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The panopticon taxman: The impact of e-invoicing on VAT compliance in Uganda

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The panopticon taxman

The impact of e-invoicing on VAT compliance in Uganda

Adrienne Lees,¹ Maria Jousté,² Nicholas Musoke,³ and Joseph Okello³

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Abstract: The digitalization of tax administration promises improved efficiency and increased tax revenues. In recent years, the information trail of the value-added tax (VAT) has been digitalized in many developing countries. We evaluate the impact of introducing an e-invoicing system in Uganda using administrative tax data in a synthetic difference-in-differences framework. To identify the effects on firms' reporting behaviour, we exploit a policy change that exposed a subset of VAT-registered firms to stricter enforcement of the e-invoicing mandate. We find that treated firms reduce their reported purchases by 43 per cent and increase their reported VAT liabilities by nearly 150 per cent, and the effects appear to grow over time. The effect on VAT due is primarily driven by reduced input VAT claims, and a related large decline in the size of negative VAT liabilities carried forward from previous periods. However, many firms in Uganda have large stocks of input VAT credits owed, and, on average, treated firms still have negative VAT liabilities by the end of our data period. We also find that firms reduce reported sales by 39 per cent, which we interpret as indicative evidence of sales suppression as firms turn to alternative margins for evasion to manage the size of their VAT liabilities. On the extensive margin, we show that the introduction of e-invoicing has coincided with an acceleration in the number of taxpayers filing VAT declarations monthly, many of whom previously filed corporate income tax returns. This indicates that e-invoicing and related enforcement action have brought new VAT payers into the tax net.

Key words: value-added tax, Uganda, tax administration, digitalization

JEL classification: H26, H32, D22, O33

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1 Introduction

Since its introduction just over a century ago, the value-added tax (VAT) has become widely-adopted and is an important contributor to domestic revenue, particularly for low-income countries (LICs) where VAT typically accounts for over 35 per cent of total tax revenue (Brockmeyer et al. 2024). The appeal and ubiquity of VAT has been justified by its efficiency and ease of collection. Since firms further downstream can claim back VAT paid on their inputs, prices and production choices are not distorted and the burden is ultimately borne by final consumers. This invoice-crediting system also creates a paper trail: buyers want receipts to prove their input claims, so sellers are less able to understate their sales. The information provided by one firm can be cross-checked against others' tax declarations, which deters evasion and enhances enforcement. As a firm's trading network expands and third-party coverage of the economy grows, it becomes ever harder to sustain collusion between trading partners (Kleven et al. 2016; Pomeranz 2015).

In practice, the VAT systems of LICs often deviate from this theory. Cross-checking tax declarations is resource intensive and many tax authorities face administrative limitations. With low enforcement capacity, the self-enforcement properties of the VAT are harder to sustain. This is true not only at the "last mile", where final customers have no incentive to request receipts and check that the correct VAT rate has been applied, but all along the production chain, for instance through sales to unregistered firms or the creation of 'ghost' firms which generate fake invoices without goods changing hands (Waseem 2023).

The idea that digitalization will improve tax administration and increase revenues has been popular in academic and policy circles for some time (Bird and Zolt 2008; CIAT 2020; Junquera-Varela et al. 2022; Okunogbe and Santoro 2023). One prominent example is electronic invoicing (e-invoicing) for VAT management, which allows sales information to be transmitted from firms to the tax authority in real time. This makes it harder to forge invoices and enables automatic cross-matching between buyer and supplier records, reducing the scope for firms to over-report purchases (inflating VAT paid on inputs) or under-report sales (suppressing VAT charged). Through digitizing the paper trail, e-invoicing promises improved efficiency, an enhanced probability of detecting evasion, and increased tax revenues. Drawn by this potential, a growing number of LICs have invested significant resources into implementing e-invoicing, and the limited empirical evidence thus far is consistent with the hypothesized benefits: for instance, Ali et al. (2021) and Mascagni et al. (2021) both show increases in reported sales and VAT liabilities in response to e-invoicing in Ethiopia, while Kotsogiannis et al. (2025) finds positive effects on VAT compliance in Rwanda.

