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Compliance rates with local and national business taxes

Evidence from Kampala, Uganda

Rose Camille Vincent,¹ Stephan Dietrich,² and Kyle McNabb³

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Abstract: This paper investigates business tax compliance in a multilevel tax structure with limited coordination. We study the case of Kampala, where firms are taxed at national and local levels—by the Uganda Revenue Authority and the Kampala Capital City Authority, respectively—and where the agencies operate quasi-independently. We begin by merging large-scale administrative tax data from the separate registries of the two agencies. In doing so, we have a rare opportunity to understand firm compliance with their due payments to the URA and KCCA. Following the idea of a reciprocal exchange of taxation for public services, we also examine whether neighbouring infrastructure and the immediate environment of the firms are associated with patterns and spatiality of business tax non-compliance. Our results suggest that non-compliance with local business taxation is widespread, even for large firms that are fully incorporated and paying corporate income tax to the URA. Less than 20 per cent of corporate income tax filers are found to be paying trade licences to the KCCA for their businesses or for all their branches on an annual basis. The results of the merging exercise also convey crucial concerns about the inability of tax administrations to properly identify and monitor taxable businesses. The parallel registries create loopholes and pose significant challenges to revenue mobilization efforts across the board, as only a small percentage of firms comply with their due payments to tax institutions on a yearly basis. Non-compliance is found to be more prevalent in villages with poor public infrastructure, showing clear signs of spatial correlation.

Key words: business taxation, tax institutions, tax compliance, Uganda

JEL classification: H70, H71, H72, O10

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¹ Chair of Public Economics, ETH Zürich, Zurich, Switzerland; ² United Nations University—MERIT and Maastricht University, Maastricht, the Netherlands; ³ ODI, London, UK, and the Center for Tax Analysis in Developing Countries, Kampala, Uganda; corresponding author: rvincent@ethz.ch

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1 Introduction

Prevalent non-compliance with tax systems poses a strong challenge to state capacity and inclusive growth in developing countries. It undermines the ability of governments to finance public goods and services, notably those with the greatest impact on poverty alleviation and socioeconomic mobility, such as education and healthcare. In line with the global discourse on state capacity, aid dependency, and fiscal sustainability, an ever-growing literature seeks to understand taxation, tax institutions, and tax attitudes of individuals and enterprises in low- and middle-income countries. Prominent research approaches include tax experiments aimed at increasing compliance and limiting illicit behaviours (Brockmeyer et al. 2019; Castro and Scartascini 2015; Mascagni and Nell 2022; Santoro 2022),¹ extended use of public opinion surveys to shed light on underlying motivations for compliance (Ali et al. 2013; Blimpo et al. 2018; Vincent 2023), and increased use of administrative tax data (Almunia et al. 2022; Mascagni et al. 2023; Pomeranz 2015).

Despite this trend, there remain very limited theoretical and empirical insights on compliance in multi-level tax settings, be it with respect to developing or developed economies.² The existing literature on tax compliance remains confined to frameworks that consider a bilateral relationship between tax authorities and taxpayers, whereas in reality taxpayers may have multiple payment obligations and often towards more than one tax authority. In contexts of limited fiscal coordination, multi-layer tax institutions—that is, a tax system overseen by multiple stakeholders—might add another layer of complexity to enforcement and result in sub-optimal levels of revenue mobilization and, potentially, higher compliance costs for firms and residents that are levied by different authorities or must pay in different jurisdictions. Fixed and transaction costs associated with tax and regulatory compliance may also create distortion, trigger inefficiency, and inadvertently disadvantage small business owners, who might deliberately choose to operate outside of the formal sector. Enforcement agencies may differ in institutional capacity and audit schedules, rendering monitoring of taxpayers complex and, thereby, tax collection subpar. It is thus of utmost importance to investigate how the multilevel structure of tax institutions influences compliance behaviours and patterns, especially in low- and middle-income countries, where the existing literature points to the lack of intergovernmental fiscal coordination as an important impediment to revenue mobilization (see e.g. Ali et al. 2014; Moore et al. 2018; Vincent 2023).

This paper analyses patterns of business (non)-compliance with local and national business taxes in Kampala, Uganda. Enterprises operating in Kampala are taxed at the local level by the Kampala Capital City Authority (KCCA) and at the national level by the Uganda Revenue Authority (URA). These agencies have been operating independently in their enforcement of business taxes, despite recent initiatives aiming at improving taxpayers' registration and ensuring coherence across registries.³ Kampala provides an ideal setting for understanding the compliance patterns of firms in a context of limited vertical coordination in enforcement. We thus study the extent to which firms have complied with the two streams of levies using comprehensive administrative tax data (the two registries from the KCCA and the URA) covering the period 2015–21.

¹ See also Mascagni (2018) for an extended review of tax experiments in developing economies.

² See, for instance, Vincent (2023) and Martinez-Vazquez (2015) for discussions on the potential ramifications of multilevel tax structure for compliance.

³ See Jouste et al. (2021) for an overview of the Taxpayer Register Expansion Program (TREP), which aims at harmonizing the administrative systems of different governmental and tax institutions in Uganda. A key feature of the TREP initiative is the establishment of one-stop shops where businesses can deal with several agencies on one visit. This research is also closely in line with Uganda's 'Domestic Revenue Mobilization Strategy 2019/20–2023/24', which was drafted and approved by the Government of Uganda (2019). The strategy document posits the harmonization of local and central government taxation as a key priority and is regarded as an important set to improve service delivery and promote good governance and competence in the management of public affairs.

The contributions of this paper are threefold. First, by merging the KCCA and URA registries for multiple years we bring forward the multilevel dimension of business taxation, shed light on critical issues regarding unintegrated tax administration, and provide prime evidence on the discretionary decisions of firms regarding when and where to pay, using their past records in both administrative tax registries. To date, existing research linking multilevel tax institutions to compliance is scarce, and there are limited insights on low- and middle-income countries.⁴ This research is among the first to use extended administrative tax data to study business compliance in a multilevel structure with limited vertical coordination. Merging comprehensive tax registries from the KCCA and the URA allows us to study the extent and patterns of non-compliance and to estimate potential revenue shortfalls resulting from such a structure.

Second, we analyse the role of neighbouring infrastructure in shaping tax compliance of enterprises in the merged sample. Recent research in Kampala also suggests that firms typically cluster next to businesses in the same sector (see e.g. Vitali 2022). While it might be difficult to trace information exchanges among firms in the merged database, we postulate that patterns of non-compliance might be embedded in a spatial dimension, thus anchored in the immediate neighbouring conditions. Therefore, we exploit Google Street View (GSV) imagery, digital maps, and machine learning to infer neighbourhood-level conditions of infrastructure. We thereby derive an indicator of the quality of neighbouring infrastructure, used as one of the key predictors of compliance. In doing so, we follow the idea of reciprocal exchange of taxation for public services (see e.g. Bordignon 1993; Cowell and Gordon 1988; Fjeldstad 2006), and align with the spatial economics literature on the embeddedness of economic outcomes, given that firms do not operate in a vacuum but are instead shaped by their immediate environment (see e.g. Alm et al. 2009; Alm and Yunus 2009; Stalans et al. 1991).

Third, this paper contributes to the growing literature on taxation, tax institutions, and tax compliance in Africa, more generally, and in Uganda, in particular (see e.g. Almunia et al. 2022; Jouste et al. 2021; Kangave et al. 2016, 2018; Koivisto et al. 2021; Moore et al. 2018). Tax compliance remains an important policy challenge in Uganda: tax morale is low, the economy is largely informal, and tax administrations face numerous challenges, including limited ability to identify taxable entities. Despite recent improvements in revenue collection, the country's tax-to-GDP ratio remains low at 11.8 per cent in 2022 (UNU-WIDER 2023), whereas net official development assistance stood at 8.3 per cent in 2020—a net increase from 7.5 per cent in 2016 (World Bank Group 2020). According to the Afrobarometer (2018), about one-quarter of respondents in the region surrounding Kampala would avoid taxes if they had a chance to do so. Recent estimates from the International Labour Organization also suggest that the informal sector accounts for more than 50 per cent of the economy.⁵ While we do not dive into tax morale or the informal economy, this paper contributes to a greater understanding of the issue of the identification of taxpayers and coherence across parallel tax registries. Identifying taxable entities has long been pointed to as a major concern for revenue mobilization in low-income countries. As discussed by Okunogbe and Santoro (2022), to tax, governments must identify and trace taxpayers. Herein we demonstrate that the inability to adequately monitor taxpayers across the board—that is, with both local and national levies—is a significant impediment to compliance and further adds to the complexity of multilevel taxation in Kampala.

⁴ Among others, Vincent (2023) explores the effects of subnational taxing rights on tax compliance, but measured through survey data, which are limited in capturing real compliance. Güth et al. (2005) evidence, through a lab experiment, that individuals are more incentivized to contribute to local public goods than national ones. Other research focuses mainly on local government autonomy or fiscal decentralization as a determinant of tax compliance, with a focus on higher-income countries (see Torgler et al. 2010 on how local autonomy shapes compliance).

⁵ See, for instance, Hisali and Ddumba-Ssentamu (2013) and the ILO note on Uganda at: https://www.ilo.org/global/programmes-and-projects/prospects/countries/uganda/WCMS_815294/lang--en/index.htm.

The findings point to alarmingly high rates of non-compliance among businesses in Kampala, even among larger corporate firms. Zooming into the tax registries separately, it is evidenced that firms pay both corporate income tax (CIT) (to the URA) and trade licences (to the KCCA) very sporadically. For instance, with the local registry the revenue shortfall is estimated at approximately UGX10 billion (Ugandan shillings) in 2022 and close to UGX25 billion between 2019 and 2021.⁶ By merging the two registries, we found that less than 15 per cent of all firms are identified or have paid their tax liability on both sides for each year between 2015 and 2021.

Surprisingly, and against expectations, more than 38 per cent of the sample of CIT filers with the URA (firm–year) could not be found in the mandated local tax registry (i.e. trade licences with the KCCA). The inability to find all firms (or their branches) in both databases appears to be systemic, given that the share represented by the merged sample has not evolved much over time. The results of the merging exercise convey crucial concerns about the inability of tax administrations and local authorities to identify and monitor taxable businesses. This evidences that the high degree of independence and the parallel registries create loopholes and pose significant challenges to revenue mobilization efforts across the board—that is, at local and national levels—as only a small percentage of firms comply with their due payments on a yearly basis with both agencies.

With the merged dataset, we investigate the minimal intent of compliance with the KCCA. Of firms filing CIT (found or not in the KCCA registry), only 15.6 per cent of them have paid for at least one trade licence for all seven years across 2015–2021, and only 58.5 per cent of them are found to have paid for at least one trade licence on an annual basis (i.e. for all seven years) in the KCCA registry. It must be highlighted that these estimates are very conservative, given that many large and incorporated firms have more than one branch or more than one trade licence per branch. On an aggregate level, we found that less than 60 per cent of the CIT filers fully comply with their KCCA payments for all firm–branch–year observations. The revenue shortfall for the KCCA, conditional on full compliance with CIT (URA), is estimated at UGX16 billion for 2020–21.

