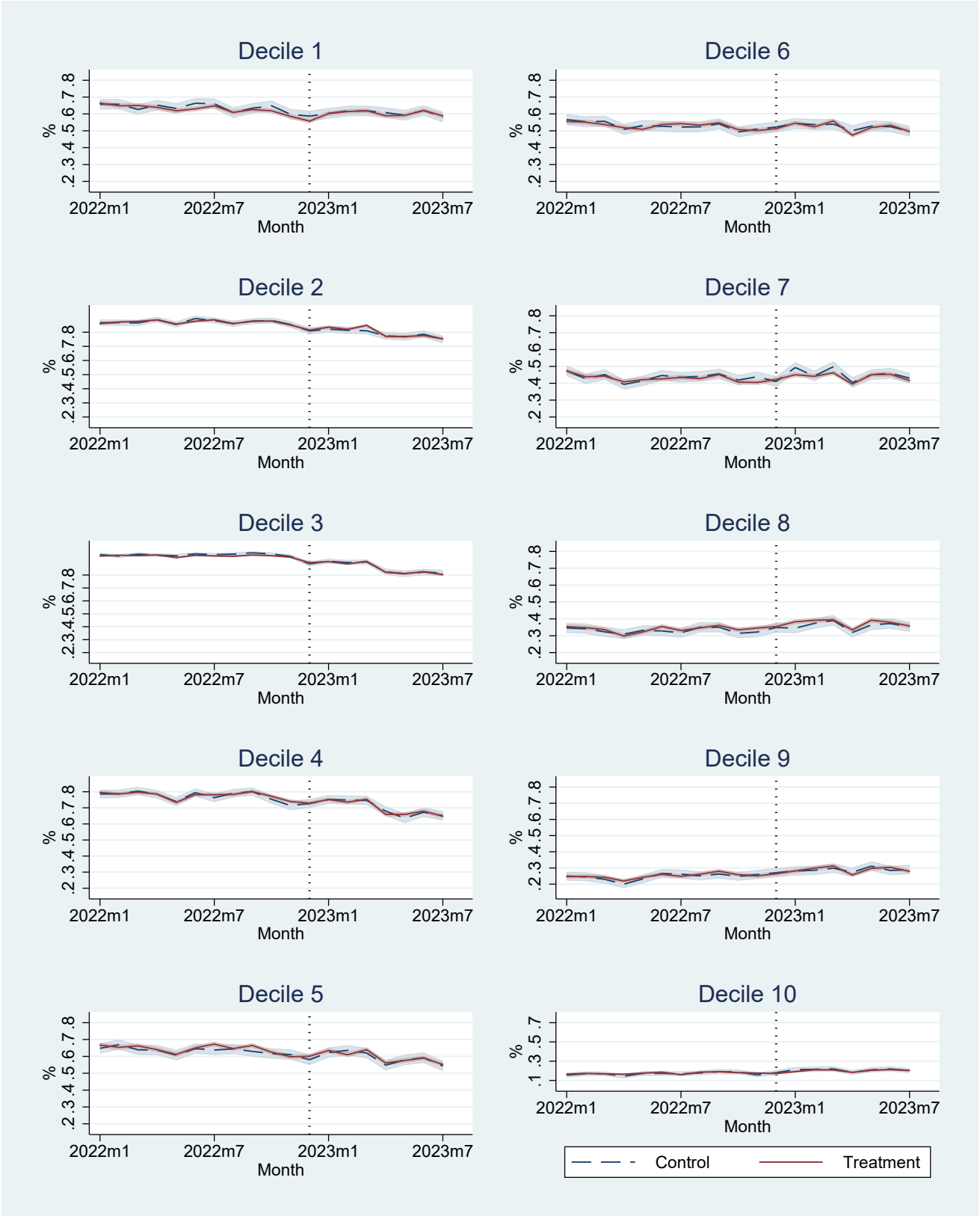
4 Treatment heterogeneity

Table A10: Treatment heterogeneity: Conditional average treatment effects

	(1)	(2)	(3)
	Made any payment	Paid current bill due	Water debt/arrears (Ksh)
ATE_Q2	0.0070	0.0091	-45.9
	(1.05)	(1.37)	(-0.96)
ATE_Q3	0.0033	-0.0015	-5.85
	(0.51)	(-0.25)	(-0.16)
ATE_Q4	-0.0020	-0.0045	-36.8
	(-0.26)	(-0.62)	(-0.90)
ATE_Q5	-0.0041	0.0057	-7.45
	(-0.53)	(0.78)	(-0.18)
ATE_Q6	-0.0033	0.0033	-36.1
	(-0.42)	(0.44)	(-0.44)
ATE_Q7	-0.012	-0.0017	13.9
	(-1.54)	(-0.23)	(0.18)
ATE_Q8	0.0096	0.0010	-14.9
	(1.26)	(0.13)	(-0.12)
ATE_Q9	-0.0029	0.0025	80.8
	(-0.38)	(0.31)	(0.43)
ATE_Q10	-0.0085	-0.0026	846.7**
	(-1.25)	(-0.30)	(2.00)
post_Q2	0.0032	0.051***	-5.13
	(0.46)	(7.62)	(-0.06)
post_Q3	0.0062	0.10***	-38.7
	(0.91)	(16.66)	(-0.50)
post_Q4	-0.014*	0.059***	14.9
	(-1.71)	(8.14)	(0.18)
post_Q5	-0.015**	0.023***	60.1
	(-1.97)	(3.16)	(0.75)
post_Q6	-0.0081	0.018**	239.6**
	(-1.04)	(2.40)	(2.31)
post_Q7	-0.0074	0.0086	332.1***
	(-0.96)	(1.15)	(3.35)
post_Q8	-0.027***	0.016**	532.6***
	(-3.62)	(2.04)	(3.99)
post_Q9	-0.036***	0.022***	602.5***
	(-4.85)	(2.71)	(3.34)
post_Q10	-0.061***	0.041***	1206.3***
	(-8.67)	(4.92)	(3.15)
L.Consumption (m3)	0.000065	0.000061	1.16
	(1.15)	(1.16)	(1.13)
Observations	1,059,737	1,059,737	1,059,737
R-sq overall	0.029	0.020	0.17
Month FEs	Yes	Yes	Yes
DiD, Account FEs	Yes	Yes	Yes

