OPTIMAL TAX ADMINISTRATION WITH LIQUIDITY CONSTRAINTS[*]

PRE ANALYSIS PLAN

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Abstract

While public revenue is critically needed in low-income countries, the welfare cost of taxation may be particularly high due to income variability and limited access to savings technologies. This project explores whether tax authorities in such settings can increase tax compliance while minimizing welfare losses by adapting tax administration to the existence of binding liquidity constraints. In a randomized field experiment conducted in collaboration with the provincial tax authority of Kasaï Central, we explore three interventions seeking to relax liquidity constraints: (1) timing collector visits according to households' stated preferences; (2) making timing flexible by allowing households to pay in installments; and (3) making timing predictable (helping households plan and save up for tax payment) by informing them about upcoming visits. Although the development literature has demonstrated the importance of liquidity constraints in economic decision-making, this project will be the first to bring this insight into the public finance of developing countries and experimentally assess policy tools capable of relaxing these constraints.

1 Introduction

In low-income settings, liquidity constraints often bind: earnings and expenditures arrive at irregular intervals, and access to credit and savings vehicles is limited. Hence, when a large tax payment is due at a time when households are less liquid, it incurs higher welfare costs. At the same time, binding liquidity constraints can make tax compliance harder, reducing revenue collection. As such, allowing taxpayers to adjust the timing of tax payments to times when they have higher liquidity has the potential to raise compliance while also minimizing the welfare cost of taxation.

Past research has identified the timing of payments as an important factor in the adoption of technology, health products, or savings instruments in developing countries (Dupas and Robinson, 2013; Casaburi and Willis, 2018; Brune and Kerwin, 2019; Casaburi and Macchiavello, 2019). However, the role of liquidity constraints is understudied in the context of taxation, even in the literature focusing on developing countries.[1] To our knowledge, there is almost no empirical evidence on how tax authorities could adapt tax policy in light of time-varying liquidity constraints. While theoretical research has focused on optimal taxation with time-inconsistent agents, we are not aware of any field experiment or quasi-experimental evidence connecting financial constraints and frictions on the savings and credit markets to tax compliance. This study seeks to address this gap.

We focus on two key research questions. First, can tax authorities in low-income countries increase compliance by (1) timing collector visits according to households' stated preferences, (2) making timing flexible by allowing households to pay in installments, and (3) making timing predictable (helping households plan and save up for tax payment) by informing them about upcoming visits? Second, do these interventions lower the welfare cost of tax compliance? We answer these questions in the context of a randomized controlled trial implemented in conjunction with Kasaï Central's provincial tax authority. The three aforementioned treatments are directly embedded into the property tax collection campaign in the provincial capital, Kananga. We also cross-randomize an enforcement intervention to compare the welfare costs associated with tax compliance induced by our main interventions.

This is a good setting to answer these questions because, as one of the world's poorest countries, liquidity constraints often bind. Indeed, in past work, we find that property owners below the median in a range of proxies for liquidity (such as income, recent expenditure, and reported meals missed) are substantially more elastic to randomly assigned property tax liability abatements (Bergeron et al., 2024). This provides evidence that liquidity constraints keep down payment of the property tax. Moreover, because property taxes are typically paid in bulky annual or semi-annual

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[1]The closest past work demonstrates that liquidity constraints hold back property tax payment (Brockmeyer et al., 2023; Wong, 2020), but does not evaluate policies capable of relaxing them.

payments, liquidity constraints are thought to hamper property tax collection — even in middle- and high-income countries (Brockmeyer et al., 2023; Wong, 2020). Finally, boosting property tax collection is important because revenue from this tax is used to fund local infrastructure, such as roads and waste collection, which is sorely needed in Kananga. Yet, when comparing low to high-income countries, the property tax makes up a significantly smaller share of GDP compared to other taxes (Brockmeyer et al., 2023).

2 Timeline

Figure 1 gives an overview of the tax campaign timeline.

