Becoming Legible to the State: The Role of Identification and Collection Capacity in Taxation

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Whereas the tax compliance literature emphasizes verifying tax liability amounts, this paper highlights two other tax capacity dimensions of particular relevance in lower-income countries: identifying taxable entities and enforcing collection of known liabilities. Leveraging a newly-digitized property database, a randomized experiment in Liberia finds that including identifying information (owners' names and property photographs) in tax notices more than quadruples the payment rate, from 2 percent to almost 10 percent, when the notice also details noncompliance penalties. A second experiment finds that signaling greater collection probability to delinquent taxpayers *further* increases compliance. These results highlight the importance of targeted investments in tax capacity.

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1 Introduction

Lower income countries, on average, collect less taxes than higher income countries, limiting their ability to invest in infrastructure and public services. This tax gap occurs despite comparable statutory rates and accounting for different levels of economic activity, suggesting the presence of deficits in lower income states' tax administration capacity (Besley and Persson, 2014). This paper distinguishes three key components of tax capacity that states must invest in to collect taxes effectively: identifying taxpayers (identification capacity), determining how much they owe (detection capacity), and taking in these liabilities to the state coffers (collection capacity). Whereas traditional tax evasion models (e.g. Allingham and Sandmo (1972)) and a resulting large literature on third-party reporting emphasize detection capacity, this paper focuses on the two other dimensions of tax capacity, identification and collection, which are particularly relevant in lower income countries.

Identifying taxpayers, a presumption in most developed economies, is a first order concern for tax collection in many lower income countries characterized by a large informal sector and the lack of proper identification systems for individuals, businesses, property and other taxable entities/ tax bases. For example, 45 percent of people in Sub Saharan Africa do not have an official proof of identity (World Bank, 2022), and majority of lower income countries have sparse and inaccurate taxpayer databases (Nyanga, 2021).[1] Many contexts are reminiscent of Scott's (1999) description of the premodern state as "in many crucial respects, partially blind; it knew precious little about its subjects, their wealth, their landholdings and yields, their location, their very identity." In order to tax, the premodern state sought to make society "legible" through the creation of permanent last names, the establishment of cadastral surveys and population registers, etc. Similarly, modern governments seeking to understand their potential tax base must increase coverage of foundational identification systems, business registries and property registries.

Detection capacity is closely related to identification and builds on it. After the presence of a taxpayer or tax base is known to the state, it must then verify the income, assets, and

[1] Of the 61 Tax Administration Diagnostic Assessment Tool (TADAT) assessments conducted in lower income countries from 2013 to 2020, only 20 percent of tax authorities had a score of good or very good for knowledge of taxpayer database and 5 percent did so for accuracy of information in taxpayer registry.

transaction amounts that are subject to taxation. Detection capacity by modern revenue agencies relies on third-party information and the centrality of this information for tax collection has been a major focus of the recent empirical literature (e.g., Kleven et al., 2011; Kleven, Kreiner and Saez, 2016; Jensen, 2019; Pomeranz, 2015; Naritomi, 2019). Identification and detection can thus be considered as the extensive margin and intensive margin, respectively, of measuring the tax base.

After taxpayers are identified and liabilities determined, there remains the challenge of collecting the revenue through administrative (billing and payment) systems and legal processes. For those who do not voluntarily comply, collection capacity includes the use of measures such as delinquent notices, penalties and interest charges, wage garnishment, and legal prosecution to recover unpaid taxes. In countries with strong collection capacity, some of these sanctions are automatically triggered and routinely applied to taxpayers. In low-capacity contexts, however, the majority of unpaid liabilities go uncollected for several years,[2] and there is limited recovery of taxes even after an individual is found to be non-compliant through audits or third-party information (Best, Shah and Waseem, 2021; Carrillo, Pomeranz and Singhal, 2017).[3]

The key contribution of this paper is to explicitly test for and highlight identification and collection capacity, separate from detection capacity, as these three are typically conflated as "enforcement" interventions in the literature. Specifically, the paper uses two randomized experiments to answer the following question: what is the impact on tax compliance of increasing taxpayers' perception of the state's identification capacity and, separately, its collection capacity? I study this question in collaboration with the Liberia Revenue Authority (LRA) in Monrovia, Liberia, a setting where, outside a small subset of properties with high revenue potential, the vast majority of property owners were not paying real estate taxes, and many had never received a tax notice. In this context, in a bid to expand the tax net, the first-order concern of the LRA was the extensive margin of compliance, as opposed to verifying

[2] See evidence of low compliance rates on known property tax liabilities from Pakistan (Khan, Khwaja and Olken, 2015), Ghana (Dzansi et al., 2022), Haiti (Krause, 2020), Senegal (Knebelmann, 2019), and the Democratic Republic of Congo (Weigel, 2020; Balán et al., 2022).

[3] Best, Shah and Waseem (2021) provide striking evidence of low collection capacity in Pakistan where less than 2 percent of amounts detected during audits are recovered at the time, with the remainder amount subject to a lengthy judicial and appeals process—leading to large amounts persistently stuck in litigation.

the property value; as such, the detection capacity channel is muted. Using a modified version of the Allingham and Sandmo (1972) tax compliance framework, the paper shows that taxpayers' decision to pay a given tax liability depends not only on their perceived probability of their property being discovered by the tax authority and the associated penalties, but also on the perceived probability that the government will enforce the law and collect the taxes and penalties they owe.

In the first phase of the project, I worked closely with the LRA to conduct a door-to-door property enumeration and develop a new electronic property database. Prior to this exercise, only 5 percent of properties in the city were on the tax register, and many records were not digitized. This exercise thus represented a significant technology investment for the LRA that made the tax base more legible.

Experiment one examines the impact of signaling this newly acquired identification capacity and providing information on penalties to property owners who had not previously paid real estate taxes. The control group received a generic tax notice addressed "Dear Property Owners." The notice provided information on the procedure for tax payment and requested compliance. A treatment group received a tax notice that, in addition, included identification information from the new database: the name of the property owner and a photograph of the property. This notice also included information on legal penalties for noncompliance. Two additional treatment groups received notices with either the identification information alone or the penalty information alone.

The combination of identification and penalty information significantly increased property owners' compliance: property owners were more than four times as likely to pay the tax. The payment rate increased from 2.2 percent of property owners in the control group to 9.7 percent in the treatment group. This effect persisted, as the treatment group continued to have a higher payment rate over the next three years of available data. The impact of the combined identification and penalty treatment is statistically different from the identification-only and penalty-only treatments, neither of which is statistically significant. These results indicate that providing taxpayers with evidence that their non-compliant property is known to the tax authority leads to increased compliance only when this evidence is accompanied by information on the associated penalties for noncompliance.

Experiment two investigates collection capacity. As an additional layer to the identification and penalty information studied in experiment one, it examines the impact of signaling to taxpayers a greater likelihood that the tax authority will enforce tax laws on them and collect the taxes and penalties they owe. The sample for this experiment was property owners who had paid real estate tax at least once in the past but had since become delinquent. The control group received a notice requesting payment. Much like the combined identification and penalty notice in experiment one, the control group notice included the name of the property owner, a photograph of the property, and information on legal penalties for noncompliance. Members of the treatment group received a similar notice with an additional notification that their property would be included in the next batch of properties to receive enforcement action if they did not comply.

This intervention increased the payment rate by 7 percentage points (a 33 percent increase over a payment rate of 21 percent in the control group). This result underscores the impact of increasing taxpayers' perception that the state will take action toward them, over and above their awareness that the tax authority has identified them as non-compliant and knowledge of the associated penalties. In particular, to the extent that providing identification and penalty information to the control group may already have signaled a greater likelihood of enforcement, this observed impact serves as a lower-bound estimate of the impact of increasing taxpayers' perception of the state's collection capacity.

These findings enhance our understanding of state capacity and taxation, turning the spotlight on identification and collection capacity in contrast to traditional tax compliance models that implicitly assume that taxpayers are known to the tax authority and that collection occurs once noncompliance is detected. To the best of my knowledge, this study provides the first evidence from a randomized experiment on the tax compliance impact of identification capacity, specifically, of alerting people that they have been identified by the state. Most closely related are studies of large government programs that match different databases to identify unregistered properties (Casaburi and Troiano, 2015) or businesses (Lediga, Riedel and Strohmaier, 2020) but these do not have exogenous variation in who is treated with the identification information, and instead use the variation arising from the intervention to study spillover effects on other outcomes. This paper shows the important relationship between identification and collection capacity: whereas making the tax base legible is an essential first step, it is insufficient to significantly increase revenues; information on penalties for noncompliance as well as signals of a greater likelihood that those penalties will be enforced are key complements to translate discovered tax liabilities into tax revenues.[4]

These results directly inform policy. Distinguishing between identification, detection, and collection capacity is crucial for improving tax collection because it allows the tax authority to determine which capacity is binding and target its investments and policy instruments accordingly. For example, a lack of commensurate increases in detection and collection capacity may be responsible for the disappointing revenue impacts of mass taxpayer registration campaigns (Gallien, Occhiali and van den Boogaard, 2023; Mascagni et al., 2022; Moore, 2023). Whereas many policy conversations on tax administration reform are centered around adopting new technology and improved databases to better understand the tax base,[5] these results emphasize the unavoidable need for investment in the state's ability to enforce tax laws and collect unpaid liabilities, which are often more politically difficult policies to implement. More broadly, this paper also relates to a large literature on the challenges of making the tax base more legible through firm formalization and business registration initiatives (Bruhn and McKenzie (2014) and Floridi, Demena and Wagner (2020) review this literature).