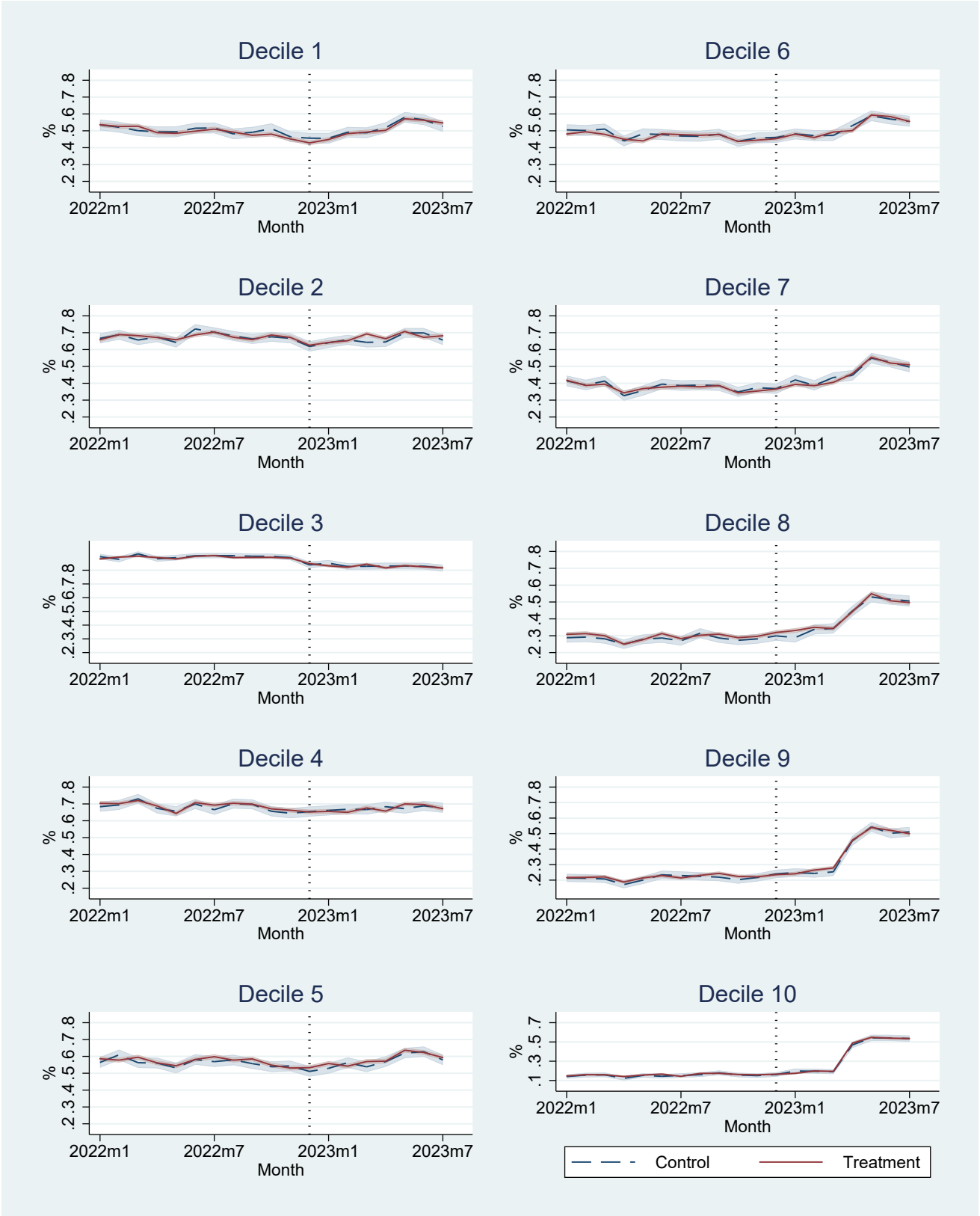
Notes: Robust standard errors clustered at the account level

Figure A2: Percent making **any payment**, pooling treatment, by deciles of pre-treatment arrears