Lastly, the findings point to a high spatial correlation between clusters of non-compliance and areas characterized by poor public infrastructure in the city. We leverage GSV images and construct an indicator measuring the quality of public infrastructure at the village level in Kampala. The results suggest that the probability of full compliance with KCCA payment is lower for firms located in neighbourhoods with poor-quality public infrastructure, eliciting a poor fiscal exchange between business taxpayers and government authorities.

The paper is structured as follows. Section 2 provides an overview of the business levies in Kampala. Section 3 describes the data sources (i.e. the KCCA and URA administrative tax registries). Section 4 dives into the merging procedures and compliance patterns of firms across registries. Section 5 empirically analyses the relevance of public infrastructure for compliance, and concluding remarks are found in Section 6.

2 Business levies in Kampala

Businesses in Kampala are taxed at the local and national levels—respectively, by the KCCA and the URA. At the local level, trade licences are required before business owners can operate. The licences are mandated by law and must be filed for or renewed on a yearly basis by all companies operating in Kampala, including those in the services sector. A predetermined schedule issued by the Ministry

⁶ For context, US\$1 is equivalent to approximately UGX3,600. The aggregated estimated revenue loss in 2022 due to non-compliance in Kampala exceeds 2 per cent of the KCCA’s total budget for the financial year 2022–23.

of Trade and Industry and the KCCA prescribes the fees per business type in the different grading or location areas. The fixed rates are thus a function of the location of the firms and the nature of the businesses. This latter is assigned upon registration from a classification list. The rate assessment is done by a revenue officer, who issues a KCCA payment advice form, and the corresponding payment is executed using any of the KCCA-designated mobile payment platforms or banks.

All firms in Kampala must also be registered and pay some form of business income tax to the URA. Registered businesses can pay into either the CIT or the presumptive tax schemes. The latter has been devised to facilitate the formalization and integration of small and medium-sized enterprises into the tax system (see e.g. Jouste et al. 2021; McNabb et al. 2022). As of 2022, the presumptive tax payment applies to firms with a turnover between UGX10 million and UGX150 million. The presumptive tax rates range from 0 per cent if annual turnover is lower than UGX10 million to $[0.7 \text{ per cent} \times \text{turnover} + \text{UGX}360,000]$ if turnover is greater than UGX80 million shillings and less than UGX150 million.⁷ Although different rates are charged for those firms that do not keep business records (McNabb et al. 2022), consideration of the turnover adds a degree of complexity to compliance with the presumptive tax scheme, given that many small and medium-sized firms do not abide by accounting practices (see e.g. Jouste et al. 2021; Verberne 2017).

In this paper we focus on the CIT scheme.⁸ The CIT rate is 30 per cent of chargeable income. It is mandated that incorporated firms file their returns electronically within six months of the end of the financial year (McNabb et al. 2022). The electronic forms gather detailed characteristics about business structures and transactions upon which is calculated the due payment for each firm in a given year. CIT thus differs from the trade licence (a flat rate) in that firms may attempt to under-report their profits and pay a lower effective rate.

Table 1: Business levies in Kampala

	KCCA TL	URA CIT	URA presumptive tax
Rates	Flat rate	30% chargeable income	0% if turnover < UGX10 million; up to $0.7\% \times \text{turnover} + \text{UGX}360,000$ if turnover UGX80–150 million
Variables	Location and nature	Turnover	Turnover, location, and nature
Timing	Fiscal/calendar year	Fiscal year	Fiscal year
Declaration	Predetermined	Self-declaration	Self-declaration

Note: the KCCA switched from a calendar payment to a fiscal year payment in 2016. Prior to 2020, the presumptive tax was solely based on the location and nature of businesses. From 2020, the calculation of tax liability also considers the turnover of businesses. Nature refers to the nature of businesses.

Source: information provided by URA and KCCA partners.

Table 1 summarizes the business levies in Kampala. While both enforcement agencies—the KCCA and URA—are tasked with enforcing business compliance, the two agencies have been operating independently with limited coordination in enforcement mechanisms—be it audit schedules, sending out reminders, or keeping records of Kampala-based firms. They also predominantly use different identification systems for their registries. A coding system known as the ‘City Operator Identification Number’ (or COIN) is used by the KCCA to identify and monitor traders or businesses, whereas the URA goes by the Tax Identification Number (TIN), resulting in parallel registries of the same firm or multiple branches of a given parent firm. Uganda, or more precisely Kampala, thus aligns with other African contexts where concerns of parallel registries, duplication of work, and inability to properly monitor

⁷ The owner of a single-person business could pay into the personal income tax scheme of the URA. Preliminary insights from the personal income tax database, however, suggest that there is a tiny number of single business owners following that path. If annual sales revenues are below UGX150 million, the owner can choose to file presumptive tax, which might result in a lower tax liability.

⁸ Access to the presumptive tax payment records was granted, and the new database will be used in an extended project.

taxpayers have been raised as impediments to revenue mobilization (see, for instance, Ligomeka (2019) for insights on Malawi).

Some efforts to circumvent issues of incoherent and parallel registries have been made in recent years, notably through the TREP. Since 2015 and owing to the TREP, the KCCA, URA, and the Uganda Registration Service Bureau (URSB) have worked towards improving information sharing across agencies to facilitate the tracing of firms across multiple registries. For instance, businesses created in 2015 or later could fulfil all their requirements at the established ‘one-stop shop’, where they pay their trade licences (thus assigned a COIN number from KCCA) and are simultaneously mandated to verify their TIN (from URA) and their business registration number from the URSB (see discussions in Verberne 2017). In addition to the ‘one-stop shop’, the KCCA and the URA have also joined hands in retrospectively assigning TIN numbers to firms registered prior to 2015, using exact or fuzzy matching based on business names, location details, and owners’ contact information. Such an initiative ensures that a firm can be identified through a unique ID in all three systems, and thus facilitates the merging of separate registries, as we do in this paper.

Yet, despite these ongoing efforts, the KCCA and the URA still operate with a high degree of independence, rendering overall business compliance challenging to measure and assess and, thereby, damping revenue mobilization efforts at the local and national levels. As depicted in subsequent sections of this paper, the distinct system appears to create structural challenges and large loopholes, with only a small percentage of firms complying with their due payments on a yearly basis with both agencies. Anecdotal evidence suggests that compliance cost is high as many firms still go to multiple offices, even though their first registration may have taken place at a ‘one-stop shop’. Previous research also hints at a low level of tax knowledge among firms in Kampala as they perceive different payments—such as the trade licences to KCCA and the presumptive tax to the URA—as double taxation and unnecessary (see e.g. Verberne 2017).

Understanding compliance patterns across multiple agencies or tiers of government is crucial, as revenue mobilization across the board matters in ensuring the effective and inclusive provision of public services in Kampala and beyond. Yet, the KCCA and the URA have not analysed patterns of compliance using a joint and merged database. We thus propose to fill the gap by linking the two main administrative tax data sources—the URA registry of corporate income taxpayers and the KCCA registry of trade licensees, which we describe in the following section—and by analysing compliance patterns of individual firms over time.

3 Data sources: administrative tax registries

This paper draws on two administrative tax datasets from the KCCA and the URA. These are the universe of trade licence holders (KCCA) and their annual payments from 2015 to 2022, and the URA panel dataset on CIT filers, covering 2014–21. To these administrative tax registries, we adjoin digital maps and geocoded information at the village level to assess the relevance of public infrastructure in shaping patterns of compliance (see Section 5). This section provides an in-depth overview of these two administrative tax registries, given the existing lack of descriptive information on these sources for the city of Kampala, while Section 4 explores the merging procedures and patterns of business (non-)compliance in the combined registry.

3.1 URA: corporate income tax panel

The URA’s CIT panel is constructed from the administrative income tax returns of incorporated firms over an eight-year period, from 2014 to 2022 (or FY2013–14 to FY2020–21). The dataset contains

approximately 350 variables from taxpayer registration forms (e.g. firms' characteristics) and income tax returns (such as balance sheets, profit and loss accounts, capital allowances, and tax calculations) (see McNabb et al. (2022) for further details on construction).⁹ The city of Kampala is predominant in the URA CIT panel. Across the eight years, some 105,528 firms were observed, of which more than 53 per cent operate in Kampala, as indicated in Table 2. The Kampala share in the CIT panel has also been growing significantly over the years, from 51.4 per cent in 2014 to 55.3 per cent in 2021. While finding concrete explanations for this rise is beyond the scope of this paper, it could be an indication of increasing agglomeration of incorporated firms, improved URA enforcement, or both. Either way, we can deduce that business activities by incorporated entities are heavily concentrated (and growing) in the capital city.

Table 2: URA CIT returns in Uganda and Kampala (2014–21)

Fiscal year	Year	# returns Uganda	# returns Kampala	% returns Kampala
2013–14	2014	30,363	15,595	51.40
2014–15	2015	35,953	18,597	51.70
2015–16	2016	41,285	21,353	51.70
2016–17	2017	43,079	22,694	52.70
2017–18	2018	47,058	25,379	53.90
2018–19	2019	51,721	28,298	54.70
2019–20	2020	56,522	31,000	54.80
2020–21	2021	55,834	30,881	55.30
			Mean 2014–21:	53.30
			Mean 2015–21	53.51

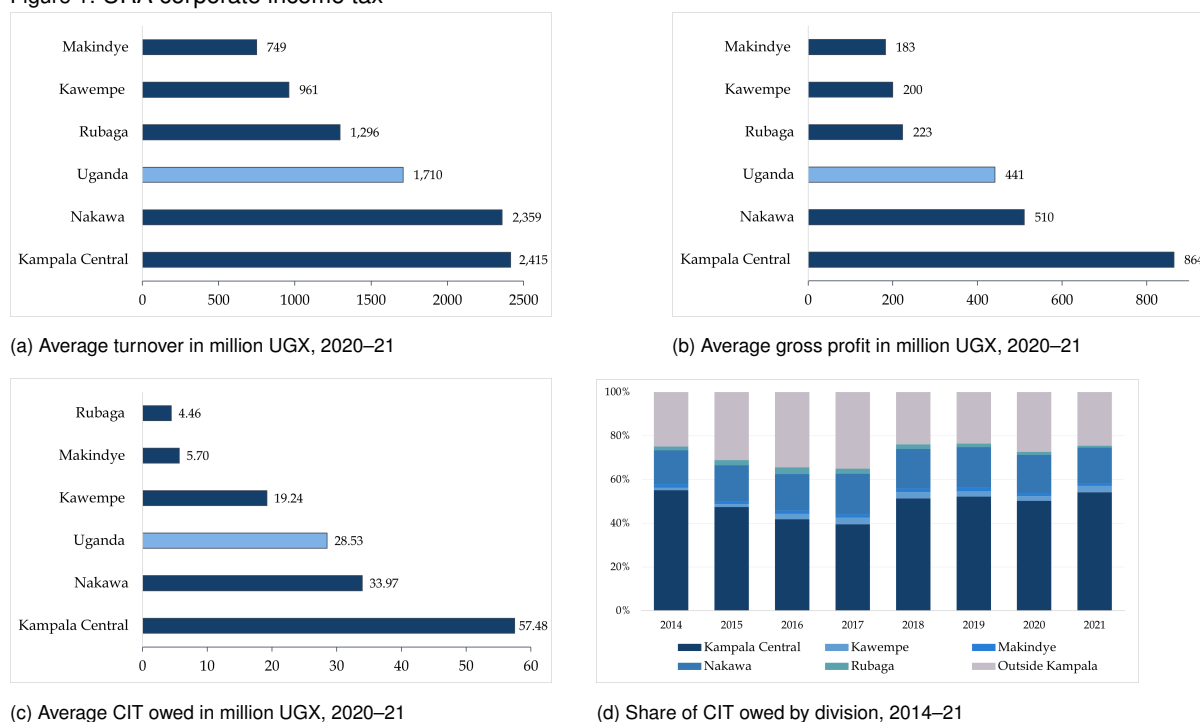
Source: authors' calculations using the URA CIT panel dataset.