This paper evaluates the impact of an e-invoicing system in Uganda, known as the Electronic Fiscal Receipting and Invoicing System (EFRIS), first introduced in January 2021. We ask two

main research questions. Firstly, on the intensive margin, how have VAT-registered firms adjusted their reporting behaviour in response? Secondly, on the extensive margin, has the intervention brought new taxpayers into the tax net? Since all VAT-registered firms were mandated to use EFRIS simultaneously and almost all of the taxpayers adopting EFRIS after the deadline had no previous history of filing VAT declarations, we cannot directly compare adopting and non-adopting or early- and late-adopting firms. Instead, we exploit a policy change in April 2022, when a subset of firms were instructed to integrate their existing computerized accounting or sales system directly with the central EFRIS system (described in detail in Section 3.2). When EFRIS was launched, the Uganda Revenue Authority (URA) allowed firms to choose between several platforms and the browser-based portal was by far the most popular, where users log in and manually enter transaction details to generate an e-invoice. From April 2022, around 5,000 larger firms with greater sales volumes were required to migrate to system-to-system (S2S) integration, which allows sales information to be communicated to the URA automatically and eliminates the need for manual data entry. This policy created variation in the enforcement environment, and made misreporting much harder for this subset of taxpayers.

Since the mandate was targeted to larger firms with more sales, we cannot compare mandated and non-mandated firms in a standard difference-in-differences (DID) set up, as the levels and trends for key outcome variables diverge. We therefore use a synthetic difference-in-differences (SDID) model, which we discuss further in Section 4.1. This method combines the strengths of DID and synthetic control to consistently estimate the effect of “treatment”, without requiring that the parallel trends assumption holds between all treatment and control units on average (Arkhangelsky et al. 2021). To conduct our analysis, we merged several administrative datasets provided by the URA. The final dataset covers all formal VAT-registered firms from 2013 until 2023, including detailed information on monthly sales and purchases from their VAT returns, as described in Section 4.2. From this dataset, we create a balanced monthly panel of EFRIS users running from January 2021 to June 2023 for our main results.

We find that the firms mandated to switch to system-to-system integration respond by substantially increasing their reported VAT due, relative to the weighted counterfactual group of firms unaffected by the mandate (see Section 5). This effect is largely driven by a decrease in reported purchases, and therefore smaller input VAT claims, and a related large reduction in the size of negative VAT liabilities carried forward from previous periods, which reduces final VAT liabilities. We interpret this as evidence that stricter enforcement of e-invoicing requirements has curbed VAT input fraud schemes, by making it harder for firms affected by the system-to-system mandate to exaggerate their input costs. This is related to difficulties obtaining VAT refunds in Uganda, which are only available for refund amounts larger than 5 million Ugandan shillings (UGX, or 1,400 US dollars) and trigger an audit. Consequently, firms generally prefer to carry forward negative liabilities, which can be done indefinitely. This is concerning for the

integrity of the VAT credit system, particularly as, on average, over a third of firms report zero or negative VAT liabilities across an entire fiscal year.

We also find that affected firms reduce their reported sales, which runs contrary to the expected impact of e-invoicing on sales, as well as results from the other literature (for instance, Ali et al. 2021; Bellon et al. 2022; Mascagni et al. 2021). Although it is possible that this is a real effect, for instance firms might lose market share if they are less able to keep certain transactions ‘off the books’, we do not find corroborating evidence for this in firms’ corporate income tax (CIT) or pay-as-you-earn (PAYE) records. Instead, we hypothesize that firms are artificially suppressing reported sales to keep their VAT liabilities manageable in response to increased monitoring of input claims. These results are robust to various alternative top-coding approaches and sample restrictions, as shown in Section 5.3.

On the extensive margin, the introduction of EFRIS and related enforcement actions coincided with a sharp acceleration in the number of VAT declarations filed monthly and the number of taxpayers filing VAT declarations for the first time (see Section 5.4). Importantly, there were no other major changes to the VAT system around this time, such as threshold or rate changes. While these new filers are more likely to file nil returns and tend to be smaller in terms of total sales and purchases, nearly 40 per cent also have a history of filing CIT returns, with a non-negligible share reporting total sales in their CIT returns exceeding the VAT registration threshold. This could indicate that the introduction of e-invoicing has increased taxpayers’ perceptions of the likelihood that evasion will be detected, and motivated taxpayers to start filing VAT.

This paper contributes to the literature on the value of third-party reporting for tax enforcement (Carrillo et al. 2017; Mittal and Mahajan 2017; Naritomi 2019; Pomeranz 2015) and the use of digital technology to support tax administration and enforcement in lower-income countries (see Okunogbe and Santoro (2023) for a recent overview this literature). In particular, this paper adds to the small number of papers examining the effects of e-invoicing systems in low-income countries (Ali et al. 2021; Eissa and Zeitlin 2014; Kotsogiannis et al. 2025; Mascagni et al. 2021) and related studies from middle-income countries (Bellon et al. 2023, 2022; Fan et al. 2024, 2025). We contribute to this literature by providing the first evidence from the Ugandan context and by examining the varying compliance effects when e-invoicing systems operate across several different platforms.