Figure 1: Tax Campaign Timeline
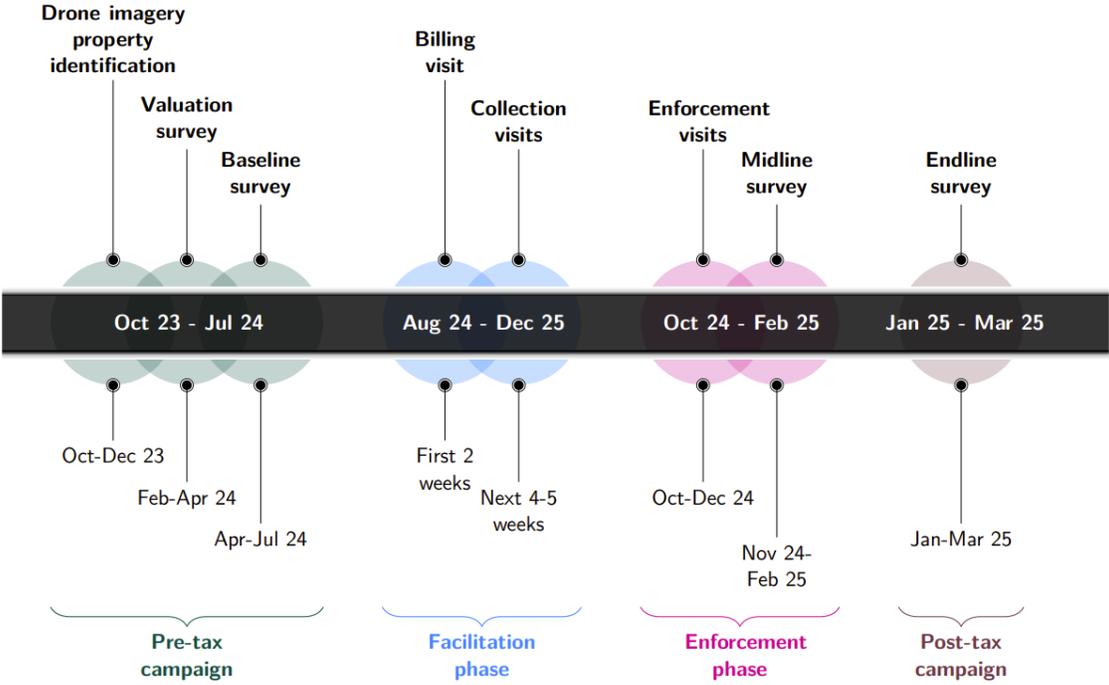
Pre-Tax Campaign Between October 2023 and July 2024, we supported the government in creating a database of estimated building values. Using drone imagery and AI, we identified and outlined building roofs to estimate surface areas, manually correcting these outlines to reflect field realities. Roof areas, used as a proxy for building surface areas, served as the primary determinant of building values. A team of 80 enumerators then recorded building features, such as wall and roof quality, window types, and more. Combining these features with geographical data, we developed a calibration model to estimate building values, with the surface area as the key determinant, adjusted by the characteristics of the buildings and the geographical variables.

Tax Bill Delivery & Facilitation Phase Between August and December 2024, the tax campaign is rolled out across the city in three phases, each lasting six weeks. Each phase begins with two weeks of bill delivery, during which collectors, working in teams of two, deliver property tax bills throughout the city. This is followed by four weeks of tax collection, during which collectors visit property owners to solicit payment of the tax. Several weeks after each phase rollout, a midline survey is conducted on a sample of approximately 30,000 randomly selected properties, including those from the baseline sample.

Enforcement Phase Between October and December 2024, after the facilitation phase has concluded for a wave, the enforcement phase takes place. During this phase, the tax enforcement team conducts follow-up visits to delinquent property owners to encourage payment of outstanding property taxes. For these enforcement visits, collectors work individually, visiting only those delinquent payers who received an enforcement notice on their bill. The messaging used in these visits differs significantly from that of the facilitation phase. Collectors inform taxpayers that this is their final opportunity to pay their property tax before facing potential legal actions. The option to pay in installments is not offered during this phase.

Post-Tax Campaign Between January and March 2025, we conduct the endline survey for the tax campaign on a sample similar to the baseline survey.

3   Experimental Design

This field experiment, embedded in the property tax collection campaign in Kananga, considers three cross-cutting interventions randomized at the property level (Table 1).[2] There are 106,111 tax-assessable properties according to the recent property valuation noted above.

First, in the *timing* intervention, property owners are assigned to either indicate a date preference for their tax collection visit (appointment treatment) or receive a visit on a randomly chosen date (control). During the billing visit, collectors ask respondents to identify the most convenient days in the following four weeks for a follow-up visit to collect the property tax due and suggest that respondents consider their liquidity constraints when selecting these days.[3] If property owners

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[2]A property includes all tax-assessable buildings belonging to a single owner (e.g., a main building, secondary building).