Such growth is, however, not uniform across the city. The data show that there are spatial disparities in business activities across districts in Kampala. Kampala has five distinct divisions: Kampala Central, Kawempe, Makindye, Nakawa, and Rubaga. Figure 1 confirms the preponderance of the Central and Nakawa districts as economically important trading centres, be it in terms of average turnover, gross profit, amount of tax owed, or the share of CIT owed by divisions between 2014 and 2021. Profits and taxes owed by firms in Kampala Central are approximately twice the national average. Profits generated or taxes owed by firms in Kampala or Nakawa are also twice or more those reported by other divisions. For instance, taxes owed by firms filing CIT in Kampala Central are ten times higher than taxes owed by incorporated firms in Rubaga.

Despite these within-city disparities, Figure 2 serves to underline the importance of Kampala as an economic hub: in 2021, 75.5 per cent of assessed CIT was from firms operating within the city, of which more than 50 per cent were from Kampala Central. Comparing Figure 2 and Table 2, it is evident that the share of CIT revenue from firms based in Kampala exceeds the share of Ugandan firms operating in Kampala. Even as a share of business activity (proxied by turnover), we see a similar pattern emerge. In 2021, the share of all national turnover generated in Kampala was 66 per cent, while the share of tax payments from the Kampala districts was 75.5 per cent. This pattern holds true for all recent years in the dataset (2018–21). These estimates confirm Kampala as a stronghold of economic activity by businesses in Uganda and, therefore, an ideal starting point for understanding business compliance with tax payments in Uganda.

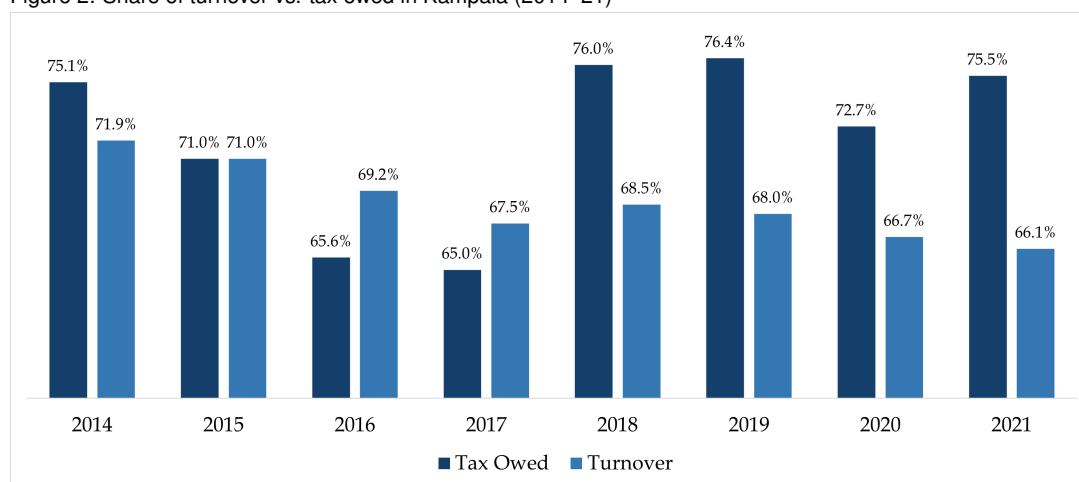
⁹ The dataset is part of an ongoing collaboration between the United Nations University (UNU-WIDER) and the URA. The anonymized dataset is made available to researchers at the URA Research Lab in Kampala.

Figure 1: URA corporate income tax



Source: authors' calculations using the URA CIT panel dataset.

Figure 2: Share of turnover vs. tax owed in Kampala (2014–21)



Source: authors' calculations using the URA CIT panel dataset.

Exploring the frequency of reporting to the URA, the data suggest that, of firms listed as registered as of 2021, only 13.6 per cent have filed CIT for all eight years in the database (panel A of Table 3).¹⁰ If we consider the time frame of 2015–21 (which overlaps with the time frame covered by the KCCA registry), only 3.9 per cent of incorporated firms have filed CIT for all seven years (panel B of Table 3). Table 3 also shows that there is no major discrepancy across divisions: the share of firms filing CIT for all seven years across 2015–21 is approximately 4 per cent across divisions. There are multiple explanations for these patterns. Since the URA CIT panel does not inform on the starting year of operations of the enterprises, it is difficult to disentangle those that fail to report CIT from those that were not operating in

¹⁰The URA CIT panel includes a variable that indicates whether a firm was registered as of 2021.

a given year. Hence, many firms reporting CIT for (for example) five years could have only existed for those five years. Alternatively, and given that the URA levies businesses according to two schemes—the CIT and the presumptive tax schemes—there exists a possibility that firms might jump out of the CIT and into the presumptive tax scheme if their turnover falls below the CIT registration threshold (UGX150 million) for a given year, and thereby benefit from a lower effective tax rate. A first exploration of the presumptive tax dataset points to a small sample of firms filing the presumptive tax in years for which they did not file for CIT.

Table 3: Frequency of CIT filing in Kampala (%)

<i>Panel A: 2014–21</i>						
Number of years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	25.3	28.3	26.8	23.7	28.4	25.6
2	17.2	17.5	17.8	16.9	17.4	17.2
3	13.2	13.0	13.1	13.7	14.0	13.4
4	10.1	9.3	9.5	9.5	9.5	9.8
5	7.5	7.2	7.4	7.8	7.5	7.6
6	6.4	6.2	7.1	6.6	6.6	6.5
7	6.4	5.9	6.1	6.8	5.8	6.4
8	14.0	12.6	12.2	15.1	10.8	13.6

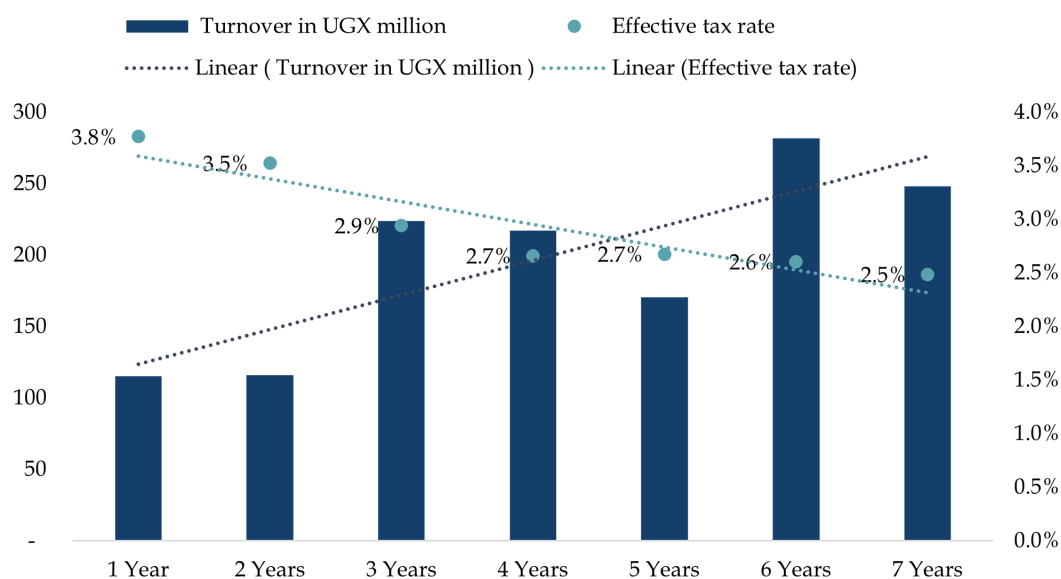
<i>Panel B: 2015–21</i>						
Number of years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	33.5	36.2	34.8	31.7	35.5	33.7
2	21.3	21.1	21.3	21.5	19.7	21.2
3	16.0	15.2	15.2	16.6	16.0	16.0
4	11.7	10.8	10.4	11.0	10.3	11.2
5	7.6	7.4	7.7	8.7	7.6	7.8
6	6.0	5.5	6.7	6.4	6.7	6.2
7	3.8	3.8	4.0	4.1	4.3	3.9

Source: authors' calculation using the URA CIT Panel dataset.

Notwithstanding, Figure 3 hints that frequent filers and those that are in the CIT for the longest timespan are of larger size in terms of business turnovers and are characterized by low effective tax rates on average.¹¹ The average gap in effective tax rate between the most and least frequent filers is approximately 1.3 percentage points (Figure 3), which might provide a justification for incorporated firms to benefit from a lower effective rate under the presumptive tax scheme. However, preliminary insights (not definitive) from the combined CIT and presumptive tax dataset do not point to a systematic transition from the former into the latter scheme. Still, further research is certainly needed to shed light on the potential strategic behaviours of firms within different URA tax schemes.

¹¹ Effective tax rates here refer to the ratio of tax liability over gross profit. It must also be noted that, in the calculation of the average effective tax rate, we included firms that had zero tax liability (or were in a loss-making position), which may have skewed the average downward.

Figure 3: Turnover and effective tax rates of frequent filers



Source: authors' calculations using the URA CIT panel dataset.

3.2 KCCA: trade licence panel

The KCCA trade licence panel is constructed from the universe of trade licence holders in Kampala from 2015 to 2022. The KCCA panel is such that multiple trade licence holders (with a COIN number) can belong to the same parent firm (with a TIN number). As such, we herein often refer to the licence holders as branches of a parent firm, although they might refer to the same enterprise in the absence of additional trade licences. The dataset accounts for 520,327 observations (unit-year), of which approximately 73,000 are unique licences (with a COIN) and 61,750 are unique parent firms (with a TIN). In addition to the fixed rate paid by each licensee per year, the dataset also contains approximately 30 other variables informing on the location (village, parish, division) of the branch, the grade, the industry classification, the nature of the business, the exact date of payment, and the date of first registration in the KCCA registry.