In addition, this paper contributes to our understanding of how technology can improve tax administration in emerging economies, complementing recent papers on how technology interventions in property taxation could improve the effectiveness of tax collectors (Dzansi et al., 2022) and the accuracy of property valuation (Knebelmann, Pouliquen and Sarr, 2022).[6] Finally, this paper contributes to a vibrant literature on interventions conducted in collaboration with tax authorities to understand different approaches to promoting tax

[4] Besides the potential revenue impacts from expanding the tax base, strengthening identification capacity may also improve horizontal equity, for example, by ensuring that taxpayers in the formal sector are treated similarly to those of same income in the informal sector.

[5] For example, in 78 percent of countries with an approved World Bank tax project from 2010 - 2022, the project included a tax digitization component (author's analysis of World Bank projects).

[6] Okunogbe and Santoro (Forthcoming) provide a review of this literature and Knebelmann (2022) describes applications for property tax in particular.

compliance and expands this literature in two ways.[7] First, unlike many experiments that give a generic nudge or reminder to taxpayers, this paper (specifically, experiment one) leverages a significant real investment in the identification capacity of the government. Second, whereas most papers in the literature can only study the immediate impact of a notice, this paper is able to show that the impact of identification and penalty information on compliance persists over three years.[8]

The rest of the paper proceeds as follows. Section 2 provides background information on Liberia and the administration of property taxes, while section 3 outlines a simple conceptual framework for thinking about these three aspects of tax capacity on tax compliance. Sections 4 and 5 describe the design of the two experiments and present the corresponding results. Section 6 concludes and provides policy implications.

2 Context

Liberia has low compliance rates for real estate taxes (as well as other tax categories). Prolonged civil conflict in the 1990s and early 2000s led to the erosion of state capacity across several sectors, including tax administration. In 2018, the real estate tax register contained fewer than 7,000 properties in Greater Monrovia, the largest urban metropolis in Liberia, with over 1 million residents. Even among properties on the tax register, timely tax collection remains a challenge. After taxpayers enter the tax base in one year, over 60 percent of them do not pay taxes in the subsequent year (according to the author's analysis of administrative tax data from 2015 to 2018). Many property owners who pay are motivated by the desire to obtain a tax clearance needed for administrative purposes in another sector, such as to bid for a contract with the government or to import goods at the port.

Several factors related to weak identification and collection capacity contribute to the low real estate tax compliance. In the absence of a cadaster that outlines all the properties in the city, the LRA adds properties to the tax register on a case-by-case basis, resulting in very low coverage, with about 5 percent of taxable properties on the tax register. Further,

[7] Mascagni (2018), Pomeranz and Vila-Belda (2019), and Slemrod (2019) provide reviews of this literature.

[8] Important exceptions are Brockmeyer et al. (2019) in Costa Rica and De Neve et al. (2021) in Belgium, who find sustained impacts of messages on tax compliance over two to three years.

it is difficult to locate registered properties for tax administration because there is no proper address system and the tax database is not geocoded. The addresses provided at the time of registration are often vague (e.g., "18th Street" or "Catholic Hospital community"). As a result, officials from the LRA typically rely on information from community members to identify buildings from the tax database, especially in cases where there is no readily available photograph of the property.[9] Because of the lack of addresses, tax bills are not routinely delivered to property owners; instead, they are required to visit the LRA to request their bills.

Besides the challenges in identifying properties, the LRA faces legal, political, and logistical constraints to implementing the penalties for noncompliance. The most common consequence for noncompliance is that penalties (up to 25 percent of the tax liability per year) and interest (an average of 15 percent per year) are added to the tax liability. Although the revenue code allows for the closure and seizure of delinquent properties, these actions require a court ruling, which implies significant time and administrative costs. As a result, in practice, enforcement consists of repeated written notices and in-person visits to property owners and, at most, the posting of a delinquent notice on the property for 72 hours. Furthermore, given the limited staff and resources of the LRA, these enforcement actions are focused on select properties that have the highest revenue potential, leaving the majority of the tax base essentially free from enforcement.

An additional key feature of real estate tax in this context is the tax rate. It is 1.5 percent of the property value per annum for commercial properties and 0.25 percent for residential properties.[10] Given the relative illiquidity of the real estate market and the lack of transaction data, it is challenging to determine property values. To facilitate extensive margin compliance, property owners are allowed to self-declare their property value, subject to the caveat that the government reserves the right to purchase the property from them at said value. Commercial properties with high revenue potential are valued by a valuation firm

[9] Although property owners are required to submit a photograph at the time of property registration, these records are typically kept in hard copy and not organized in a way that allows for easy matching with electronic payment records for enforcement purposes.

[10] Commercial properties are those that are used for income-generating activities, such as a rented apartment, a store, or an office building, whereas residential properties are used strictly for housing and do not generate any income.

from a list of approved providers, and valuation audits are typically restricted to this subset of properties. The average annual tax liability for a residential property is US$70 per annum, about two-thirds of the one-month GDP per capita in Liberia of US$96. Further, for newly registered properties, the first bill is typically issued not only for the current tax year but also for the previous four years. To ease liquidity constraints, payment plans are available.

The low compliance rate in Liberia is comparable to estimates from cities in both fragile and otherwise stable low and middle income countries, such as 5 percent in Carrefour, Haiti (Krause, 2020), 5-20 percent in Bengaluru and Jaipur, India (Government of India, 2017), 8 percent in Kananga, Democratic Republic of Congo (Bergeron, Tourek and Weigel, 2021), 9 percent in Dakar, Senegal (Knebelmann, 2019), 10 percent in Kampala, Uganda (Manwaring and Regan, 2023), and 12 percent in Madina, Greater Accra, Ghana (Dzansi et al., 2022). This suggests that the lessons from Liberia can be valuable for understanding tax compliance in a wide range of settings.

3 Conceptual Framework

In the canonical model of tax evasion, the taxpayer decides how much of her true income to reveal to the tax authority by trading off the utility gains from a lower tax bill (in the event that the true amount is not detected) against the risk of being detected and punished by having to pay a penalty in addition to the tax (Becker, 1968; Allingham and Sandmo, 1972; Yitzhaki, 1974). In the case of property tax, where the tax base is visible and verifiable (at some cost to the tax authority), we model the taxpayer as deciding whether to pay a fixed tax liability (rather than as deciding how much tax to pay) given the perceived costs and benefits.[11] As such, we abstract away from the standard detection problem and will focus instead on identification and collection.[12] [13]

[11] This framework can also be used to understand a taxpayer's decision to pay income tax after declaring her income (Hallsworth et al., 2015, 2017).

[12] Many local government settings with a flat tax on property units also abstract from the detection problem, such as described in Bergeron, Tourek and Weigel (2021). More broadly, given the visible and verifiable nature of real estate, relative to other tax bases, the detection problem can be more easily solved with appropriate technology such as by using satellite imagery to calculate square footage of buildings for valuation purposes (Ali, Deininger and Wild, 2020).

[13] This framework can be extended from having a fixed tax liability to the standard detection problem by including three different probabilities and the relevant payoffs: first, the probability that the government

An agent with income Y ($Y \geq 0$) owns property valued at V ($V \geq 0$) and faces a tax rate t ($0 \leq t \leq 1$) on the property. If the agent pays the tax, he is left with a posttax income of $Y - tV$. If the agent does not pay the tax, there is a probability of p ($0 \leq p \leq 1$) that he is discovered as non-compliant. Thus, with probability $1-p$, his noncompliance is undiscovered by the tax authority, and he keeps his full income Y. Although real estate taxes have the advantage of an observable and immobile tax base, without effective data management tools that identify and track property ownership and payments, the noncompliance of individual property owners may nevertheless remain undiscovered. Further, the penalties for noncompliance are only enforced with probability q ($0 \leq q \leq 1$). Thus, there is a probability of $p(1-q)$ that the agent keeps his total income when noncompliance is detected but penalties are not enforced. Finally, there is a probability of pq that his noncompliance is discovered and the penalties are implemented, in which case, the agent faces penalty aV ($0 \leq a$) in addition to the tax tV.