[3]During the facilitation phase, we elicit between one and six date preferences from individuals in the appointment treatment. They can choose any date within the 28-day tax collection period. To avoid bunching of choices within a single week, we require that at least two selected dates be spaced six days apart. For individuals in the random appointment treatment arm, we randomly generate a ranked pool of six dates. Then, we establish a value system that assigns the highest value to an individual's most preferred date, with decreasing values for less preferred options, and a value of zero for non-selected dates. Finally, we implement an algorithm that assigns each date to the polygon

Table 1: Summary of Cross-Randomized Intervention Arms

	Random Timing (N=53,055)		Chosen Timing (N=53,055)	
	No Date Announced (N=12,127)	**Date Announced** (N=12,127)	**No Date Announced** (N=12,127)	**Date Announced** (N=12,127)
No Installments (N=53,055)	High / Low	High / Low	High / Low	High / Low
Installments (N=53,055)	High / Low	High / Low	High / Low	High / Low

Notes: This table summarizes the four cross-randomized interventions. "High" or "low" indicate the cross-randomized enforcement messages.

have the will to pay but are simply constrained by time-varying liquidity shocks, then this treatment will allow them to schedule the collection visit at the optimal time. Of course, this treatment will backfire if the owner has no intention to pay and indicates a day, for instance, when they know they will be out of town. Because we aggregate visit date preferences at the neighborhood level and partition tax collection days to neighborhoods, we inform potential taxpayers that we may not always be able to honor their top choice for a visit day. Tax collectors receive a bonus if they honor their visit schedule.[4] By comparing compliance among owners across treatment groups, we will be able to ascertain whether this simple intervention allows tax authorities to better facilitate compliance.

Second, a random subset of property owners (n=53,055) are offered the chance to pay their property tax in *installments* of at least one-third of the total liability. Offering taxpayers a more flexible payment schedule can help break up large, lump-sum payments into smaller amounts, thereby potentially relaxing liquidity constraints and improving tax compliance. Owners assigned to this treatment are informed of this option when they receive their property tax bill. Payments are not tied to specific dates; owners can pay on any date they are visited by the collector, or directly at the tax authority, as long as they settle at least one-third of their tax bill. Paying in installments does not incur additional costs, and no interest is levied. While paying in installments could help ease liquidity constraints, it could also encourage owners to pay less than their full liability if they expect the tax authority not to enforce payment of the remaining amount. Therefore, it remains an empirical question whether this intervention will increase tax compliance in a setting of low state

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with the highest average value across both treatment arms. If we lack information on a household's date choice — because, for instance, the owner was not present during bill delivery — we assume the household moves in line with their neighbors by taking the most common date among the five closest choice treatment neighbors.

[4]In addition, there are two other components of collector wages: (1) a fixed daily salary during bill delivery if they deliver all assigned tax bills in the required two-week window, and (2) a variable share of the tax revenue collected by the collector pair.

capacity.

Third, we send *date alert* SMS messages in the name of the tax authority to property owners in the treatment group to make timing more predictable and help households plan for upcoming tax collection visits. The date announcement SMS alerts consist of two messages — sent 7 and 2 days before the visit — informing them of the exact date of the collector visit. The intention is to make timing more predictable, by helping owners remember and plan for the visit, especially so they can save sufficient funds to pay their property tax. Owners assigned to control receive a general alert about the property tax campaign without mention of the date of the visit. This placebo message helps to neutralize any enforcement impact of these messages, as hearing from the tax authority for the first time by SMS could lead owners to update their beliefs about the probability of enforcement. By comparing owners who receive treatment and control messages, we can isolate the importance of being able to plan and save up before the tax collection visit — especially when visits are randomly chosen. We also expect that choosing the date of your visit may have a more pronounced effect when coupled with these SMS alerts. The sample is smaller for this treatment because not everyone has a phone registered with the tax authority.[5]

Fourth, independent of these facilitation interventions, the tax authority randomly includes an *enforcement* message on a subset of tax bills. On control bills, property owners are only informed of the payment deadline. On treatment bills, they are also informed (i) of penalties that apply after the deadline, (ii) the potential for legal action in case of non-payment, and (iii) that their household has been selected to receive a visit from a dedicated enforcement team.[6] The SMS alert (either date announcement or general information SMS) reiterates a short version of the bill enforcement message. Similar interventions have been studied extensively in the public finance literature (e.g., Blumenthal et al., 2001; Pomeranz, 2015) and reliably boost tax compliance by a few percentage points. We use this intervention both to benchmark the impacts of other interventions and to compare welfare costs of "facilitated compliance" to "enforced compliance."