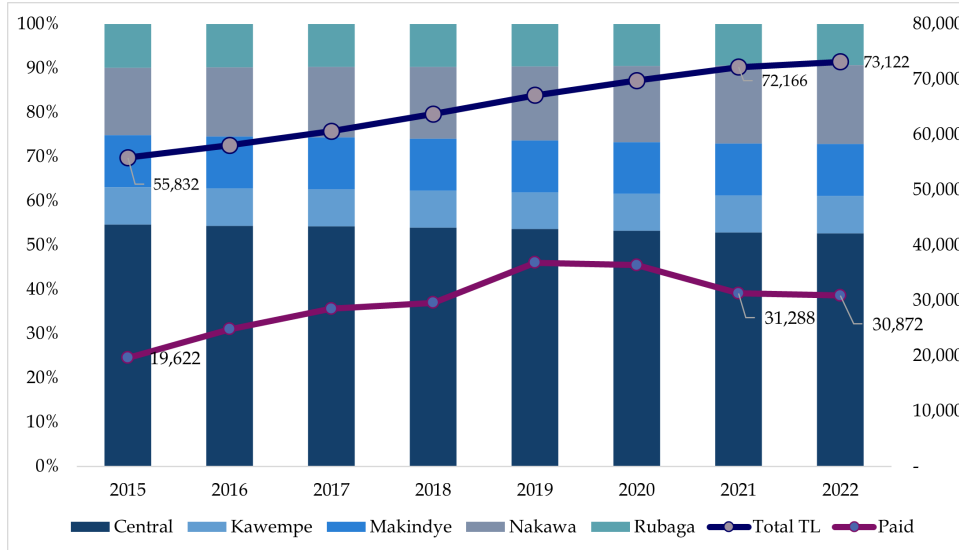
Figure 4 suggests that the cumulative number of licensees has increased significantly over the past years, from 55,832 in 2015 to 72,122 in 2022.¹² Despite this overall increase, Figure 4 also denotes that the share per division has remained relatively steady over time, with the largest share of licence holders operating in Kampala Central and Nakawa divisions (similarly to the CIT as in Figure 1). The spatial disparities in the number of traders across Kampala are further illustrated in Figure 5. Given the reported location details, we use an algorithmic approach to match each trader to the official village administrative boundaries of Kampala, with an accuracy rate of about 90 per cent.¹³ At the village level, Figure 5 further confirms the bunching of firms, with a large spatial variation and several commercial clusters where the licensees are registered. The spatial variation is also interlinked with the *grades*, which are assigned to businesses upon registration. For every type of licence, firms of grade 1 pay a higher flat rate, as grade 1 is also related to the location and accessibility of the firm. Unsurprisingly, Table 4 indicates that licensees in Kampala Central division are almost all grade 1, which is explained by the ascendancy of

¹²It must be noted that not all trade licenses are renewed on a yearly basis. The number of licences purchased for the first time or renewed represents less than 50% of the registry, although the share of paid or renewed has increased in recent years.

¹³The names of the 757 villages, as reported in the official maps and the tax registries, differ in about one-fifth of villages due to differences in spelling or additions in village names (for example, a number after the name). These discrepancies follow patterns that we detect through an algorithmic de-duplication approach in about half of the cases.

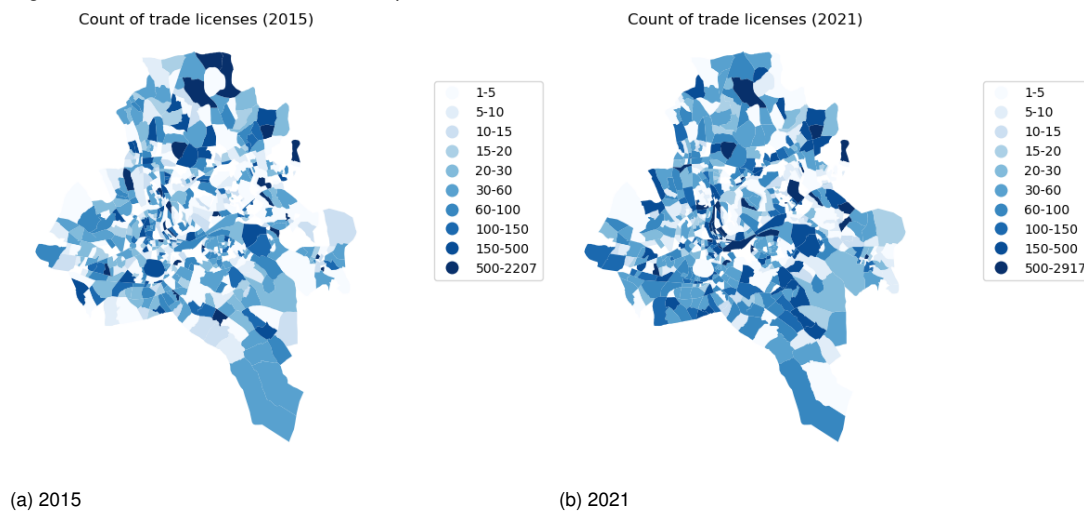
that business area in the ranking of Kampala divisions. ¹⁴ Panel B of Table 4 also highlights a critical issue in the identification of licensees: more than 65 per cent of all firms, regardless of the division, are classified as ‘General’ or ‘Others’, indicating a certain fluidity in business activities, rendering industry identification more challenging to measure and, thereby, compliance to be enforced correctly as the flat rates are set according to the nature of businesses.

Figure 4: KCCA trade licenses



Source: authors' calculations using the KCCA trade licence dataset.

Figure 5: Count of trade licences in Kampala in 2015 and 2021



Source: authors' calculation using the KCCA trade licence dataset.

Unlike CIT payments, which are a function of the level of taxable business profit, trade licensees, as already described, pay a fixed rate based on a predefined schedule that accounts for their grade and the nature of the business. While we have insufficient information on taxable profit at the branch level, we can certainly estimate the frequency of trade licence renewals or payments for traders or branches of firms in Kampala across 2015–22 (or 2021 to align with the CIT) as we do for CIT payments in Table 3. Hence, according to Table 5, only 9 per cent of traders have actually paid or renewed their trade licences for all eight years in the registry, hence between 2015 and 2022 (panel A). When considering

¹⁴ More details on the classification of businesses and the assigned grades can be found on the website of the KCCA at <https://kcca.go.ug/trading-licence-rates>.

the seven-year period that aligns with the time frame of the CIT, 11.5 per cent of traders that have paid their licences for all years between 2015 and 2021 (Panel B).

Table 4: Trade licences by grade and sector in 2021 (%)

<i>Panel A: Share of trade licences by grade and division (%)</i>					
Grades	Central	Kawempe	Makindye	Nakawa	Rubaga
Grade 1	98.7	63.5	87.2	61.4	78.7
Grade 2	1.0	33.4	12.6	38.3	21.1
Grade 3	0.1	3.1	0.2	0.3	0.2
Grade 4	0.2	0.0	0.0	0.0	0.0
<i>Panel B: Share of trade licences by sector and division (%)</i>					
Nature of businesses	Central	Kawempe	Makindye	Nakawa	Rubaga
Agency and representative business	5.52	5.73	6.82	9.94	6.50
Construction business	0.96	1.63	1.60	2.54	1.42
Education institution business	0.30	3.42	3.45	1.64	3.23
Financial institution business	0.96	0.88	0.65	0.96	1.02
Garage and workshops	1.60	3.79	2.62	2.08	4.25
General	74.07	54.46	54.37	49.74	56.37
Health and medical business	0.36	2.41	2.07	1.34	1.82
Hostels	0.15	1.18	0.33	0.68	0.64
Hotels	0.17	0.27	0.59	0.22	0.37
Lodges/guest houses	0.36	1.84	2.45	0.78	2.36
Others	7.38	12.64	12.08	13.92	12.66
Printing or publishing house business	1.04	0.25	0.20	0.21	0.18
Professional and consultancy business	3.78	4.35	4.09	8.99	3.09
Recreation/entertainment	3.32	7.08	8.51	6.70	6.04
Security investigation and guarding business	0.03	0.07	0.17	0.26	0.06

Source: authors' calculations using the KCCA trade licence dataset.

Unlike the CIT panel, there is no indication of current or recent business operations of traders in the KCCA registry as of 2021 (i.e. no variable on current registration status for traders that are listed in 2017, for instance). Given that the KCCA data includes the first registration date of each trade licence, we consider refining the sample by only including those that have either registered for the first time or renewed their trade licences in 2017 or later. In addition, we exclude firms that may have benefited from a potential waiver. A court decision which dates back to 2016 has granted exemption (upon request) to some categories of businesses, including foreign exchange bureaus, ATM machines, legal firms, maternity homes, pharmacy and drug stores, tertiary education, and private schools. While those firms account for less than 2 per cent of the entire sample, excluding them post-2017 might limit biases in our estimates. With the refined sample, panel C of Table 5 still suggests that only 12.5 per cent of all licensees have paid or renewed with the KCCA for all seven years (2015–21)—an estimate that is very close to the one reported in panel B. We thereby conclude that traders pay or renew their licences very sporadically and that the intent of compliance with trade licences is extremely low (as there is no parallel scheme, as with the URA's CIT).

Table 5: Frequency of paying/renewing trade licences with the KCCA

<i>Panel A: All licensees, 2015–22</i>						
Number of years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	31.8	43.8	37.6	48.2	37.9	37.0
2	14.3	14.2	15.0	16.0	16.5	14.9
3	11.8	10.3	10.9	9.4	11.2	11.1
4	8.4	7.4	7.8	6.0	8.2	7.8
5	7.6	5.6	6.7	4.7	6.5	6.7
6	7.0	5.7	7.0	4.8	6.3	6.5
7	8.0	6.6	7.1	5.1	6.4	7.1
8	11.1	6.4	7.9	6.0	7.1	9.0

<i>Panel B: All licensees, 2015–21</i>						
Number of years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	31.8	42.2	38.6	48.7	39.6	37.1
2	16.6	16.8	17.4	16.8	18.4	16.9
3	10.8	9.6	9.6	8.5	9.7	10.1
4	8.7	7.6	7.6	6.1	8.0	8.0
5	7.9	6.6	7.4	5.4	6.9	7.2
6	10.3	8.8	9.3	7.0	8.5	9.3
7	14.0	8.4	10.1	7.5	9.0	11.5

<i>Panel C: Reduced sample, 2015–21</i>						
Number of years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	27.9	40.3	36.7	46.3	37.8	34.1
2	15.6	16.0	17.2	16.6	18.0	16.2
3	11.8	9.9	9.9	9.1	9.9	10.8
4	9.5	7.9	7.9	6.6	8.4	8.6
5	8.6	7.0	7.6	5.7	7.2	7.7
6	11.2	9.7	9.9	7.6	9.0	10.1
7	15.3	9.3	10.9	8.2	9.7	12.5

Note: sample of licensees with payment in 2017 or later and excluding potential exemptions.