Faced with the choice of whether to pay the tax ($i = 1$) or not to pay it ($i = 0$), the agent therefore chooses i to maximize

$$U_i = \begin{cases} Y - tV & \text{if } i = 1 \\ (1-p)Y + p((1-q)Y + q(Y - tV - aV)) & \text{if } i = 0\,. \end{cases} \tag{1}$$

The agent will pay the tax when $U_1 > U_0$—that is, when

$$pq(t + a) > t\,. \tag{2}$$

From this condition, the agent's likelihood of paying the tax is increasing in p, q, and a. Importantly, this condition highlights that p and q are multiplicative. This implies that even if p is very high or takes on its maximum value of $p = 1$—that is, if the agent knows with certainty that he has been identified as non-compliant—if q is very low or zero—that is, if he does not expect any sanctions to follow—then it is possible that $q(t + a) \leq t$ and the

identifies the taxpayer; second, conditional on being identified, the probability of discovering the true tax liability; and third, conditional on discovering the true tax liability, the probability that penalties would be enforced.

agent does not pay the tax. The standard Allingham-Sandmo model, by contrast, does not include q, suggesting that the model implicitly assumes that discovered evasion is *always* penalized—that is, that $q = 1$ or that q is not distinct from p. Under the scenario where $q = 1$, if $p = 1$ (perfect identification), there is no incentive to evade any amount of tax liability if there are penalties for evasion—that is, if $a > 0$. More broadly, this condition implies that in settings where perceptions of p, q, and a are low, as is the case in many low capacity settings, increasing only one parameter would have marginal impacts.

Experiment one aims to increase property owners' perception of p (the probability that the tax authority has identified them as non-compliant) and approximate a scenario where $p = 1$. In addition, it provides information on a (the associated penalties) and examines the impact of these two interventions, separately and jointly, on tax compliance.

Experiment two aims to increase property owners' perception of q (the probability that the tax authority will enforce tax laws and make them pay their uncovered liability), relative to a control group that only receives information on p and a as in the combined treatment in experiment one, and examines the impact on tax compliance. These experiments thus attempt to manipulate separately taxpayers' perception of the tax authority's identification capacity and its collection capacity. We do not have an experimental arm to measure the impact of q in the absence of p and a because it is most policy relevant to examine the impact of increasing perceptions that the state will enforce collection of owed liabilities when taxpayers know that their liability has been discovered.

As will be discussed in section 5.3, informing taxpayers about penalties for noncompliance may also indirectly signal a greater likelihood that these penalties will be enforced. Similarly, providing identification information may signal to taxpayers that the tax authority is able to target them for enforcement, affecting their perceptions of collection capacity as well. Either of these scenarios suggests that the estimates of the impact of increasing q in experiment two may be a lower-bound estimate.

4 Experiment One

4.1 Experiment Design

This study took place among property owners in Congo Town, one of the tax zones in Monrovia, the capital city of Liberia. This area was identified as having many properties that could be brought into the tax net.

The first activity was creating a property database. From April to June 2014, I worked closely with the LRA to conduct a "block mapping" project to collect information on property locations and features. Enrollment agents (short-term government contractors) went door-to-door in teams of two to raise awareness of the real estate tax using brochures and flyers. They also completed a brief survey with residents, using mobile devices to obtain information about each property and its owner. The data collected in this enumeration process resulted in an electronic property database for taxation. This was the first time the government had electronic records and digital photographs of these properties.[14]

High-value properties, such as hotels, banks, and other commercial properties, were excluded from the enumeration list because the LRA did not want to include them in the experiment, given their revenue potential. In addition, 5 percent of the enumerated properties were found to be on the tax roll already and were thus removed from the experiment sample. In all, 571 properties belonging to 464 owners made up the sample.

Properties in the sample were randomly assigned to four groups. The control group received a generic notice that informed property owners of their responsibility to pay the real estate tax and gave instructions about how to comply. The notice did not contain any information specific to the property owner but was simply addressed "Dear Property Owners." The notice for the first treatment group (the *identification and penalty notice*) contained the same information about how to comply; however, it was personalized by including the owner's name and a photograph of the property (obtained during the door-to-door enumeration). It also included the legal penalties for noncompliance, citing relevant sections of the Liberia Revenue Code. The notice for the second treatment group (the *identification no-*

[14] Following this initial phase, the government extended data collection to over 40,000 properties across Monrovia a few years later.

tice) contained only the personalized information (the owner's name and a photograph of the property) and the compliance instructions. Finally, the notice for the third treatment group (the *penalty notice*) had no personalized information but included the information on penalties. Appendix Figure A1 provides images of the notices.

Due to the 2014 Ebola outbreak, field activities were suspended following the property enumeration. In March 2017, using the information from the property enumeration list, the LRA prepared the different notices for property owners according to their randomized group. Delivery agents were provided with "address books" containing the photograph and location of each property to hand-deliver the notices. If the property owner was not present, the notice was handed to the resident to deliver to the property owner.

Given the three-year lag between the enumeration process and the delivery of the notices, there was some attrition in the sample. The team successfully delivered notices to 90 percent of the property owners in the sample, and this rate was not significantly different across the treatment and control groups.[15]

4.2 Data and Empirical Specification

The data for this study come from two main sources: the baseline enumeration data and administrative records on tax payments. The baseline enumeration data include the property block and number (using a numbering system put in place by a pilot project of the postal office), the community name, the name and phone number of the resident with whom the enumeration survey was completed and his or her relationship to the property owner, the name and phone number of the property owner(s) (if they were not the survey respondents), and property characteristics, such as the number of rooms and bathrooms, the presence of a porch and/or garage, building materials, and whether the property is residential or commercial. The enumerators also measured and recorded the exterior dimensions of the property using sketches and took photographs of the exterior. The LRA determined property values using a formula that incorporates the square footage of the buildings calculated from the sketches and the construction materials observed from the images.

[15] The reasons for nondelivery were relocation of the property owner, destruction of the property, or inability to locate the property.

Tax administration records provide data on whether the property owner visited the tax office in response to the notice, whether the owner paid the tax, and how much tax was paid. Visiting the tax office was the first step of the compliance process. For most property owners, this was their first interaction with the tax system, so they first had to obtain a personal tax identification number (TIN). To track responses, each notice included a unique number, and property owners were asked to bring the notice along when they came to the tax office. Data on tax payments come from the integrated tax administration systems that record all tax payments electronically and are available for this sample from 2017 to 2020.

Although tax revenue leakage may occur in several ways, this paper focuses on the extensive margin of compliance, where it is possible to determine with certainty the compliance status of a property owner— that is, whether or not the property owner made a tax payment. In addition, the paper also reports whether the property owner responded to the tax notice at all and the total amount paid.

The unit of observation for outcomes is at the owner level because payments are recorded by the property owner's TIN; however, randomization was done at the property level. To address this discrepancy, we use the property-level randomization to infer owner-level treatment assignments using the cumulative exposure that each property owner had to different elements of the treatments, as follows: (i) property owners who have only one property are assigned to the treatment group for that property; (ii) property owners who have multiple properties that were all assigned to the same treatment group (or to a single treatment group and the control group) are assigned to that treatment group; (iii) property owners who have multiple properties and who have any property assigned to the identification and penalty treatment group are assigned to the identification and penalty treatment group because they are considered to have been exposed to both the identification and penalty messages; and (iv) property owners who have multiple properties and for whom some properties were assigned to the identification treatment group and others to the penalty group are assigned to the identification and penalty treatment group because they were exposed to both the identification and penalty messages. This process affects the 10 percent of property owners in the sample who received notices with different treatments.[16]

One implication of using property-level randomization to determine owner-level treatment is that owners of multiple properties are significantly more likely to be assigned to the identification and penalty treatment group for the owner-level randomization (but not for the property-level randomization). Of the identification and penalty treatment group, 30 percent own multiple properties, compared to 10 percent in each of the other groups. To account for this differential propensity to be assigned to the combined treatment, we control for owning multiple properties in all regressions given that, conditional on the number of properties owned, assignment to treatment is random (Hardy and McCasland, 2023).[17] As discussed in section 4.3, we also show comparable results from conducting the main analyses on a restricted sample of property owners who are not affected because they own only one property or received the same treatment for all their properties.

Table 1 provides summary statistics for the different variables and shows that the randomization achieved balance across different characteristics.[18] For property owners who own more than one property, we used the characteristics of the highest-value property. The average property has three rooms and two bathrooms, and its average value is US$27,000. About 70 percent of property owners own solely residential properties, and 24 percent of property owners are women (or include a woman if there is more than one owner).

We use the following equation to examine the impact of each of the three treatments in promoting compliance:

$$D_i = \beta_0 + \beta_1 T_{1,i} + \beta_2 T_{2,i} + \beta_3 T_{3,i} + \alpha X_i + \epsilon_i \,, \tag{3}$$

where D_i is one of three outcome variables—an indicator variable for whether a property owner responded to the notice, an indicator variable for whether a property owner paid real estate tax, and the amount of tax paid. β_1, β_2, and β_3 estimate the causal effect of receiving

[16] Of the sample, 84 percent owned only one property, while 6 percent owned more than one property but received the same treatment for all their properties.

[17] Since very few individuals own more than 2 properties (Figure A2), we prefer the specification with a dummy variable for owning more than one property. The specification with dummy variables for the number of properties owned yields identical results, as shown in section 4.3.

[18] Table A1 provides the analogous balance table for the property-level randomization.

each of the three treatments, respectively, on the outcomes. X_i are control variables for whether the property owner owns more than one property, the value of the property, whether the property has a female owner or co-owner, whether any of the properties is used for commercial purposes, and the location (one of three blocks) of the property.[19] We report randomization inference p-values obtained using the `ritest` command in Stata. To mirror the reassignment protocol described above, in each iteration, we rerandomize at the property level and use the property-level treatment to determine owner-level treatment, holding fixed the ownership structure in the data.