We also employ new methodological advances. A wave of recent papers have shown that the standard DID model based on a two-way fixed effects (TWFE) estimator is biased in the presence of staggered treatment adoption and heterogeneous treatment effects (among others, Borusyak et al. 2024; de Chaisemartin and D’Haultfœuille 2024; Sun and Abraham 2021).¹ Since TWFE estimators make “forbidden” comparisons between already-treated units, as well as permitted comparisons between treated and not-yet-treated units, the estimand is no longer an intuitive causal parameter, even if the (conditional) parallel trends and no-anticipation assumptions hold (Roth et al. 2023).² Most of the earlier studies were conducted before these methodological advances.³ In contrast to these papers, we employ a synthetic difference-in-differences model, which does not require such a strong parallel trends assumption.

2 Conceptual framework

The foundational premise of VAT’s appeal is its self-enforcement properties: firms have an incentive to ask suppliers for a proper receipt in order to deduct VAT paid on non-labour inputs from their final VAT liability. When firms submit their VAT returns, they report their total sales, the amount of VAT collected on sales (output VAT), their total input purchases, and the amount of VAT paid on these purchases (input VAT). Firms then remit the difference (VAT due) to the revenue authority.⁴ This invoice-credit system means that, in theory, the VAT can be thought of as a retail sales tax where taxes are withheld at each stage of production (Slemrod and Velayudhan 2022).

Since revenue authorities receive reports on the same transaction from both buyers and suppliers, the risk of exposure through cross-checking buyer and supplier reports deters evasion. Theoretically, the probability of evasion being detected is close to one for income that can be verified through third-party information, and significantly lower than one for non-verifiable income sources (Kleven et al. 2011). Taxpayers would therefore report income at least as high as their third-party verifiable income, while potentially under-reporting the non-verifiable component. As an economy grows and the number of formal trading partners a firm has expands, it becomes harder to sustain misreporting as a greater share of sales and purchases are covered by third-party reporting (Kleven et al. 2016). By implication, an increase in third-party re-

¹ In complex policy evaluation settings, the traditional difference-in-differences assumptions are unlikely to hold. For instance, treatment effects might change over time, such that short-run treatment effects are different to longer-run effects. Treatment effects might also differ between earlier-treated and later-treated units, if, for instance, some units are treated during a recession and later units are treated during an economic expansion.

² See Roth et al. (2023) and Baker et al. (ming) for detailed reviews of the latest advances in the DID literature.

³ Appendix Table A2 gives a summary of the methodologies used and results from comparable papers across several countries, including examples from middle- and high-income countries.

⁴ See Crawford et al. (2010) for a more detailed discussion of the textbook VAT design.

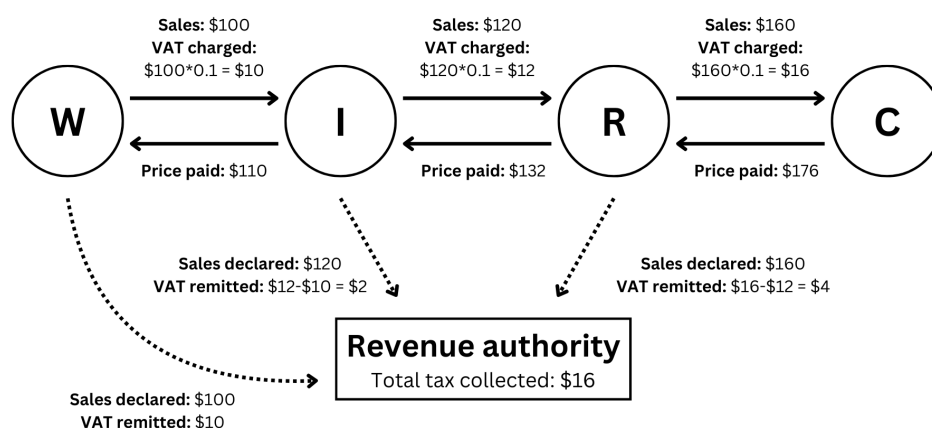
porting would increase reported sales, reduce exaggerated input credit claims, and thus increase total VAT remitted to the revenue authority.

In high compliance settings, this self-enforcement mechanism effectively deters evasion until the point of sale to final consumers, which is not covered by third-party reporting (Naritomi 2019). Consumers have little incentive to demand a proper receipt and might even collude with firms to avoid paying VAT on their purchases. In low compliance settings, the self-enforcement mechanism can break down for other reasons. Firstly, a large share unregistered businesses means that firms have the potential to under-report sales at any point along the VAT chain. Although the smallest businesses might fall below the VAT registration threshold, so legally do not have to file VAT returns, registered firms should still charge VAT on sales to these unregistered businesses. Secondly, the deterrence factor of third-party reporting only works if that information is actually used for enforcement, which depends on the capacity of the revenue administration. When the threat of third-party reporting is not credible, firms might run the risk of under-reporting sales or over-claiming input credits despite the discrepancies that this creates, because they do not expect the revenue authority to cross-check records systematically.