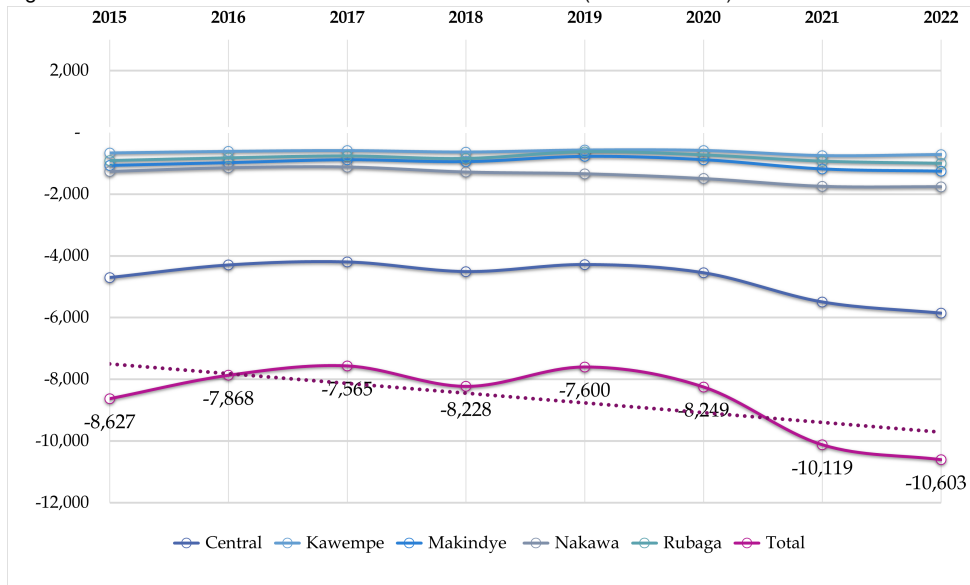
Source: authors' calculations using the KCCA trade licence dataset.

Given the predefined schedule and rates, estimating the revenue shortfalls from trade licences is straightforward, as the rates have not changed since 2014. We thus compute the gap between amounts paid and amounts due and derive the revenue shortfalls by year and by division in Kampala.¹⁵ Figure 6 indicates that the revenue shortfall is highly significant and stood at approximately UGX10 billion in 2022 and close to UGX30 billion in the last three years. In line with panel C of Table 5, we refine the sample and exclude firms that are potentially exempt from trade licences and only consider the sample of traders that have paid or renewed in 2017 or later. The resulting estimates are depicted in Figure 6b and point to a revenue shortfall of UGX9.1 billion as of 2022 and UGX24.5 billion in the last three years. In both cases, it is noted that the estimated shortfall is the highest in Kampala Central division, where close to 99 per cent of licensees are of grade 1—supposedly in a better position to comply with a fixed-rate payment for the trade licences. Given that most incorporated firms, be it by turnover or tax owed or their share in the local economy,¹⁶ are located in the Central division, the following section seeks to understand compliance with KCCA trade licences for firms that file CIT, and most notably those that are the most likely to have the resources to be compliant on both sides.

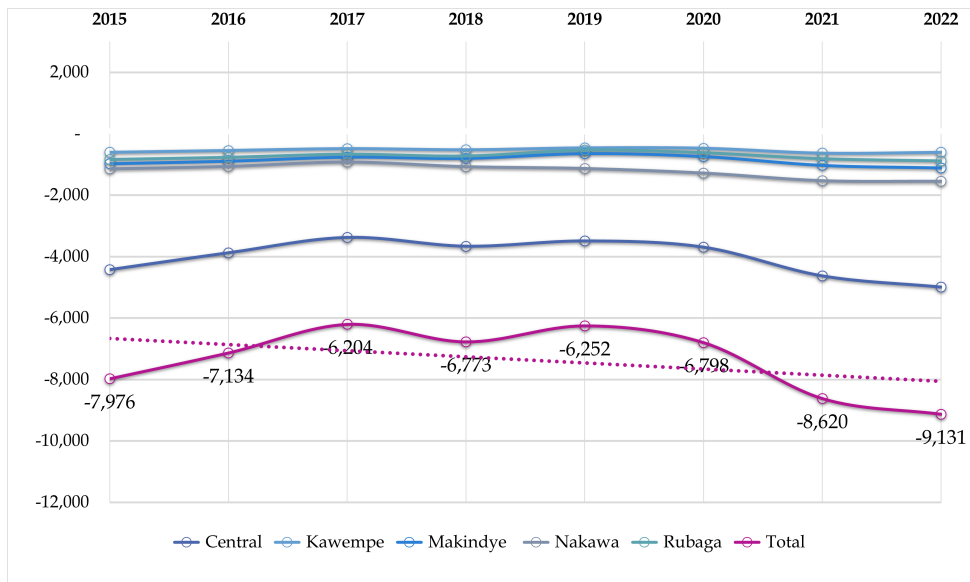
¹⁵ These calculations include all firms that have paid trade licences at least once between 2015 and 2021.

¹⁶ See previous insights from Figures 1 and 2.

Figure 6: Revenue shortfalls on trade licences for the KCCA (in million UGX)



(a) Full sample



(b) Sample of licensees with a payment in 2017 or later and excluding potential exemptions

Source: authors' calculation using the KCCA trade licence dataset.

4 Merging procedures and compliance patterns

This section explores compliance patterns of trade licence holders conditional on filing for CIT with the URA.¹⁷ Given the parallel registries and the high degree of independence in enforcement operations by the two agencies, the TIN number is the sole merging parameter on a year-to-year basis for the period 2015–21. As previously indicated in Section 2, firms registered in 2015 or later at the ‘one-stop shops’ are automatically assigned a TIN, whereas those with registries prior to 2015 have been retrospectively assigned a TIN number through matching characteristics of businesses and their owners’ details. Thus, using anonymized TIN numbers, we are able to merge and match records in the URA CIT panel and the KCCA trade licence registry.

Given the structure of business registration in Kampala and that of the two administrative tax data sources, many licensees (identified through the COIN) can be associated with a single parent firm (identified through the TIN). An incorporated firm can acquire a new licence either for a new branch or for adding different commercial activities to an existing location (e.g. a gambling venue inside a hotel). Each licensee can thus be considered as a different branch or entity of the same enterprise. Table 6 suggests that, on average, more than 75 per cent of traders are their own parent firms (i.e. 1 COIN = 1 TIN), whereas close to 22 per cent of parent firms are associated with 2–5 branches.¹⁸

Table 6: Number of branches by parent firm (TIN)

# branches	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1 branch	71.4	78.9	77.0	83.1	76.8	75.3
2–5 branches	25.9	18.0	20.0	14.9	19.0	21.9
6–10 branches	1.6	1.5	1.2	1.0	1.4	1.4
11–20 branches	0.5	0.6	0.8	0.3	1.0	0.5
More than 20 branches	0.6	1.1	1.1	0.7	1.9	0.8

Source: authors’ calculations using the KCCA trade licence dataset.

For the merging of the two registries, we adopt two approaches. First, we explore whether firms filing CIT are paying for at least one branch/licensee in the KCCA registry for each given year. This first approach is rather conservative, given more than 25 per cent of firms in the sample have two or more branches (see Table 6). Still, given that various commercial activities could occur at a single location, this procedure provides a minimal overview of the intent to comply with the KCCA by parent firms which file for CIT under the URA CIT scheme. Second, we merge and match all branches or licensees to their corresponding parent firms in the CIT. This second approach provides a fuller picture of compliance with trade licences conditional on filing CIT and allows us to more accurately estimate the revenue shortfalls for the KCCA from firms that are compliant with the URA CIT scheme.¹⁹

4.1 First merging approach and minimal intent to comply

As noted above, the first merging approach consists of identifying firms filing CIT with the URA that have at least paid for one trade licence in the KCCA for each given year. In the merging process we

¹⁷ Access to the presumptive tax payment dataset is limited at the time of writing. As mentioned above, an extended project will seek to understand compliance in the other direction—that is, compliance with the URA—either through CIT or the presumptive tax schemes, provided that a firm has been recorded and paying the KCCA.

¹⁸ Most certainly, not all parent firms of KCCA traders are found in the CIT, as some might fall under the presumptive tax payment scheme.

¹⁹ The first approach results in a merging procedure of 1:1 based on 1 TIN in the CIT and the maximum payment associated with that same TIN in the KCCA (i.e. payment for one trade licence associated with a COIN). In contrast, the second approach results in a merging of $m:1$ based on 1 TIN in the CIT and the repeated occurrence of that same TIN in the KCCA, which corresponds to multiple COIN numbers.

also narrowed the sample to CIT firms that are labelled as registered as of 2021. Ideally, and given the expected credentials of incorporated firms, we should, at a minimum, expect that all firms filing CIT are also paying their dues (fixed rates) with the KCCA and for at least one branch in each given year. The merging results are displayed in Table 7. At a minimal level, only 10.41 per cent of the sample could be matched across the two registries. More than 50 per cent of trade licensees with the KCCA could not be matched with their parent firms in the CIT. As previously discussed, some of those parent firms could fall under other schemes, such as the presumptive tax scheme (yet to be analysed).

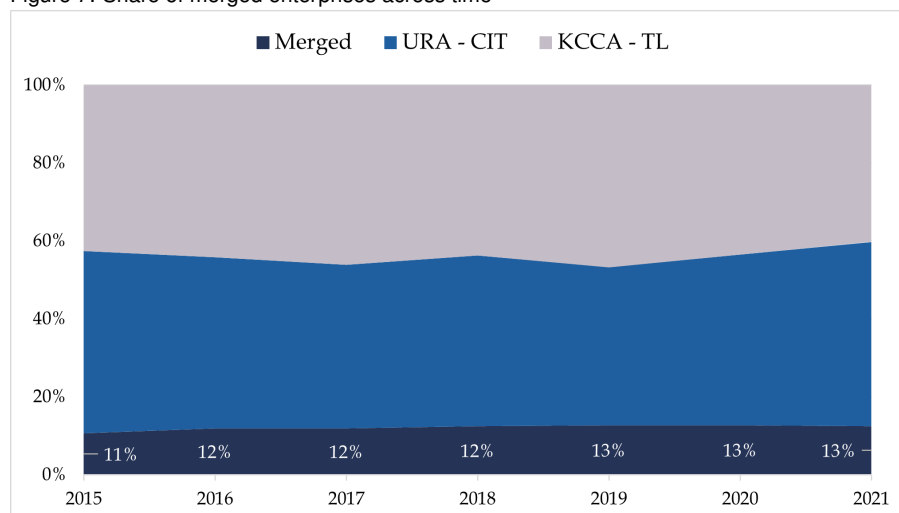
Table 7: Merging results: first approach (2015–21)

	Observations	Percentage	Unique TINs
(1) URA: CIT (unmerged)	139,418	37.36	41,952
(2) KCCA: TL (unmerged)	194,859	52.22	45,037
(3) Merged	38,848	10.41	9,488

Source: authors' calculations using the URA CIT panel and the KCCA trade licence datasets.

Surprisingly, however, more than 37 per cent of the entire CIT sample could not be found in the KCCA registry at all. In other words, those firms filing CIT could not be matched with any licences or branches in the KCCA. Table 7 also indicates that CIT filers could only be found in the KCCA 22 per cent of the time across the period 2015–21.²⁰ The inability to find CIT filers in the KCCA appears to be intrinsic as the share of the matched sample has not evolved much over time, as depicted in Figure 7. While there might be suspicions regarding data quality, all firms registering or renewing their trade licences are mandated to provide their TINs, particularly since the instigation of the TREP initiative in 2015. Regardless, these numbers convey crucial concerns about the inability of tax administrations to identify and monitor taxable businesses across the board, and point to the inefficiency that might arise in enforcement strategies and revenue mobilization.

Figure 7: Share of merged enterprises across time



Note: this graph refers to the minimal intent of compliance—that is, whether a parent firm filing CIT is found to be paying a trade licence to the KCCA for at least one branch in each given year.