4 Data

The study leverages a combination of administrative tax data and household surveys. The administrative tax data includes information about property values, liabilities, assessability and exemption

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[5]Moreover, even among those with phones, text messages often cannot be sent because the devices are powered down or disconnected. The SMS provider fortunately records delivery information. In addition to ITT analysis, this information should allow us to run an IV-style analysis where we instrument the receipt of the text message with assignment.

[6]One concern with such interventions in developing countries is that tax authorities lack the capacity to honor these threats if owners fail to pay. This could make such enforcement messages dynamically inefficient, as taxpayers realize the government is making non-credible threats. Fortunately, the tax authority in Kananga has a separate enforcement phase in each tax campaign. Our team can help them ensure that any owner who received an enforcement message and is delinquent by the payment deadline does indeed receive an enforcement team visit.

status, and property tax payments for all 106,111 tax-assessable properties across the 460 neighborhoods of Kananga. We also observe tax campaign program data, including whether taxpayers received visits from collectors. In addition we administer three household surveys.

1. **Baseline Survey** The baseline survey targets approximately 10,000 randomly selected property owners throughout the city of Kananga. This survey collects information on individual beliefs about total revenue, state responsiveness, and enforcement capacity.

2. **Midline survey** The midline survey collects short-term outcomes soon after tax collection with a broader sample of 30,000 properties, including the baseline sample. This survey captures data on household experiences with tax collectors, tax payments, salience of different treatments, and consumption patterns.

3. **Endline survey** The endline survey revisits a sample similar to that of the baseline to assess changes in the same set of outcomes measured previously.

5 Outcomes

The goal of this project is to study the causal effects of relaxing liquidity constraints on tax compliance and revenue as well as taxpayer wellbeing. We measure tax compliance and revenue using the administrative data. We will primarily look at revenue in levels, but if the distribution is highly skewed we will also use Poisson regression. To measure taxpayer wellbeing, we will use midline and endline survey data. We will use principal components analysis to identify which of these questions appear to capture a latent measure of wellbeing. We will then use PCA to output an index that is our outcome variable.

6 Hypotheses

Our main hypotheses are as follows.

1. *Choosing visit dates increases compliance and revenue.* By comparing properties in the random versus chosen timing groups, we can test whether the ability to influence when tax collectors' visits impacts tax compliance. There are two countervailing forces that could impact compliance. First, taxpayers likely have private knowledge about their own future liquidity, and this treatment could help them time visits when liquidity constraints are less likely to bind. However, it is possible that taxpayers make appointments in bad faith, choosing times they know they will not be home. Which of these forces dominates is an empirical question, but we hypothesize that the former will dominate and on net the treatment will increase tax compliance. We also hypothesize that compliance will be correlated with the

proximity of the collector visit to the owner's preference. That is, we expect higher compliance if an owner receives a tax visit on their first choice date than on their sixth choice date.

2. *Installments increase compliance and revenue.* Again, the net effect of an installment plan on tax collection is ex-ante ambiguous in a setting with low enforcement capacity. Overall, we nonetheless expect a net positive effect on revenue.

   - *Extensive margin.* We expect that installments will allow more owners to pay at least part of their tax bill by breaking the bulky liability into smaller pieces.

   - *Intensive margin.* Installments might allow taxpayers to avoid paying the full amount (in a low enforcement capacity setting). That is, conditional on paying any amount, we expect the amount collected will be lower among taxpayers in the installment treatment group. Some taxpayers who would have paid in full (absent the intervention) will likely only settle part of their balance when offered to pay in installments.

3. *Alerts increase compliance and revenue.* We expect higher tax compliance among property owners who receive date alerts. The effect of interest is the ability to plan and save for the visit, especially when visits are randomly assigned (and thus not likely at a "good" time with respect to liquidity constraints). However, the intervention could also backfire if the alert warns citizens and helps them hide from the state. On net, we expect the positive effect to dominate and to observe higher compliance in the date alert treatment group.