Since the delivery rate was balanced across the treatment and control groups (table A2), the subsequent analysis will focus on those property owners who received the notices. Table A3 shows that property/property owner characteristics are also balanced in this group.

4.3 Results and Discussion

Table 2 shows the impact of the different treatments (figure 1 displays the results graphically). The identification and penalty notice leads to an 8.1 percentage point increase in the likelihood of responding to the notice, almost tripling the 4.4 percent response rate in the control group. Similarly, this combined intervention more than quadruples tax payment rates: it results in a 7.6 percentage point increase over the control mean of 2.2 percent. For the impact on the amount of tax paid, the coefficient (a US$66 increase) is 11 times the control mean of US$6. However, the standard errors are large given the low overall compliance rate, and we are unable to detect a statistically significant difference.

The other two treatments—the identification notice and the penalty notice—do not have a detectable statistically significant effect on any of the outcomes. For the identification notice, we can reject a 5.1 percentage point increase and a 4.3 percentage point decrease in the likelihood of making a payment. For the penalty notice, we can reject a 2.6 percentage point increase in the likelihood of making a payment and a 5.2 percentage point decrease. Importantly, the increase in payment from the identification and penalty notice is statistically different from the impact of the identification notice ($p = 0.014$) or the penalty notice ($p =$

[19] For most property owners with multiple properties, the properties were colocated. When not colocated, the location of the highest-value property was used.

0.001).

Notably, we find a positive long-term effect on whether property owners make a tax payment due to bringing people into the tax net using this intervention (figure 2). Table 2, panel B shows that the identification and penalty treatment leads to a 4.3 percentage point increase in the likelihood that a property owner paid property tax at least once over the three years following the intervention (2018–20)—this represents a fivefold increase over a base of 1.1 percent in the control group.

As a robustness check, we repeat the analysis on a restricted sample of property owners for whom we do not infer owner-level treatment from property-level randomization because they own only one property or received the same treatment for all their properties. These results (table A4, panel A) are comparable: we find a 6 percentage point increase in the likelihood of making a payment ($p = 0.036$). In addition, table A4, panel B shows that including dummy variables for the number of properties owned to account for the differential propensity to be assigned to the combined treatment group yields identical results to the main results (table 4) where we include a dummy variable for owning multiple properties.

In all, these results reveal that taxpayers' receiving graphic confirmation that the tax authority has identified them as noncompliant leads to a sustained increase in tax payment when accompanied by information on the associated penalties for noncompliance.

5 Experiment Two

5.1 Experiment Design

One key goal of this paper is to distinguish the role of collection capacity, separate from identification (and detection) capacity. Specifically, once people know that they have been identified as non-compliant and they know the associated penalties, how does increasing their perception that the tax authority will enforce the stated tax laws increase their likelihood of compliance? Experiment two addresses this question.

The sample for this experiment is delinquent property owners across different communities in the Greater Monrovia area. While the sample in experiment one was also non-compliant in the sense that they had never paid the tax, this sample differs in that they had paid tax at least once, but had overdue taxes for one year or more. Their prior compliance suggests their ability to overcome barriers to compliance and thus makes them a more practical focus for targeted enforcement action. Similar to experiment one, this sample also excluded property owners with the highest tax liabilities (above US$1,000) as the LRA prioritized them for enforcement given their revenue potential. In practice, taxpayers below this threshold often effectively fall out of the radar of the tax authority and do not receive significant enforcement attention.

To locate these delinquent properties, a verification team was dispatched with the name of each owner and the property address on file. The task of the team was to go to the broad location indicated on the property registration record (e.g., "18th Street" or "Catholic Hospital community") and ask around in the community to identify the property. Once the property was verified, the team was to capture the GPS coordinates of the property and a photograph using a form on a mobile device. Of the 1,382 properties the team attempted to locate, 728 were identified.

Property owners were randomized into two groups. The control group received a notice requesting the payment of delinquent tax liability. The notice was comparable to the combined identification and penalty notice in experiment one: it was personalized to include the name of the property owner and a photograph of the property and also stated the penalties for noncompliance. The treatment group received a similar notice (the *enforcement notice*) with one addition: it included a sentence informing property owners that their property had been included in the current batch of properties designated for intensive follow-up and, if they did not respond by the deadline, that the LRA would proceed to the next stage of enforcement actions. Figure A2 provides an image of the notice.

The randomization was stratified by two variables: location (communities across the city were divided into three broad areas) and payment history (whether the individual had only one year or more than one year of unpaid taxes). These variables were considered to be potential dimensions of heterogeneity in the responses of taxpayers to the intervention.

The properties were located in October and November 2018, and the treatment notices were sent out in May 2019. Before randomization, some of the identified property owners had become compliant and were thus excluded. The final sample to which notices were sent included 529 individuals who own 580 properties. Of these, 3 percent did not receive notices due to not meeting anyone at the property during all delivery attempts. The delivery rates for both the treatment and control groups were equal at 97 percent of property owners (table A5), so we use this subsample for the subsequent analysis.

5.2 Data and Empirical Specification

The data for this study come from two main sources: the property location verification data and administrative records on tax payments. The property location verification data provide the name of the property owner, as well as the address (directions), a photograph, and the GPS coordinates of the property. They also include descriptions of external property characteristics provided by the verification team on the basis of their observations, such as the number of floors, the presence of a fence, the quality of landscaping, and the kind of road the property is on.

The administrative tax records provide the payment history of each property owner from 2014 to 2020. In addition, clerks at the tax office made note of each property owner that visited the tax office in response to the notice: even if no payment was recorded, taxpayers might visit the office to set up a payment plan or dispute the tax notice.

Table 3 provides summary statistics and shows that the randomization achieved balance across different characteristics. The average property value is about US$38,000. About 8 percent of property owners own more than one property, and over 90 percent own solely residential properties. About 84 percent of properties have only one floor, and 56 percent do not have a fence. For property owners with multiple properties, we use the characteristics of the highest-value property.

We use the following equation to examine the impact of the enforcement notice in promoting the payment of property tax arrears:

$$P_i = \beta_0 + \beta_1 T_i + \alpha X_i + \lambda S_i + \epsilon_i \, , \tag{4}$$

where P_i is one of three outcome variables—an indicator variable for whether a property owner responded to the notice by visiting the tax office, an indicator variable for whether a property owner paid their real estate tax, and the amount of tax paid. β_1 estimates the causal effects of the enforcement notice on the outcomes. S_i is a vector of six strata indicator variables (one for each pair of the three areas in the city and whether the individual has more than one year of arrears). X_i are control variables for whether the property owner owns more than one property, the value of the property, whether there are any female owners, and whether the property owner owns any commercial properties. We report randomization inference p-values.

5.3 Results and Discussion

Before turning to the impact of the enforcement notice, it is interesting to observe that the payment rate in the control group is much higher than the payment rate for owners who received the identical identification and penalty treatment in experiment one (21 percent versus 10 percent). This likely reflects the lower barriers to tax payment for the experiment two sample as they have paid at least once in the past.

It is important to note that this analysis does not require the impact of manipulating the identification and penalty information on the notices to be the same across the two samples. Rather, this study examines whether there is an additional role for q in a setting where p and a are already in operation. To the extent that increasing perceptions of p and a in the control group may also have implicitly signaled greater collection capacity to recipients, the following results may be interpreted as a lower-bound estimate of the impact of this intervention.

Table 4 shows the main results from experiment two (figure 3 displays the results graphically). Receiving a notice with the enforcement message leads to a 7.6 percentage point increase ($p = 0.054$) in responding to the tax notice, a 32 percent increase relative to the 23.7 percent response rate in the control group. It also causes a 6.9 percentage point increase ($p = 0.070$) in the likelihood of paying the tax, a 33 percent increase relative to the 20.6 percent tax payment rate in the control group. The average payment also rises by US$47 ($p = 0.037$), a 70 percent increase relative to US$67 in the control group.

These results indicate that the signal of higher enforcement probability sent by the tax authority was effective in causing more property owners in the treatment group to pay their arrears, relative to property owners in the control group who were notified that the tax authority was aware of the delinquency on their arrears and informed about the penalties for noncompliance. This finding demonstrates that the implicit assumption in standard models that $q = 1$ does not hold and that taxpayers' expectation that any penalties associated with noncompliance will be enforced on them is an important parameter to consider in tax compliance models (alongside the probability of identification/ detection and penalties, which are typically included).

Taxpayers' low q may, in part, explain why tax compliance remains quite low overall, even in the combined identification and penalty group in experiment one, of which only 13 percent responded to the notice. Low q is also consistent with evidence from other studies (e.g., Carrillo, Pomeranz and Singhal, 2017) in which a large majority do not respond evidence sent by the tax authority that their tax declarations were inconsistent with data from third-party information.

While we find an additional impact from the enforcement message, the response rate in the treated group is still only 31 percent, meaning that there is a large proportion of taxpayers for whom significant compliance barriers remain. These barriers may include a low perceived enforcement probability (despite the message), liquidity constraints, difficulty navigating the tax system, or political-economic factors, such as low tax morale (Prichard et al., 2019).