Source: authors' calculations using the URA CIT panel and the KCCA trade licence datasets.

Table 8 zooms into firms that are fully compliant with the CIT—that is, firms that have filed their CIT for all seven years between 2015 and 2021. With this sample, we explore the minimal intent to comply with the KCCA—that is, paying or renewing trade licences for at least one branch in each given year. Table 8 shows only 15.6 per cent of those firms—which have fully complied with the URA for all seven years—are also compliant with at least one branch with the KCCA on a yearly basis (panel A). This is

²⁰ This refers to the ratio of (3)Merged in (3)Merged + (1)URA-CIT only

assuming that firms which have filed CIT for all seven years and not merged with the KCCA are simply non-compliant.

Table 8: Frequency of trade licences renewal given CIT filing (%)

<i>Panel A: Full CIT sample (merged & unmerged)</i>						
Years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
0	61.6	69.7	71.5	67.2	69.9	65.2
1	3.5	3.3	3.0	3.4	3.9	3.5
2	2.0	1.4	2.2	2.3	1.4	2.0
3	1.9	1.9	1.7	2.1	2.2	2.0
4	1.6	1.9	1.5	1.5	2.7	1.7
5	2.8	3.5	3.0	2.6	1.9	2.8
6	7.9	5.4	6.3	7.6	5.3	7.3
7	18.7	12.8	10.7	13.4	12.8	15.7

<i>Panel B: CIT & KCCA merged sample</i>						
Years	Central	Kawempe	Makindye	Nakawa	Rubaga	Full sample
1	2.1	1.4	1.9	2.1	3.3	2.1
2	1.8	0.7	2.6	3.4	2.6	2.2
3	2.8	5.5	3.8	3.8	4.6	3.4
4	2.8	4.1	5.1	2.5	7.2	3.3
5	6.5	12.3	10.2	7.9	5.2	7.4
6	22.2	20.6	24.8	26.0	19.0	23.0
7	61.8	55.5	51.6	54.4	58.2	58.7

Source: authors' own calculations using the URA CIT panel and the KCCA trade licence datasets.

Alternatively, if we assume inaccuracies with the TIN numbers across registries and only consider the sample of CIT firms that have paid for all seven years and which could be matched with their respective branches for at least one year across this period, panel B suggests less than 60 per cent of all firms could be matched with at least one of their respective branches for all seven years (or minimally compliant with the KCCA). Considering that many firms have multiple branches (see Table 6), less than 60 per cent is a very conservative estimate as it indicates that even those who are found to be regular filers with the URA are only sporadically compliant with the KCCA.

Moreover, fully compliant CIT firms which failed on their due payments with the KCCA (i.e. paying less than the seven mandated years) do not appear to be subpar on average, be it in terms of turnover or gross profit or effective tax rates. In fact, Table 9 indicates that firms paying less than seven years to the KCCA tend to have, on average, lower tax liability, except those paying four years out of seven. These ratios point to a low intent to comply with the KCCA despite firms filing all required years with the URA under the CIT scheme. The underlying motives for non-compliance with the KCCA by large incorporated firms thus remain a significant window for additional research.

Table 9: Characteristics of frequent CIT filers

# KCCA payments (years)	Million UGX				
	Turnover	Gross profit	Taxable income	Tax liability	Effective tax rate (%)
1	19,080.7	382.3	22.1	6.6	2.15
2	3,124.4	482.0	162.9	48.9	2.83
3	7,629.8	4,542.0	96.8	29.0	3.06
4	5,338.7	1,285.4	121.1	36.3	4.21
5	6,306.9	3,071.5	824.8	247.4	3.53
6	7,040.0	1,669.5	314.8	94.4	3.81
7	5,253.8	1,593.1	184.9	55.5	3.89

Note: CIT filers here refer to firms that have filed CIT for seven years. The estimates for turnover, gross profit, taxable income, tax liability, and effective tax rates are averages.

Source: authors' calculations using the URA CIT panel and the KCCA trade licence datasets.

4.2 Second merging approach and full compliance

In the second merging approach, we match individual licensees to their parent firms in the CIT. Similar to the previous approach, we only consider parent firms that have been identified as registered (i.e. active) as of 2021 in the URA registry. Table 10 suggests that for every year, less than 20 per cent of all trade licence holders appear, together with their parent firms, on both records for each year. While this ratio seems to have been improving over time, from 8.3 per cent in 2015 to 16.1 per cent in 2021, it remains very low in view of the expectations—that is, that incorporated firms are able to pay the flat rate of trade licences.

Table 10: Share of licensees and parent firms filing both KCCA and URA (CIT)

Year	Jointly compliant (%)	# branches	# parent firms
2015	8.3	885	580
2016	11.5	1,204	735
2017	13.1	1,529	834
2018	14.7	1,724	967
2019	17.7	2,726	1,438
2020	18.7	3,069	1,652
2021	16.1	2,859	1,864

Source: authors' calculations using the URA CIT panel and the KCCA trade licence datasets.

With this approach, we can also compute the paid-due-share for each firm filing CIT, considering their corresponding number of branches or licensees in the KCCA registry. The paid-due-share ratio ranges from 0 to 1, with 1 referring to fully compliant parent firms. In this case, we define as 'fully compliant' any parent firm that has filed CIT and which has paid trade licences for *all* its respective branches in a given year (hence paid-due-share = 1). Table 11 suggests that, of the small sample of CIT filers that appear in the KCCA registry in the same year, less than half are fully compliant with their KCCA payments for all firm–branch–year combinations. For example, in 2020 there were slightly more than 600 firms that filed CIT and simultaneously paid mandated trade licences for all their supposed branches. While there seems to have been an increase in 2021, it remains that even for parent firms that are registered on both sides, the gap in payment with the KCCA is highly significant. Furthermore, as previously suggested, Figure 8 does not point to much variation across divisions. It is also shown, in Table 12, that fully compliant firms are not systematically different on average from non-compliant firms (in line with Table 9).

Table 11: Share of CIT filers paying KCCA licences for all their branches

	2015	2016	2017	2018	2019	2020	2021
Share (%)	43.1	32.4	31.6	32.7	32.9	39.5	57.8
Number of parent firms	271	241	269	316	455	657	1113

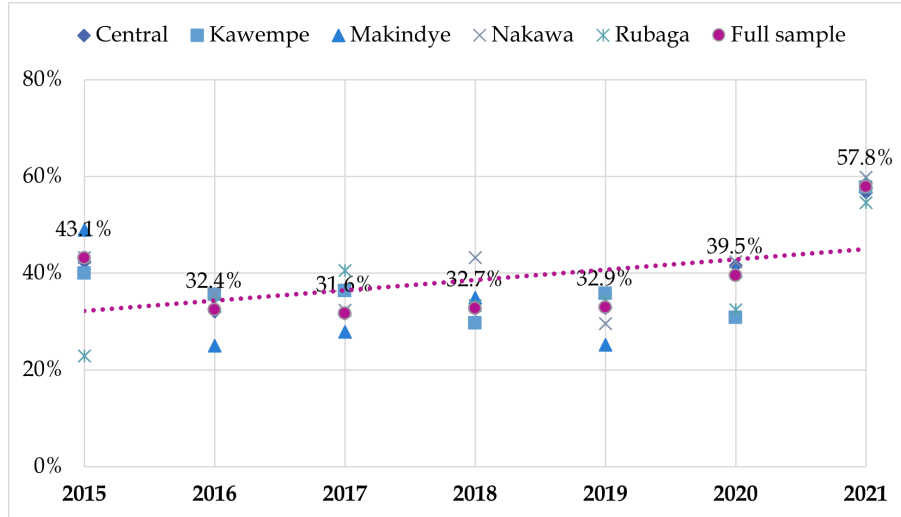
Source: authors' own calculations using the URA CIT panel and the KCCA trade licence datasets.

Table 12: Characteristics of fully compliant vs. partially or non-compliant firms (compliance with KCCA licences conditional on filing CIT)

Types	Million UGX					Average # branches
	Turnover	Gross profit	Taxable income	Tax liability	Effective tax rate (%)	
Compliant	2,689.00	687.96	120.83	36.25	3.46	1.32
Non-compliant	2,237.46	613.18	112.83	33.85	3.78	1.44

Source: authors' calculations using the URA CIT panel and the KCCA trade licence datasets.

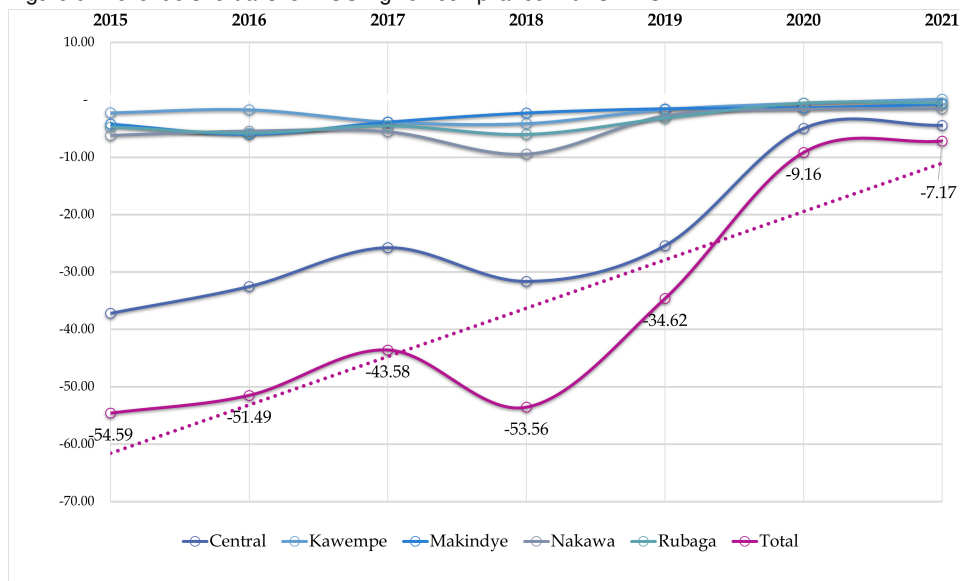
Figure 8: Share of CIT filers paying KCCA licences for all their branches, by division and by year



Source: authors' calculations using the URA CIT panel and the KCCA Trade licence datasets.

With this approach, we are also able to coherently estimate the revenue shortfalls for the KCCA conditional on parent firms complying with their CIT payments with the URA in each given year, in line with Figure 6. We do so by computing the revenue gap based on the number of branches and the corresponding licence rate per branch. If we consider the sample of firms that are found in both registries (for one branch or more), Figure 9 indicates that the revenue gaps have decreased for firms in both registries over the years. This, perhaps, might be an outcome of the TREP initiative, which may have ensured enhanced regularities of payments across registries since 2015. Notwithstanding, it remains that the gap is more than UGX7 billion in 2021 and more than UGX16 billion in the last two years. It must be noted that these estimates are very conservative. As noted above, if we assume that firms filing CIT and not found in the KCCA registry through their respective TIN numbers are non-compliant, the revenue shortfall would be much greater. Unfortunately, it is technically unfeasible to infer the nature of businesses or the number of branches of such firms and thus compute the associated revenue gap. In what follows, we assess how neighbouring characteristics shape firms' compliance with local payments as they file CIT.