4. *Facilitating compliance through these interventions will have lower costs to taxpayer well-being than compliance induced by enforcement.* Turning to welfare, in a hypothetical scenario with perfect compliance, allowing citizens more discretion or flexibility in their payment schedule should weakly increase taxpayer welfare. Taxpayers can shift the cost to a time when the marginal utility of consumption is relatively lower while keeping the flow of benefits from public goods constant. However, in a setting with low extensive margin tax compliance, the welfare implications are more complex and ambiguous in sign. The facilitation interventions we study will likely have both (i) a *causal effect* in which property owners who would have complied anyway enjoy a weakly higher welfare thanks to a better timed / smoother payment schedule, and (ii) a *selection effect* because owners who would not have paid absent the treatments have strictly lower welfare compared to a counterfactual world in which they had not paid the tax.

   Our strategy to deal with this challenge is to compare compliance induced by the facilitation interventions to compliance induced by the enforcement intervention. Given that similar enforcement messages are a widely used approach to increasing compliance, this intervention

provides a more relevant counterfactual when assessing the welfare impacts of our facilitation treatments. We hypothesize that the welfare cost of tax compliance induced by the facilitation interventions will be lower than that induced by enforcement.

6.1   Heterogeneity

1. *Take-up.* The timing, installment, and enforcement treatments all depend on the compliance of the tax collectors with the randomization. Although we coded the survey to reflect the randomization, collectors can always skip questions and ignore assignments in the field. We therefore ask a series of questions in the midline survey to help us ascertain if property owners received the treatments as intended. A "no" answer to these questions could indicate a collector ignored the treatment or that the property owner forgot. In either case, it is unlikely that the treatment affected their behavior. We can thus estimate the LATE by instrumenting remembered treatment with actual treatment. This isolates the impact of the treatment on the set of property owners who could have plausibly had their behavior change because of the treatment.

2. *Error in visit date preferences.* While we can ensure a random day assignment for all households in the random timing treatment arm, we may lack information about some households' preferred date choices in the chosen timing treatment arm. This occurs when the household either (i) is not present during bill delivery and therefore cannot be interviewed about their visit date preferences, or (ii) declines to select a date. In such cases, we assume that the household has similar preferences to their neighbors. This no doubt introduces some measurement error, and we expect stronger effects among households whose preferences we were truly able to honor.

3. *Distributional Consequences.* Ex-ante, the distributional implications of the interventions are ambiguous. Low-value properties are more likely to be liquidity-constrained, making them ceteris paribus more responsive to the treatment. However, low-value properties also face lower tax liabilities, which should make it easier to pay the property tax ceteris paribus. Which of these forces dominates depends on the relative elasticities (of compliance with respect to liability and of liquidity constraints with respect to property value). We therefore have no strong prior about the distributional consequences of these facilitation interventions.

4. *Interaction with enforcement message.* Past work in Kananga found that enforcement messages increased tax compliance on average and made properties less elastic to rate changes (Bergeron et al., 2024). We therefore expect a complementarity between the enforcement message and the other treatments. The enforcement message could, for instance, reduce the

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share of taxpayers who respond to the timing and date alert treatments in bad faith (by planning to be absent). It could also reduce the temptation to use the installment treatment as a discount rather than a way to spread payments over time.

5. *Interaction with tax systems.* A separate ongoing RCT examines variation in the system of property tax rates — proportional, progressive, or fixed fees that end up being regressive — across different neighborhoods. We expect meaningful interactions with these different tax rate systems. In particular, we expect that the facilitation interventions will have larger effects when the burden of taxation is relatively higher. The average tax liability is higher in proportional and progressive neighborhoods, so we expect more pronounced effects there. We expect fairly uniform effects throughout proportional, whereas we expect heterogeneous effects in progressive according to the property value distribution. Because the tax rate is lower as a share of property value in the bottom band, we expect the facilitation treatments to have more muted effects there and to have more pronounced effects in higher-value bands.

6. *Time-varying liquidity constraints.* A natural source of heterogeneity in tax compliance behavior would be households' time-varying liquidity constraints. Ideally, we would know for each household when they are more and less able to pay (due to exogenous shocks to income and expenditures), and then study if households that receive a randomly timed visit when they are cash "rich" are more likely to pay than those that receive a visit when they are cash "poor." The challenge is estimating time-varying liquidity constraints. To this end, we collected data on school fee payments, as well as payment deadlines for electricity and water bills (though these only affect a small percentage of property owners). Although there is likely measurement error in these data, we plan to study heterogeneity using these common expenditure dates as a source of variation in whether liquidity constraints are likely to bind.

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