We conduct heterogeneity analyses to examine whether certain recipients were more responsive to the enforcement treatment, focusing on the two variables by which the randomization was stratified. First, we find no differential response from taxpayers by the length of the delinquency (one year versus multiple years). Thus, the results do not support the hypothesis that taxpayers with longer delinquencies are more difficult to bring back to compliance. Second, as shown in table 5, we find evidence that the treatment effect is driven by two of the three tax areas (area two and area three). The three areas of the city differ along multiple dimensions, such as property value, commercial activity, degree of enforcement, etc. While it is difficult to disentangle the different factors, we find some evidence consistent with the hypothesis that property owners who had been more exposed to prior enforcement activity by the LRA were more responsive to the enforcement message.

In the absence of direct information on the different enforcement activities carried out by area, the billing and payment records provide some suggestive evidence of the outcome of enforcement efforts across areas. We use the delinquency recovery rate from the prior fiscal year as a proxy for the extent of prior enforcement efforts. Table A6, column 4, shows that for properties similar to the experimental sample (tax liability below $1,000 and with tax arrears), the payment rate in area two is 9 percentage points higher than in area one ($p = 0.0003$), and the rate in area three is 5 percentage points higher than area one ($p = 0.057$). This pattern is consistent with a greater effect of the enforcement treatment in area two due to higher credibility of enforcement based on past experience.

Although the LRA did not systematically record follow up enforcement activities carried out against delinquent property owners in the treatment group that did not respond, there were no significant changes to their collection capacity around this time and the available evidence suggests that their actions, if any, were not substantial. We find no impact of the intervention beyond the first year (table 4 and figure 4). This result contrasts with the sustained compliance impact in experiment one, where there was a notable investment in identification capacity and indicates that shifting long-term beliefs about enforcement probability requires real changes in collection capacity.

6 Conclusion

This paper offers a framework to study tax capacity of emerging economies as three different dimensions: identification, detection, and collection capacity. Given the well-established body of evidence on the importance of verifying the amount of tax liabilities, for example, through third-party information, this paper focuses instead on identification and collection. It highlights the importance of first of all identifying taxable entities and tax bases to make the tax base more legible to the state. However, it also underscores that legibility is insufficient and demonstrates the key complementary role of the state's capacity to enforce tax laws and collect the unpaid tax liabilities it detects.

Experiment one shows that alerting property owners that their noncompliance has been discovered leads to increased compliance, when accompanied by information on penalties for noncompliance. Experiment two reveals that even with the identification of the tax base and information on penalties already in operation, increasing the perception that penalties will be enforced leads to additional compliance.

Distinguishing identification, detection and collection capacity is imperative for policy making. Diagnosing which capacity is the binding constraint in a given setting and investing accordingly is key to achieving higher tax receipts. There is significant policy interest in investments in identification and detection capacity, such as third-party reporting, the use of electronic databases, and technology-based tools for understanding and monitoring the tax base. However, donors and governments may overprioritize investment in costly information technology projects to the detriment of the less attractive and often politically costly task of increasing traditional enforcement to ensure the payment of known tax obligations (Arewa and Davenport, 2022). Further, investments in collection capacity can be challenging as they are often outside the tax system and require coordination with other government agencies—for instance, by improving the efficiency of the legal system for processing court cases.

This framework of identification, detection and collection capacity is useful for analyzing a broad range of issues in taxation and other compliance contexts. For example, to realize the self-enforcing compliance properties of value-added tax (VAT), the tax authority needs to 1) register VAT-eligible firms, 2) use data analytics to uncover mismatched reports between buyers and sellers, and 3) adopt policies to ensure detected liabilities are paid. On another note, the rising popularity of the controversial policy of taxing mobile money transactions in some African countries is linked to the ease of meeting the different tax capacity requirements: the amount transacted is easily recovered and can be collected at source by the mobile phone company.[20] Beyond taxation, separating the compliance problem into identification, detection and collection can also be useful for improving compliance with environmental regulations and labor laws, among other applications.

[20] Uganda, Ghana, Malawi, Tanzania, Cameroon, and the Republic of Congo have recently introduced or implemented legislation to impose taxes on mobile money transactions.

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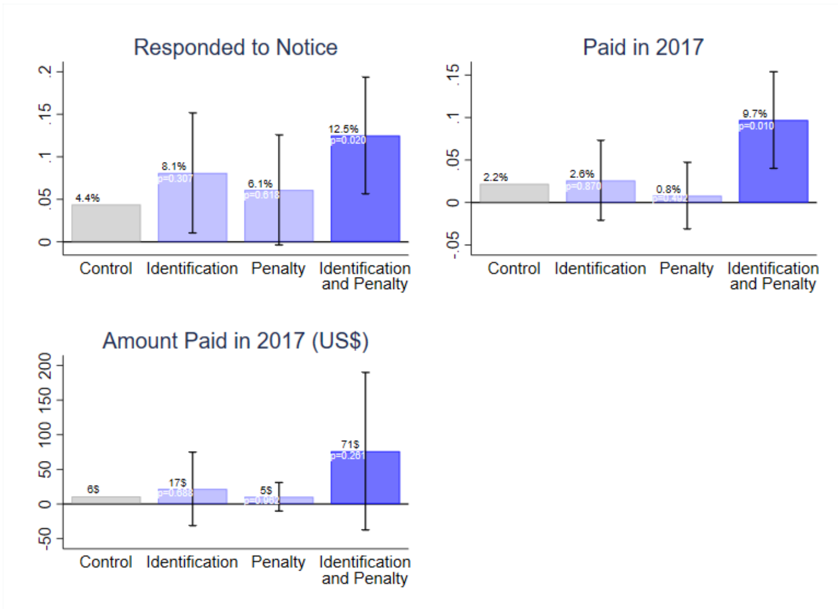
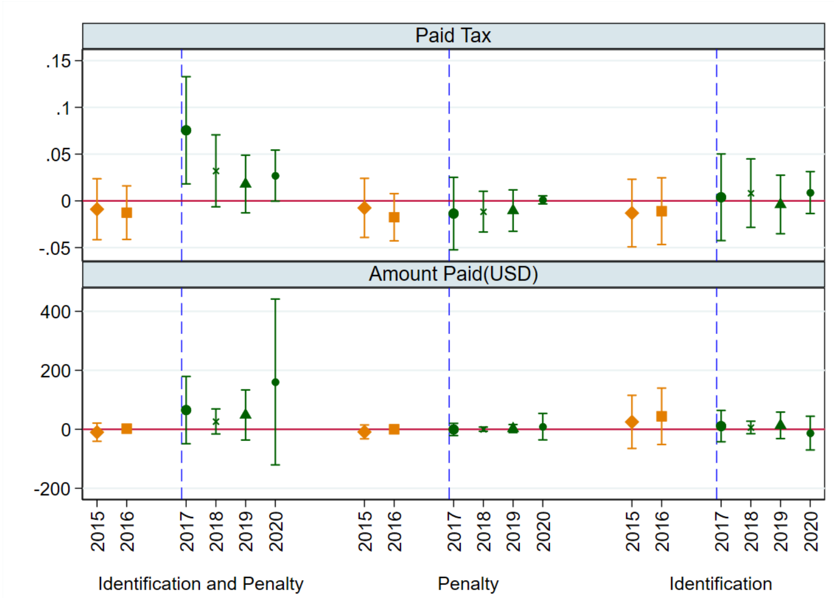
Figure 1: Impact of Identification and Penalty Notices on Registration, Payment, and Amount Paid, Experiment One



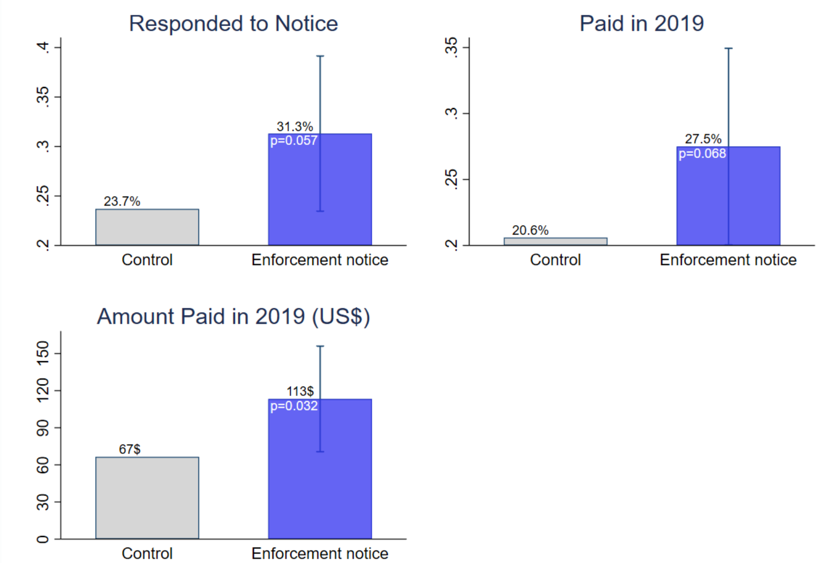
Note: This figure shows the treatment effect and 95 percent confidence interval from OLS regressions of the outcomes on the different treatment groups in 2017. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and location (one of three subareas). $N = 421$.