Figure 9: Revenue shortfalls for KCCA given compliance with URA CIT



Source: authors' calculations using the URA CIT panel and the KCCA Trade licence datasets.

5 Neighbourhood characteristics and compliance

5.1 Measuring neighbourhood infrastructure quality

The previous sections describe the tendencies of firms to not comply with their KCCA payments despite having fully or partially complied with their filing obligations under the CIT scheme with the URA. From the data, we cannot infer the underlying non-compliance motives. However, we can profile firms at risk of non-compliance. To date, both the URA and the KCCA invest in communication interventions either in the form of Taxpayer Appreciation Weeks (URA) or regular community meetings (KCCA), but communication efforts remain highly non-targeted. A growing number of machine learning applications show how improved targeting can help improve public policies (Aiken et al. 2022; Andini et al. 2018; Dietrich et al. 2022; McBride and Nichols 2018).

In this section, we explore whether village-level characteristics could be useful predictors for the targeting of communication interventions. Yet, to understand the embedding in which firms operate, external data on neighbourhood-level information is needed. A new approach in the field of urban studies, even though, to date, mainly restricted to high-income country contexts, is the use of GSV imagery. Here, randomly sampled images within neighbourhoods are processed to classify elements such as housing/road infrastructure, traffic information, or building information (Goel et al. 2018; He et al. 2017; He and Li 2021). This approach has, for example, been used to link health outcomes, crime, or well-being reports to neighbourhood conditions (see e.g. Diego-Rosell et al. 2020; He et al. 2017; Rzotkiewicz et al. 2018). As rich GSV information is available for most of Kampala, we will apply this approach to gather such data on the villages.

Images collected by GSV provide a promising alternative to measuring neighbourhood conditions (Bader et al. 2017). We employ this approach to GSV images from Kampala to measure the quality of public infrastructure in neighbourhoods, which we then relate to non-compliance patterns. More broadly, this exercise aims to explore whether a data-driven targeting approach could support tax authorities in contacting and communicating with their clients more effectively.²¹

The procedures to compile a neighbourhood-level database are illustrated in Figure 10. First, we use maps of the 757 village boundaries in Kampala, the lowest administrative level. Thereafter, we match the administrative data with OpenStreetMap road network data. From the road network we can randomly sample nodes. With the location of these nodes, we pull GSV images at each of the sampled points using the GSV API. Not every sampled point has a usable GSV image, but GSV coverage is (surprisingly) high. Out of 1,000 sampled points, we obtained about 700 suitable images that were all taken in April/May 2015.²² To train an image classification model, we manually rated the public infrastructure as shown in the images in Figure 10.

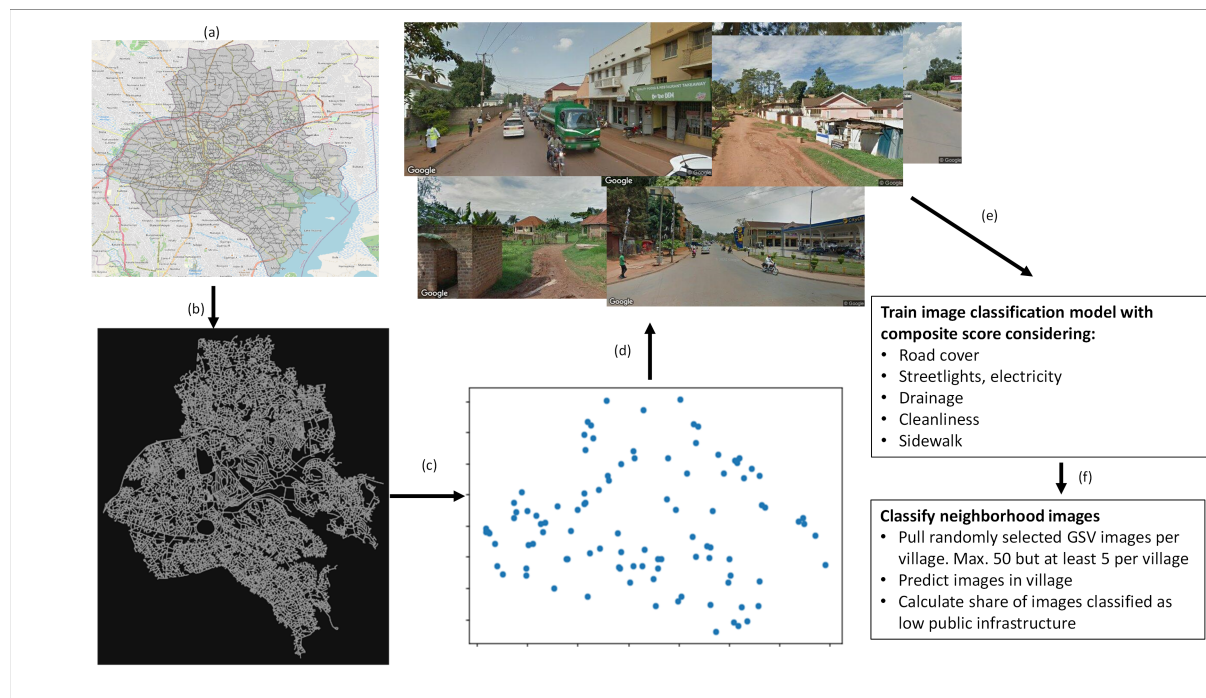
With a list of dimensions, including road coverage, street lights and electricity, sidewalks, drainage, and cleanliness, we build a composite score ranging from 0 to 100. With this training data, we build a neural network to classify images. To reduce noise in the public infrastructure ratings, we decided to classify

²¹ It is important to stress that, even if the accuracy should be high, predictions are not free of errors, and algorithms are often biased (Kleinberg et al. 2018). We do not regard this as problematic for low-stakes decisions such as whether to send a text message, but it would be problematic if applied to high-stakes decisions such as tax audits. For instance, in the context of this study, identifying firms at high risk of non-compliance could allow tax authorities to provide firms with additional information on tax procedures and possible consequences of non-compliance. These nudges, for example in the form of text messages or letters, have been shown to increase compliance significantly in a plethora of tax experiments. See reviews by Hallsworth et al. (2017) and Mascagni and Nell (2022).

²² Besides the availability of images, the perspective and neighbourhood representation in images need to be meaningful. For instance, close-up images of walls/buildings or other unfavourable image angles are not suitable for our purposes.

images that suggest a poor public infrastructure score (below 40), which is clearly distinct from images showing higher scores. Example images are provided in Figure 11. Our model performs reasonably well, achieving a prediction accuracy of about 85 per cent. False classifications are mainly around the cut-off used to define the low public infrastructure and related to the noise in ratings. To classify villages, we extracted about 8,000 GSV images for all street nodes in a village, restricting to 50 randomly selected images in larger villages. We then applied the classification model to these images and calculated the share of images that indicated a low public infrastructure for each village. We only consider scores for villages with at least five images and do not consider low-probability predictions.

Figure 10: Procedure for automated neighbourhood environment audits

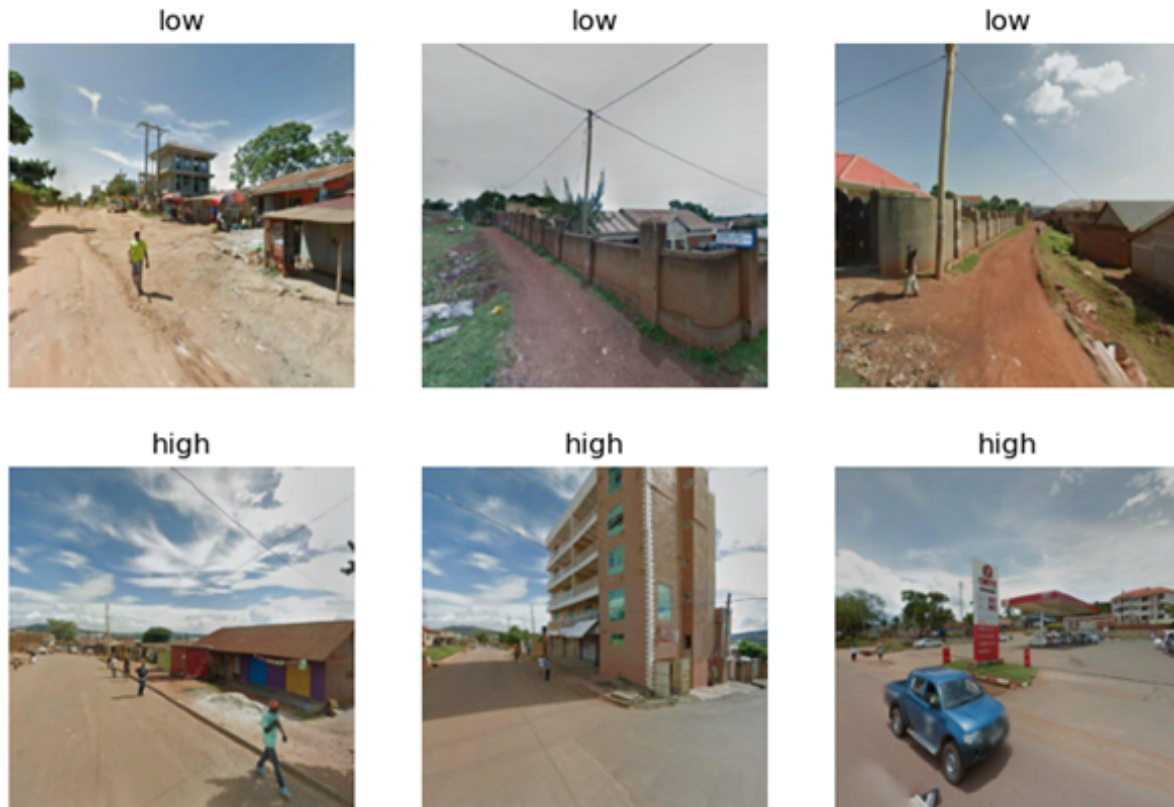


Note: the step-by-step procedure is as follows: (a) shape file with village boundaries; (b) OpenStreetMap shape file of road network in Kampala; (c) random sample of road points for each administrative region; (d) for each point, pull a GSV image using the GSV API; (e) train the model to classify public infrastructure; (f) extract GSV images per village and compute the share of images with a low infrastructure rating.

Source: authors' compilation.