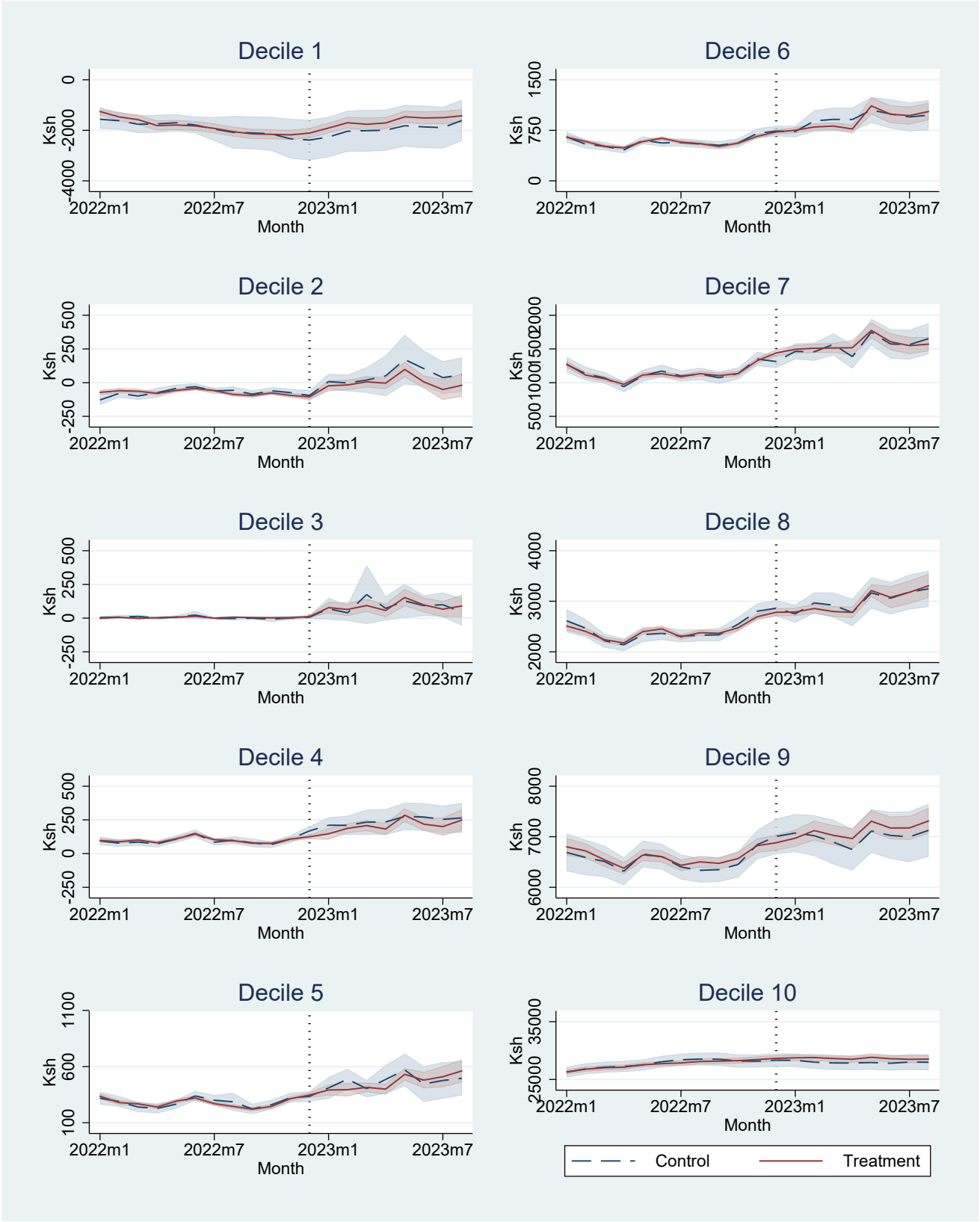
Notes: 95% confidence intervals shown in red (treatment) and blue (control) areas

Figure A3: Percent **paying current bill in full**, pooling treatment, by deciles of pre-treatment arrears