Figure 2: Event Study Graph, Experiment One



Note: This figure shows the treatment effect coefficient and 95 percent confidence interval from OLS regressions of the outcomes on the indicator for the treatment group for each year. The dotted lines indicate the year of the intervention. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and location (one of three subareas). $N = 421$.

Figure 3: Impact of Enforcement Notice on Response, Payment, and Amount Paid, Experiment Two



Note: This figure shows the treatment effect and 95 percent confidence interval from OLS regressions of the outcomes on the indicator for the treatment group in 2019. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and strata fixed effects (the interaction of being located in one of three areas and owing more than one year of arrears). $N = 511$.

Figure 4: Event Study Graph, Experiment Two

Note: This figure shows the treatment effect coefficient and 95 percent confidence interval from OLS regressions of the outcomes on the indicator for the treatment group for each year. The dotted line indicates the year of the intervention. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and strata fixed effects (the interaction of being located in one of three areas and owing more than one year of arrears). $N = 511$.

Table 1: Randomization Balance Table (Property Owners), Experiment One

	(1)	(2)	(3)	(4)	(5)	(6)
		Difference between control group and				
	Mean and SD of Control group	Identification and Penalty	Identification	Penalty	P-value of f-test	N
Property value (USD)	27722.224	151.764	-313.375	-3986.625	0.606	464
	[24673.623]	(3300.924)	(4236.209)	(3476.295)		
		{0.964}	{0.939}	{0.256}		
Area	1380.313	55.810	90.184	-129.496	0.487	464
	[1058.523]	(140.327)	(178.568)	(142.096)		
		{0.704}	{0.620}	{0.367}		
Rooms	3.349	0.204	0.112	-0.181	0.415	463
	[2.541]	(0.307)	(0.314)	(0.290)		
		{0.505}	{0.701}	{0.538}		
Bathrooms	1.925	0.029	-0.267	-0.252	0.375	462
	[1.516]	(0.221)	(0.222)	(0.210)		
		{0.901}	{0.236}	{0.235}		
Has Porch	0.840	0.002	-0.038	-0.046	0.692	464
	[0.369]	(0.048)	(0.053)	(0.053)		
		{0.963}	{0.453}	{0.390}		
Has Garage	0.113	-0.034	-0.028	-0.057	0.541	464
	[0.318]	(0.039)	(0.041)	(0.038)		
		{0.401}	{0.521}	{0.149}		
Commercial property	0.358	-0.031	-0.026	-0.038	0.933	464
	[0.482]	(0.063)	(0.066)	(0.065)		
		{0.628}	{0.697}	{0.556}		
Block two	0.509	-0.124*	-0.048	-0.034	0.234	464
	[0.502]	(0.065)	(0.069)	(0.069)		
		{0.058}	{0.443}	{0.589}		
Block three	0.311	-0.130**	-0.029	-0.060	0.117	464
	[0.465]	(0.058)	(0.063)	(0.062)		
		{0.025}	{0.678}	{0.320}		
Has female owner	0.236	0.010	0.083	0.024	0.549	464
	[0.427]	(0.057)	(0.062)	(0.060)		
		{0.855}	{0.175}	{0.673}		

Note: Column 1 gives the standard deviation in brackets. Columns 2, 3, and 4 give the coefficient and robust standard errors (in parentheses) from an OLS regression of the property/property owner characteristic on treatment indicator variables, controlling for owning multiple properties. Randomization inference p-values are in brackets.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table 2: Impact of Identification and Penalty Notices on Registration, Payment, and Amount Paid, Experiment One

	(1) Responded to notice	(2) Paid in 2017	(3) Amount paid (USD)	(4) Paid in 2018-2020	(5) Amount paid 2018-2020 (USD)
	Panel A: Short-term results			Panel B: Long-term results	
Identification and Penalty	0.081**	0.075**	65.266	0.043**	235.762
	(0.035)	(0.029)	(57.993)	(0.021)	(207.185)
	{0.032}	{0.007}	{0.389}	{0.042}	{0.432}
Identification	0.037	0.004	10.867	0.006	6.859
	(0.036)	(0.024)	(27.070)	(0.019)	(55.743)
	{0.361}	{0.894}	{0.807}	{0.755}	{0.951}
Penalty	0.017	-0.014	-0.503	-0.012	12.053
	(0.033)	(0.020)	(10.502)	(0.012)	(32.897)
	{0.681}	{0.638}	{0.988}	{0.580}	{0.897}
Identification and Penalty=Identification (*p-value*)	0.244	0.014	0.421	0.095	0.391
Identification and Penalty=Penalty (*p-value*)	0.090	0.001	0.317	0.012	0.386
Identification=Penalty (*p-value*)	0.581	0.540	0.782	0.395	0.946
Control mean of dependent var.	0.044	0.022	5.929	0.011	2.691
Number of observations	421	421	421	421	421

Note: This table gives results of OLS regressions of the outcome variables on the treatment indicator variables. Robust standard errors are in parentheses. Randomization inference *p*-values are in brackets. The omitted group is the control group. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and location (one of three subareas).
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table 3: Randomization Balance Table (Property Owners), Experiment Two

	(1) Mean and SD of control group	(2) Difference in treatment group	(3) N
Property value (USD)	37943.081 [48799.840]	3887.978 (4359.233) {0.381}	528
One floor	0.836 [0.371]	-0.032 (0.032) {0.347}	528
No fence	0.557 [0.498]	0.045 (0.041) {0.329}	528
Has landscaping	0.511 [0.501]	0.006 (0.043) {0.934}	528
Very good quality	0.706 [0.456]	-0.030 (0.040) {0.506}	528
On footpath	0.187 [0.391]	0.018 (0.033) {0.649}	528
Owner has 2+ properties	0.080 [0.272]	0.014 (0.024) {0.634}	528
Owner has commercial property	0.069 [0.253]	0.021 (0.024) {0.422}	528
Female owner	0.351 [0.478]	-0.084** (0.040) {0.034}	528
One year of arrears	0.508 [0.501]	0.000 (0.000) {1.000}	528
Zone 2	0.294 [0.456]	0.000** (0.000) {1.000}	528
Zone 3	0.355 [0.479]	-0.000 (0.000) {1.000}	528

Note: Column 1 gives the standard deviation in brackets. Column 2 gives the coefficient and robust standard errors (in parentheses) from an OLS regression of the property/property owner characteristic on treatment indicator variables, controlling for strata fixed effects.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table 4: Impact of Enforcement Notice on Response, Payment, and Amount Paid, Experiment Two

	(1) Responded to notice	(2) Paid in 2019	(3) Amount paid (USD)	(4) Paid in 2020	(5) Amount paid in 2020 (USD)
	Panel A: Short-term results			Panel B: Long-term results	
Enforcement notice	0.076*	0.069*	46.754**	-0.002	10.924
	(0.040)	(0.038)	(21.781)	(0.028)	(12.289)
	{0.054}	{0.070}	{0.037}	{0.947}	{0.504}
Control mean of dependent var	0.237	0.206	66.521	0.107	21.521
Number of observations	511	511	511	511	511

Note: This table gives OLS regressions of the outcome variables on the treatment indicator variable. Robust standard errors are in parentheses. Randomization inference p-values are in brackets. The omitted group is the control group. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and strata fixed effects (the interaction of being located in one of three areas and owing more than one year of arrears).
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

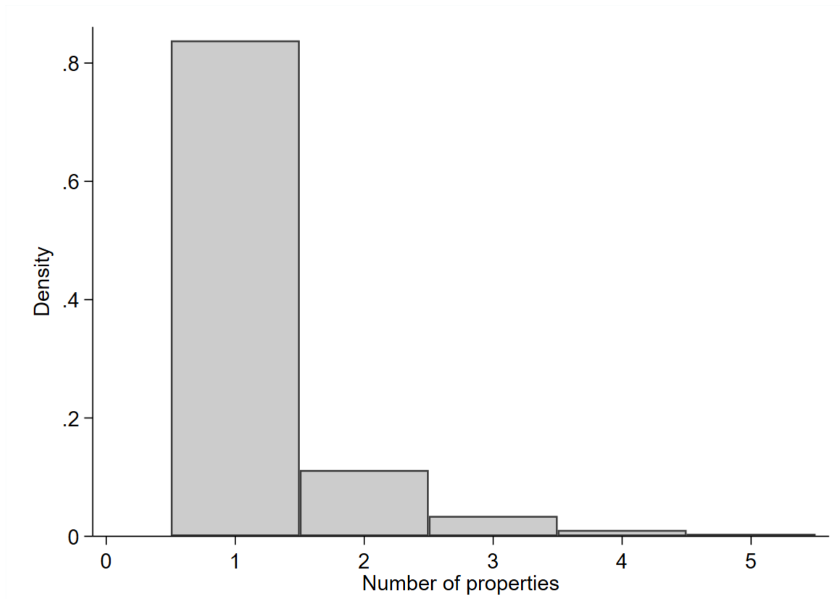
Table 5: Heterogeneous Impact of Enforcement Notice on Response, Payment, and Amount Paid, Experiment Two