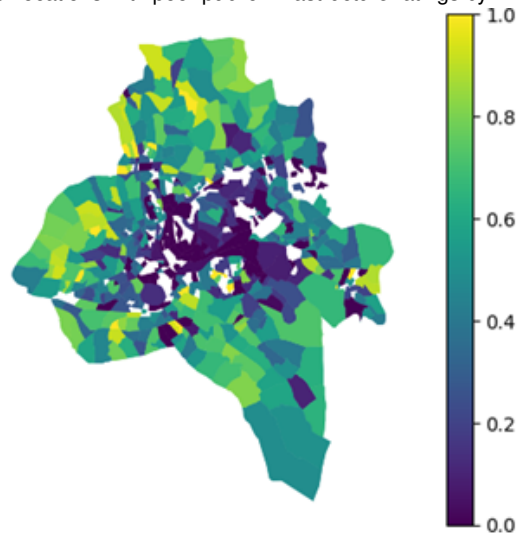
The results are presented in Figure 12. The darker the shade of the village region, the lower the share of low public infrastructure ratings. In contrast, yellow regions describe villages with images that predominantly show low public infrastructure levels. On average, the share of poor public infrastructure images is slightly above 40 per cent, but, as expected, we observe large variations across villages. The city centre clearly indicates a higher level of public infrastructure than the periphery. In the outskirts we see more variation in ratings, which in smaller villages can be related to lower numbers of images per village. However, particularly the northern villages consistently show a high share of poor infrastructure images. To summarize, the GSV ratings match the public perception of the public infrastructure, and while this information is not novel, it is digitalized and can be used for analytic purposes. In addition, while we use the images to rate local public infrastructure, many other relevant aspects could be elicited, too.

Figure 11: Examples of public infrastructure ratings



Source: Google Street View images.

Figure 12: Share of locations with poor public infrastructure ratings by villages



Note: a score of 0 means that none of the sampled GSV images was rated as showing low public infrastructure.

Source: authors' estimations based on GSV images.

5.2 Relevance of public infrastructure in compliance

Estimation strategy. We adopt a generalized linear mixed model (GLMM) with probit estimation techniques (also known as a mixed-effects probit model) as the primary identification strategy. This strategy nests the outcome variable in village contexts (Rabe-Hesketh and Skrondal 2012; Raudenbush and Bryk 2002). It is noted that such an approach has previously been used in empirical enquiries regarding tax compliance norms and attitudes (see e.g. Lago-Peñas and Lago-Peñas 2010; Vincent 2023). Given that

full compliance with KCCA payments (i.e. payment for all branches) conditional on filing CIT is binary, the likelihood of KCCA full compliance of parent firm i in village j is a function of the $1 \times q$ row vector \mathbf{x}_{ij} of firm characteristics, $1 \times p$ vector \mathbf{w}_j of contextual factors including the above proxy on infrastructure (i) lives, and random effects \mathbf{u}_j . $\Phi(\cdot)$ is the standard normal cumulative distribution function. \mathbf{z}_{ij} is the $1 \times n$ vector of covariates corresponding to the random effects and can be used to represent both random intercepts and random coefficients, which is the scalar 1 in the random intercept model. The probability of falling into the group of fully compliant firms is given as follows:

$$P(y_{ij} = 1 | \mathbf{x}_{ij}, \mathbf{w}_j, \mathbf{u}_j) = \Phi(\mathbf{x}_{ij}\beta + \mathbf{w}_j\delta + \mathbf{z}_{ij}\mathbf{u}_j) \quad (1)$$

Equation (1) can also be written in a latent linear form where the binary responses y_{ij} are determined by the latent continuous responses via the threshold model as in Equation (3). The error terms ε_{ij} and \mathbf{u}_{ij} follow the standard normal distribution with mean 0 and variance 1. ε_{ij} is also assumed to be independent across villages and independent of \mathbf{u}_{ij} . The random effects are not directly estimated as model parameters but are instead summarized according to the variance components. The random intercept can be seen as the combined effects of omitted village covariates that induce some firms to be more compliant than others. In all specifications, it is assumed that \mathbf{u}_{ij} are independent across individual respondents and independent of the covariates, and thus do not affect the probability of observing the firm-level outcome given the random intercept—strict exogeneity conditional on the random intercept (Rabe-Hesketh and Skrondal 2012: chapter 10):

$$y_{ij}^* = \mathbf{x}_{ij}\beta + \mathbf{w}_j\delta + \mathbf{u}_j + \varepsilon_{ij} \quad (2)$$

$$\text{with } i = 1 \dots I, j = 1 \dots J$$

$$\text{and } y_{ij} = \begin{cases} 1 & \text{if } y_{ij}^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

To assess the level of correlation within clusters or villages, the intra-class correlation or the variance partition coefficient can be derived. ρ is understood as the proportion of the variation explained by the hierarchical structure or village context. σ^2 is the variance of the random component \mathbf{u}_j , and θ^2 is the variance of the individual error term, which equals 1 in standard probit models. The ICC, calculated as follows, is reported for each specification under Table 13:

$$\text{ICC} = \rho = \frac{\sigma^2}{\sigma^2 + \theta^2} \quad (4)$$

Outcome variable. As indicated above, we define as ‘fully compliant’ firms that have paid all their dues with the KCCA—that is, for all branches and with a paid-due-share of 100 per cent—while also filing CIT payment in given years.

Main explanatory variable. Our main explanatory variable is the indicator measuring the quality of public infrastructure. It must be noted that although the images from GSV are predominantly tagged as collected or uploaded in 2015 for the village level in Kampala (which coincides with the beginning of our research period), we do not expect the indicator to vary significantly across the years. While changes over time are possible, it should be noted that we look at village averages. As described above, the model has been trained with consideration to various parameters such as road coverage, electricity, sidewalks, drainage, and cleanliness, and includes various images for each village. We do not realistically expect all these parameters to have changed drastically between 2015 and 2021. These features thus make the indicator less sensitive to changes in some construction works, and huge jumps in village aggregate level infrastructure are unlikely.

Other explanatory variable. Aside from the indicator on public infrastructure, additional control variables include, at the firm level, the number of branches, and at the village level, the village-averaged estimates of business income turnover, taxable income, and tax liability. In addition, we also control time dummies, which implicitly account for time variations that are common to all villages, such as city-wide or national policies related to taxation, infrastructure, and so on.

Table 13: Neighbourhood characteristics and compliance: generalized linear mixed model (GLMM-probit)

<i>Dependent variable: full compliance with the KCCA conditional on filing URA CIT</i>				
	(1)	(2)	(3)	(4)
Low-quality public infrastructure	-0.722** (0.290)	-0.847** (0.383)	-0.835** (0.384)	-0.835** (0.383)
Effective tax rate ^a		-1.567** (0.700)	-1.685** (0.655)	-1.637** (0.642)
Turnover ^a		0.049* (0.027)	0.057* (0.030)	0.059** (0.030)
Tax liability ^a		0.047 (0.034)	0.049 (0.033)	0.047 (0.033)
Number of branches			-0.085 (0.101)	-0.081 (0.101)
Constant	-0.208 (0.134)	-0.422* (0.222)	-0.391* (0.219)	-0.267 (0.225)
σ_2^2	0.684*** (0.153)	1.135*** (0.267)	1.137*** (0.266)	1.125*** (0.263)
Observations	10,131	7,642	7,642	7,642
Villages	170	148	148	148
χ^2	6.2	25.7	32.4	298.5
Log-likelihood	-6,545.2	-4,923.4	-4,918.6	-4,895.7
ICC	0.406	0.532	0.532	0.529
Time FE	No	No	No	Yes

Note: this table presents the results testing the relevance of neighbourhood quality infrastructure on the propensity of CIT-paying firms complying with the KCCA. σ_2^2 refers to the variance of the random components (village level). Control variables include the number of branches (at the firm level) and the averages of firms' turnover, effective tax rate, and tax liability. Average turnover and CIT tax liability are in the natural logarithm form. Specification (4) also includes year dummies. ^a refers to village-level averages. Significance level * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: authors' calculations.

Results and discussions. Table 13 reports the coefficient estimates. At the baseline, it is shown that approximately 4 per cent of the variation in compliance at the village level is due to within-village variation (ICC). It is noted that the number of villages has fallen to fewer than 150. This implies that most of the CIT parent firms are concentrated in a few villages out of more than 700 across Kampala. Across all specifications, it is demonstrated that the probability of full compliance with KCCA payment—that is, for all branches of a given parent firm—is lower for firms in villages with poor-quality public infrastructure as measured through the GSV images. While we do not infer causation, the coefficient estimates are robust across specifications, with or without the inclusion of variables that capture overall business activities and the economic importance of the villages where such firms are located. It is also noted that in specification (4) we control for year dummies, which capture both city-wide or country-wide policies that may have affected all firms. The results also indicate that firms in villages with higher average effective tax rates tend to be less compliant, whereas firms in villages with higher average turnover tend to be more compliant across the board.

6 Conclusion

This paper provides a data-driven insight into the pervasive issue of tax non-compliance among businesses in Kampala, embedded within a multi-layered tax system. Through the merging of administrative

tax data, we are able to profile non-compliant businesses and ascertain the substantial revenue losses due to non-compliance. We observe alarmingly high non-compliance rates, even among larger corporate firms, with only a fraction of firms fully compliant in terms of annual trade licence payments.

Interestingly, our findings demonstrate a high spatial correlation with clusters of non-compliance in city areas characterized by poor public infrastructure. We adopted a new approach in the field of urban studies, which leverages machine learning models and GSV imagery to classify elements such as housing/road infrastructure, traffic information, or building information and thereby derive a measurement of the quality of public infrastructure. The empirical estimates suggest that compliance with trade licences (local business taxes) is lower in villages with poor-quality public infrastructure, even when the firm is paying CIT to the URA.

The aggregated estimated revenue loss to the KCCA due to this prevalent non-compliance is estimated at more than UGX9 billion in 2022, exceeding 2 per cent of the KCCA's total budget for the financial year 2022–23. Such a loss is estimated at UGX7 billion in 2021 for incorporated firms that file CIT with the URA (thus compliant with the URA) and which are found in the merged registry. When analysing national tax compliance, we also found that only a modest proportion of corporate businesses in Kampala consistently filed national business taxes during the research period. The extent of these businesses' engagement in the presumptive tax scheme remains uncertain at present. This significant shortfall in tax revenue has serious implications for public finance and the provision of essential public goods and services in Kampala.

Therefore, it is essential to acknowledge several limitations of this study. First, our data-merging process, particularly concerning the presumptive income tax, is not complete. Once finalized, this will further corroborate our findings regarding non-compliance with national taxes. Second, our reliance on tax registry data could be prone to errors or omissions in recorded firm payments. We plan to undertake surveys with businesses to verify the validity of tax registry data and to delve deeper into motivations for non-compliance. Third, our measurement of non-compliance is admittedly incomplete. We cannot entirely rule out data entry errors or missed payments into the presumptive tax scheme. In addition, we only consider compliance at the extensive margin without verifying the accuracy of declared amounts, which falls outside this paper's scope. We are currently merging new data and survey data sources, which will refine and validate these estimates.

Despite these limitations, our findings underscore significant gaps in the tax system, leading to substantial revenue losses for both local and national tax authorities. It is clear that closer coordination between these authorities could drastically improve tax revenue monitoring and significantly boost collections. Our data suggest large loopholes and common non-compliance practices that could be relatively easily detected through increased coordination between tax authorities.

In conclusion, the fight against tax non-compliance in Kampala requires more than mere policy adjustments; it requires a systemic and coordinated effort across multiple levels of tax authorities. Our study marks a crucial step in that direction, underscoring the urgency of fostering a robust, integrated tax system to achieve sustainable revenue mobilization and promote socioeconomic development. Future work will develop coordinated communication efforts by tax authorities as a potential strategy for enhancing compliance, which will be tested through a randomized controlled trial.

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