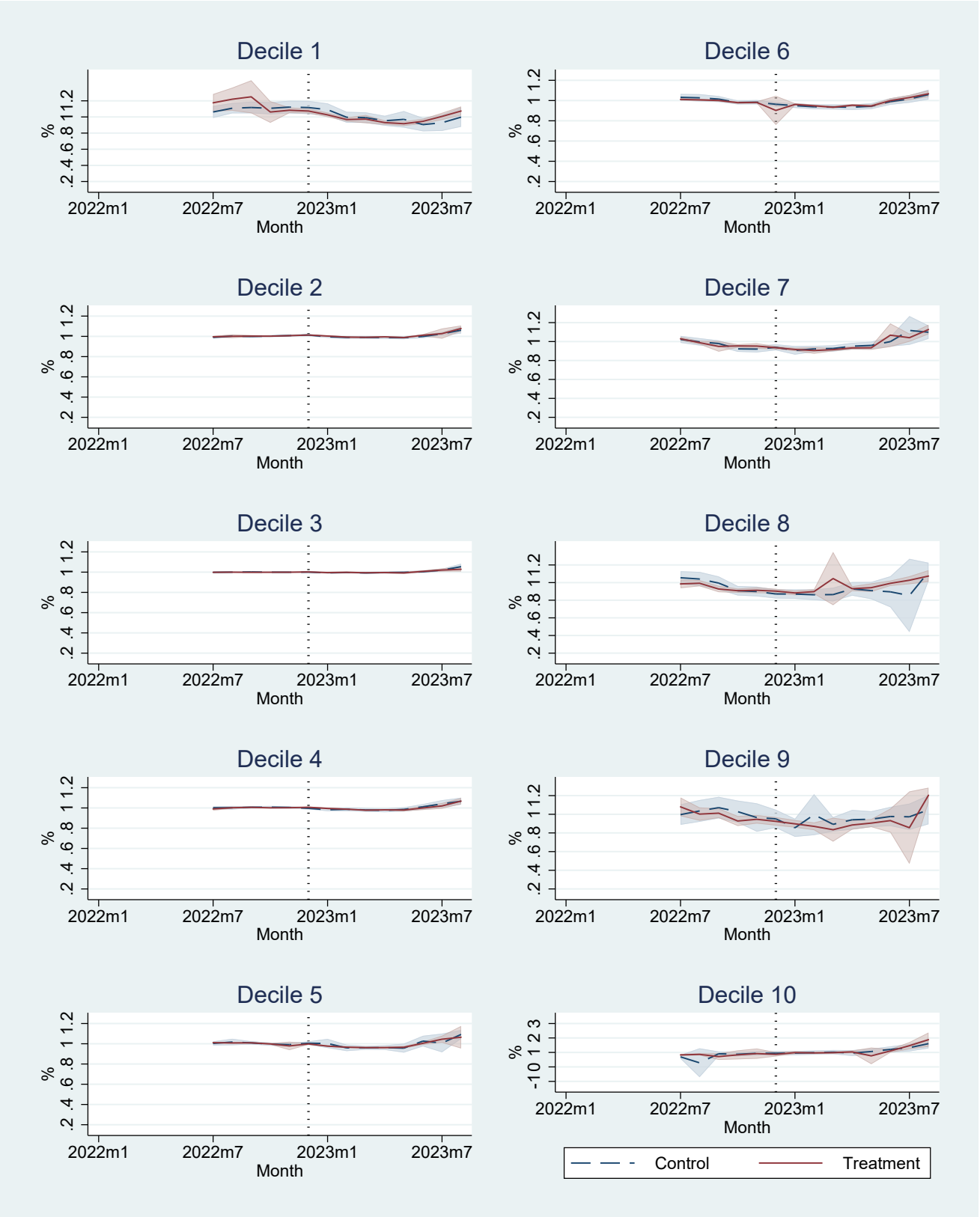
Notes: 95% confidence intervals shown in red (treatment) and blue (control) areas

Figure A4: Total arrears (Ksh), pooling treatment, by deciles of pre-treatment arrears



Notes: 95% confidence intervals shown in red (treatment) and blue (control) areas

Figure A5: Fraction of six-month bill paid (rolling average), pooling treatment, by deciles of pre-treatment arrears



Notes: 95% confidence intervals shown in red (treatment) and blue (control) areas

5 Message delivery and treatment on the treated

Table A11: Difference between group who had all SMS delivered vs. some or none delivered, by outcome, during the pre-treatment period

	(1)	(2)	(3)
	Paid current bill due	Water debt/arrears (Ksh)	Made any payment
alldelivered	0.014***	5.15	0.017***
	(0.0036)	(123.3)	(0.0041)
Constant	0.49***	3672.7***	0.57***
	(0.0021)	(42.6)	(0.0021)
Observations	646,956	646,956	646,956
Month FEs	Yes	Yes	Yes

Notes: = 90%, **=95%, ***=99%.*

Table A12: Difference between group who had no SMS delivered vs. some or all delivered, by outcome, during the pre-treatment period

	(1)	(2)	(3)
	Paid current bill due	Water debt/arrears (Ksh)	Made any payment
nonedelivered	-0.026***	494.2***	-0.030***
	(0.0029)	(97.6)	(0.0033)
Constant	0.50***	3562.5***	0.58***
	(0.0022)	(44.5)	(0.0022)
Observations	646,956	646,956	646,956
Month FEs	Yes	Yes	Yes

Notes: * = 90%, **=95%, ***=99%.