	Responded to notice	Paid in 2019	Amount paid (USD)
	(1)	(2)	(3)
Impact of treatment in area one	-0.031	-0.016	56.458
	(0.070)	(0.067)	(49.750)
	{0.654}	{0.830}	{0.264}
Impact of treatment in area two	0.140**	0.128**	45.444*
	(0.064)	(0.060)	(24.974)
	{0.035}	{0.042}	{0.074}
Impact of treatment in area three	0.124*	0.101	38.436
	(0.069)	(0.067)	(33.532)
	{0.073}	{0.129}	{0.248}
Area one= area two (*p-value*)	0.071	0.128	0.844
Area one= area three (*p-value*)	0.106	0.212	0.758
Area two= area three (*p-value*)	0.852	0.784	0.871
Control mean of dependent var.	0.237	0.206	66.521
Number of observations	511	511	511

Note: This table gives the heterogeneous effect of the treatment in the three areas of the city. Robust standard errors are in parentheses. Randomization inference p-values are in brackets. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and strata fixed effects (the interaction of being located in one of three areas and owing more than one year of arrears).
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

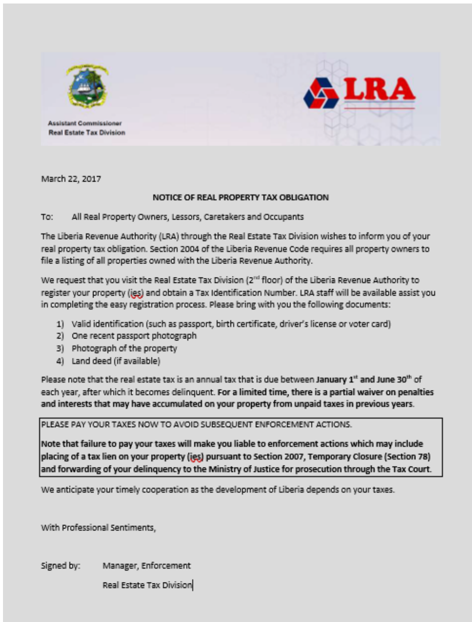
Appendix

Figure A1: Distribution of Number of Properties Owned



Note: This figure displays the distribution of property ownership among the sample for Experiment one.

Figure A2: Experiment One Notices



Assistant Commissioner
Real Estate Tax Division

March 22, 2017

NOTICE OF REAL PROPERTY TAX OBLIGATION

To: All Real Property Owners, Lessors, Caretakers and Occupants

The Liberia Revenue Authority (LRA) through the Real Estate Tax Division wishes to inform you of your real property tax obligation. Section 2004 of the Liberia Revenue Code requires all property owners to file a listing of all properties owned with the Liberia Revenue Authority.

We request that you visit the Real Estate Tax Division (2nd floor) of the Liberia Revenue Authority to register your property (ies) and obtain a Tax Identification Number. LRA staff will be available assist you in completing the easy registration process. Please bring with you the following documents:

1) Valid identification (such as passport, birth certificate, driver's license or voter card)
2) One recent passport photograph
3) Photograph of the property
4) Land deed (if available)

Please note that the real estate tax is an annual tax that is due between **January 1st and June 30th** of each year, after which it becomes delinquent. **For a limited time, there is a partial waiver on penalties and interests that may have accumulated on your property from unpaid taxes in previous years.**

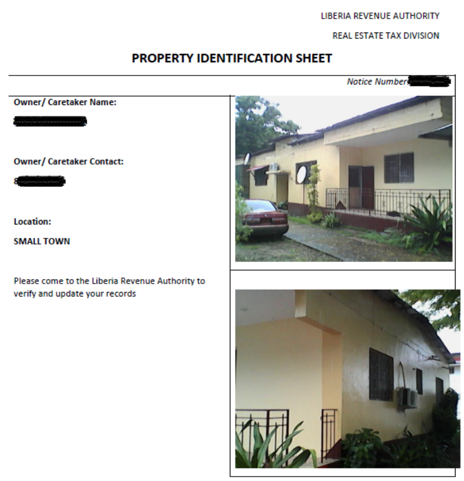
PLEASE PAY YOUR TAXES NOW TO AVOID SUBSEQUENT ENFORCEMENT ACTIONS.

Note that failure to pay your taxes will make you liable to enforcement actions which may include placing of a tax lien on your property (ies) pursuant to Section 2007, Temporary Closure (Section 78) and forwarding of your delinquency to the Ministry of Justice for prosecution through the Tax Court.

We anticipate your timely cooperation as the development of Liberia depends on your taxes.

With Professional Sentiments,

Signed by: Manager, Enforcement
Real Estate Tax Division



LIBERIA REVENUE AUTHORITY
REAL ESTATE TAX DIVISION

PROPERTY IDENTIFICATION SHEET

Notice Number [redacted]

Owner/ Caretaker Name:
[redacted]

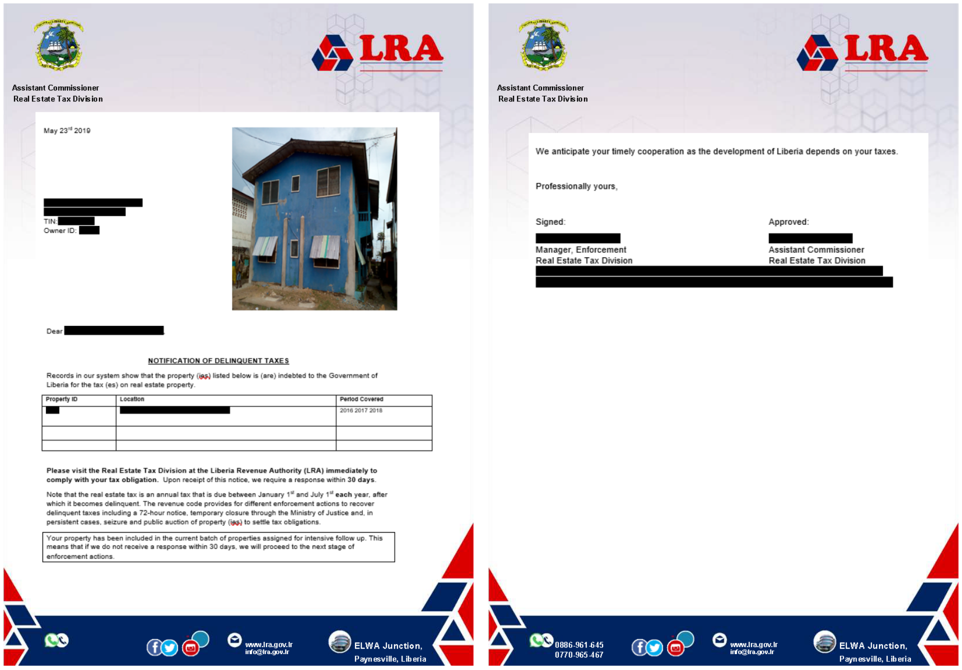
Owner/ Caretaker Contact:
[redacted]

Location:
SMALL TOWN

Please come to the Liberia Revenue Authority to verify and update your records

Note: The identification and penalty notice included both the letter and the property identification sheet shown above, stapled together. The penalty notice included only the letter above. The identification notice included the letter and the property identification sheet, but the letter did not include the boxed section containing penalty information. The control group received only the letter without the boxed section.

Figure A3: Experiment Two Notices



Assistant Commissioner
Real Estate Tax Division

May 23rd 2019

[redacted]
TIN: [redacted]
Owner ID: [redacted]

Dear [redacted],

NOTIFICATION OF DELINQUENT TAXES

Records in our system show that the property (ies) listed below is (are) indebted to the Government of Liberia for the tax (es) on real estate property.

Property ID	Location	Period Covered
[redacted]	[redacted]	2016 2017 2018

Please visit the Real Estate Tax Division at the Liberia Revenue Authority (LRA) immediately to comply with your tax obligation. Upon receipt of this notice, we require a response within **30 days**.

Note that the real estate tax is an annual tax that is due between January 1st and July 1st **each** year, after which it becomes delinquent. The revenue code provides for different enforcement actions to recover delinquent taxes including a 72-hour notice, temporary closure through the Ministry of Justice and, in persistent cases, seizure and public auction of property (ies) to settle tax obligations.

Your property has been included in the current batch of properties assigned for intensive follow up. This means that if we do not receive a response within 30 days, we will proceed to the next stage of enforcement actions.

www.lra.gov.lr
info@lra.gov.lr
ELWA Junction,
Paynesville, Liberia

Assistant Commissioner
Real Estate Tax Division

We anticipate your timely cooperation as the development of Liberia depends on your taxes.

Professionally yours,

Signed:
[redacted]
Manager, Enforcement
Real Estate Tax Division

Approved:
[redacted]
Assistant Commissioner
Real Estate Tax Division

[redacted]

0886-961-645
0770-965-467
www.lra.gov.lr
info@lra.gov.lr
ELWA Junction,
Paynesville, Liberia

Note: These are the front and back pages of the enforcement notice. The control notice did not include the boxed section of the letter.