Table A13: Difference in outcomes, by percent of messages delivered, during the pre-treatment period

	(1)	(2)	(3)
	Paid current bill due	Water debt/arrears (Ksh)	Made any payment
Percent of SMS delivered	0.041***	-711.3***	0.050***
	(0.0034)	(113.3)	(0.0039)
Constant	0.47***	4095.1***	0.54***
	(0.0030)	(81.2)	(0.0032)
Observations	539,100	539,100	539,100
Month FEs	Yes	Yes	Yes

Notes:* = 90%, **=95%, ***=99%.

Table A14: Treatment on the treated, difference-in-difference (Jan 2022 - July 2023): pooling treatments

	(1)	(2)	(3)
	Made any payment	Paid current bill due	Water debt/arrears (Ksh)
Any SMS*post	-0.0045	-0.0055	22.1
	(0.0032)	(0.0036)	(64.7)
post	-0.052***	0.094***	321.1***
	(0.0041)	(0.0047)	(67.5)
Any SMS	0.0053	0.0056	59.9
	(0.0048)	(0.0042)	(129.6)
Constant	0.58***	0.50***	3309.0***
	(0.0048)	(0.0044)	(118.6)
Observations	629,030	629,030	629,030
R-sq overall	0.0022	0.0088	0.00031
Month FEs	Yes	Yes	Yes
DiD, Account FEs	Yes	Yes	Yes

Notes: Drops 36% and 37% of accounts in the treatment and control groups (respectively) that did not successfully receive a test SMS message sent in May 2024, after the experiment ended. * = 90%, **=95%, ***=99%.

Table A15: Treatment on the treated, difference-in-difference (Jan 2022 - July 2023): by information treatment

	(1)	(2)	(3)
	Made any payment	Paid current bill due	Water debt/arrears (Ksh)
T1*post: descriptive	-0.0037	-0.0040	-21.8
	(0.0041)	(0.0047)	(81.7)
T2*post: injunctive	-0.0016	-0.0054	-40.1
	(0.0041)	(0.0046)	(87.0)
T3*post: payment=quality	-0.011***	-0.0055	87.5
	(0.0041)	(0.0046)	(88.2)
T4*post: payment=quality + pipeline	-0.0046	-0.0069	57.3
	(0.0041)	(0.0047)	(85.4)
T5*post: public health	-0.0017	-0.0059	26.9
	(0.0041)	(0.0047)	(89.4)
post	-0.052***	0.094***	304.9***
	(0.0041)	(0.0047)	(68.7)
T1: descriptive	0.0062	0.0076	37.1
	(0.0061)	(0.0053)	(168.3)
T2: injunctive	0.011*	0.0069	43.3
	(0.0062)	(0.0054)	(168.5)
T3: payment=quality	0.0046	0.0053	-50.9
	(0.0061)	(0.0054)	(163.8)
T4: payment=quality + pipeline	0.0039	0.0054	19.6
	(0.0062)	(0.0054)	(169.2)
T5: public health	0.00093	0.0030	251.2
	(0.0062)	(0.0054)	(172.4)
Constant	0.58***	0.50***	3309.0***
	(0.0048)	(0.0044)	(118.6)
Observations	629030	629030	629030
FEs	Yes	Yes	Yes

Notes: Drops 36% and 37% of accounts in the treatment and control groups (respectively) that did not successfully receive a test SMS message sent in May 2024, after the experiment ended* = 90%, **=95%, ***=99%.

Figure A6: Treatment on the treated: CATEs, by decile of pre-treatment arrears