Table A1: Randomization Balance Table (Properties), Experiment One

	(1)	(2)	(3)	(4)	(5)	(6)
		Difference between control group and				
	Mean and SD of Control group	Identification and Penalty	Identification	Penalty	P-value of f-test	N
Property value (US$)	26444.264	-2060.367	-4238.109	-135.445	0.469	571
	[24002.115]	(2712.522)	(2838.611)	(3539.482)		
		{0.447}	{0.965}	{0.142}		
Owner has multiple properties	0.329	0.000	-0.005	-0.038	0.881	571
	[0.471]	(0.055)	(0.055)	(0.055)		
		{0.993}	{0.505}	{0.940}		
Area	1356.580	-57.137	-188.388	67.002	0.257	571
	[1061.960]	(119.362)	(118.068)	(153.369)		
		{0.626}	{0.658}	{0.114}		
Rooms	3.370	0.013	-0.263	0.003	0.510	570
	[2.441]	(0.272)	(0.241)	(0.277)		
		{0.957}	{0.991}	{0.277}		
Bathrooms	1.932	-0.267	-0.313	-0.215	0.424	568
	[1.745]	(0.184)	(0.194)	(0.225)		
		{0.153}	{0.353}	{0.107}		
Has Porch	0.829	0.024	-0.054	-0.045	0.286	571
	[0.378]	(0.043)	(0.047)	(0.047)		
		{0.574}	{0.340}	{0.240}		
Has Garage	0.103	-0.036	-0.053*	-0.021	0.363	571
	[0.305]	(0.033)	(0.031)	(0.035)		
		{0.276}	{0.561}	{0.083}		
Commercial property	0.397	-0.089	-0.073	-0.084	0.362	571
	[0.491]	(0.056)	(0.057)	(0.057)		
		{0.116}	{0.130}	{0.198}		
Block 2	0.521	-0.138**	-0.063	-0.028	0.098	571
	[0.501]	(0.058)	(0.059)	(0.060)		
		{0.012}	{0.627}	{0.277}		
Block 3	0.281	-0.073	-0.041	-0.020	0.508	571
	[0.451]	(0.050)	(0.052)	(0.053)		
		{0.150}	{0.736}	{0.454}		

Note: Column 1 gives the standard deviation in brackets. Columns 2, 3, and 4 give the coefficient and robust standard errors (in parentheses) from an OLS regression of the property/property owner characteristic on treatment indicator variables, controlling for owning multiple properties. Randomization inference *p*-values are in brackets.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table A2: Delivery Balance across Treatment Groups, Experiment One

	(1) Notice delivered
Identification and Penalty	0.052
	(0.042)
	{0.224}
Identification	0.064
	(0.043)
	{0.134}
Penalty	0.046
	(0.044)
	{0.297}
Identification and Penalty=Identification (*p-value*)	0.745
Identification and Penalty=Penalty (*p-value*)	0.872
Identification=Penalty (*p-value*)	0.666
Joint F-test (*p-value*)	0.510
Control mean of dependent var	0.858
Number of observations	464

Note: This table gives an OLS regression of the property/property owner characteristic on treatment indicator variables, controlling for owning multiple properties. Robust standard errors are in parentheses. Randomization inference p-values are in brackets.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table A3: Randomization Balance Table (Property Owners- Delivered Notices), Experiment One

	(1)	(2)	(3)	(4)	(5)	(6)
		Difference between control group and				
	Mean and SD of Control group	Identification and Penalty	Identification	Penalty	P-value of f-test	N
Property value (USD)	27722.224	-437.852	-980.220	-7168.440**	0.060	421
	[24673.623]	(3665.449)	(4628.924)	(3301.363)		
		{0.915}	{0.827}	{0.027}		
Area	1380.313	30.642	61.952	-231.491	0.131	421
	[1058.523]	(155.473)	(194.465)	(143.868)		
		{0.856}	{0.759}	{0.103}		
Rooms	3.349	0.110	0.033	-0.270	0.471	420
	[2.541]	(0.344)	(0.350)	(0.328)		
		{0.745}	{0.922}	{0.414}		
Bathrooms	1.925	0.037	-0.298	-0.310	0.287	419
	[1.516]	(0.244)	(0.244)	(0.231)		
		{0.880}	{0.226}	{0.179}		
Has Porch	0.840	-0.020	-0.062	-0.064	0.569	421
	[0.369]	(0.050)	(0.055)	(0.055)		
		{0.699}	{0.270}	{0.255}		
Has Garage	0.113	-0.034	-0.028	-0.069*	0.396	421
	[0.318]	(0.043)	(0.045)	(0.041)		
		{0.428}	{0.545}	{0.108}		
Commercial property	0.358	0.004	0.030	0.002	0.960	421
	[0.482]	(0.065)	(0.069)	(0.068)		
		{0.953}	{0.649}	{0.970}		
Block two	0.509	-0.132*	-0.047	-0.043	0.238	421
	[0.502]	(0.069)	(0.073)	(0.073)		
		{0.055}	{0.503}	{0.543}		
Block three	0.311	-0.125**	-0.012	-0.051	0.145	421
	[0.465]	(0.063)	(0.068)	(0.067)		
		{0.045}	{0.865}	{0.434}		
Has female owner	0.236	0.008	0.072	0.034	0.674	421
	[0.427]	(0.061)	(0.065)	(0.064)		
		{0.899}	{0.279}	{0.583}		

Note: Column 1 gives the standard deviation in brackets. Columns 2, 3, and 4 give the coefficient and robust standard errors (in parentheses) from an OLS regression of the property/property owner characteristic on treatment indicator variables, controlling for owning multiple properties. Randomization inference p-values are in brackets.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table A4: Robustness Checks, Experiment One

	(1) Responded to notice	(2) Paid in 2017	(3) Amount Paid (USD)
Panel A: Unaffected sample			
Identification and Penalty	0.050	0.060*	72.822
	(0.036)	(0.031)	(70.802)
	{0.171}	{0.026}	{0.325}
Identification	0.041	0.007	9.221
	(0.037)	(0.024)	(29.178)
	{0.318}	{0.809}	{0.807}
Penalty	0.021	-0.011	-1.891
	(0.034)	(0.020)	(10.774)
	{0.600}	{0.735}	{0.962}
Identification and Penalty=Identification (*p-value*)	0.836	0.052	0.409
Identification and Penalty=Penalty (*p-value*)	0.434	0.010	0.313
Identification=Penalty (*p-value*)	0.622	0.538	0.784
Control mean of dependent var.	0.044	0.022	5.929
Number of observations	371	371	371
Panel B: Controlling for dummies for number of properties owned			
Identification and Penalty	0.077**	0.071**	65.647
	(0.035)	(0.029)	(58.731)
	{0.049}	{0.013}	{0.389}
Identification	0.038	0.004	10.862
	(0.036)	(0.024)	(27.205)
	{0.348}	{0.904}	{0.805}
Penalty	0.019	-0.016	-0.474
	(0.034)	(0.020)	(10.592)
	{0.627}	{0.579}	{0.987}
Identification and Penalty=Identification (*p-value*)	0.301	0.022	0.423
Identification and Penalty=Penalty (*p-value*)	0.133	0.002	0.322
Identification=Penalty (*p-value*)	0.608	0.494	0.783
Control mean of dependent var.	0.044	0.022	5.929
Number of observations	421	421	421

Note: This table gives results of OLS regressions of the outcome variables on the treatment indicator variables, similar to Table 2. Panel A includes dummies for number of properties owned (replacing a dummy variable for owning more than one property). Panel B restricts the sample to property owners who own only one property or whose multiple properties were all assigned to the same treatment group. Robust standard errors are in parentheses. Randomization inference p-values are in brackets. The omitted group is the control group. Control variables are owning multiple properties, owning a commercial property, property value (the highest value for those with multiple properties), having a female owner or co-owner, and location (one of three subareas).
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table A5: Delivery Balance across Treatment Groups, Experiment Two

	(1) Notice delivered
Enforcement notice	0.004
	(0.015)
	{0.806}
Control mean of dependent var	0.966
Number of observations	528

Note: This table gives an OLS regression of the property/property owner characteristic on the treatment indicator variable. Robust standard errors are in parentheses. Randomization inference p-values are in brackets.
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.

Table A6: Prior Year's Tax Arrears Payment Rate across Areas of Monrovia, Experiment Two

	(1) All	(2) Below US$1000 liability	(3) Owes tax arrears	(4) Below US$1000 liability and owes tax arrears
Area two	0.101***	0.086***	0.115***	0.091***
	(0.012)	(0.013)	(0.024)	(0.025)
Area three	0.046***	0.043***	0.066**	0.053*
	(0.013)	(0.014)	(0.027)	(0.028)
Number of observations	7496	6390	2203	2067
Mean of area one	0.207	0.228	0.290	0.320

Note: This table shows the success of prior enforcement actions in different areas of Monrovia. Robust standard errors are in parentheses. The omitted group is the control group. Control variables are owning multiple properties, owning a commercial property, property value, having a female owner, and location (one of three subareas).
Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.