2.1 Illustrative example

To see this potential for evasion in a low-capacity setting, we outline a toy model of a simplified VAT system with five players: three firms, a final consumer, and a revenue authority. The supply chain starts with a wholesaler (W), who supplies an intermediary (I), who sells to a retailer (R), and ends with a final consumer (C). The good sold in this system is subject to a standard VAT rate of 10 per cent. All firms in the chain charge VAT on their sales, and remit the difference between VAT charged and VAT paid on inputs to the revenue authority. Figure 1 shows how this works under full compliance: each firm charges VAT on their sales and declares their full sales to the revenue authority, which collects \$16 in tax. Notice that only the value-added is taxed: since the difference between Firm W and Firm I's sales price is \$20, Firm I remits 10 per cent of \$20. Firm I (R) is able to deduct the VAT paid on their inputs because their supplier, Firm W (I), is also registered and charges VAT. Since the revenue authority can credibly cross-check firms' reports and detect misreporting, all firms in the supply chain are incentivized to report accurately.

Figure 1: Toy model of VAT system without evasion



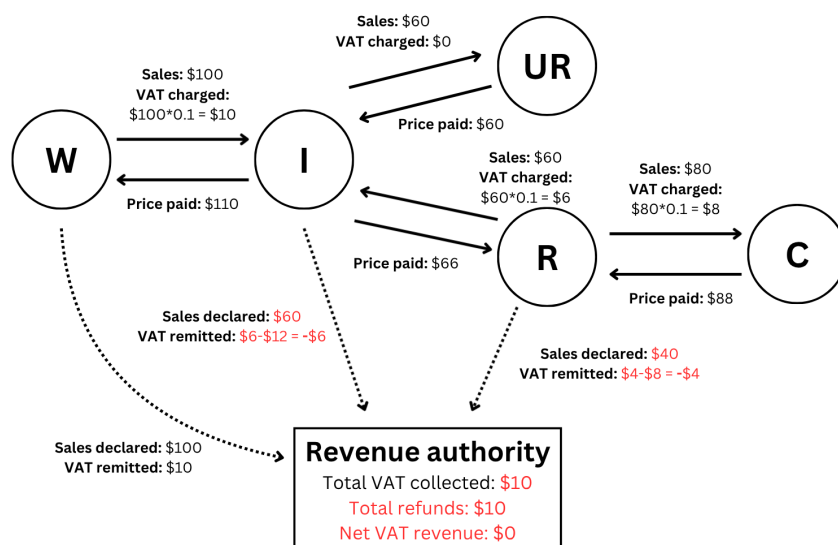
Source: Authors' own construction, based on Mittal and Mahajan (2017).

In Figure 2, we can see this system of opposing incentives and self-enforcement breaking down. The invoice paper trail is still created, but firms do not believe that the revenue authority has the ability to systematically cross-check invoices and detect evasion. In this example, VAT evasion takes place in two ways: under-reporting sales and/or over-claiming input VAT credits (for instance, by inflating purchase amounts or through completely fictitious invoices). Firm W still sells \$100 worth of goods to Firm I, which then sells to a VAT-registered retailer (R), charging VAT on \$60 worth of goods, and to an unregistered retailer (UR), without charging VAT. This represents a form of negotiated collusion, as registered firms should charge VAT on all sales, but might agree to remove the VAT, lowering the sales price for Firm UR.⁵ The introduction of an unregistered firm means that the revenue authority no longer has third-party information on all of Firm I's sales. Firm I knows this and only reports \$60 worth of sales. Firm I also decides to exaggerate their input purchases, claiming \$12 of input VAT credit instead of the \$10 they actually paid. This results in a negative VAT liability. Similarly, since there is no third-party reporting on Firm R's sales to final consumers, Firm R decides to declare only half of their sales and also exaggerates their input deduction. In this scenario, the revenue authority only collects \$10 in tax, but 'owes' refunds to Firm I and Firm R totalling \$10, such that net revenue is zero.

The scenario in Figure 2 could be complicated in various other ways. For instance, Firm I might collude with Firm W to keep part of their transaction 'off the books', reducing reported purchases to ensure that input costs do not exceed reported sales, and reducing Firm W's liability relative to the scenario in Figure 1. The key point for our setting is that the self-enforcement properties of the VAT can unravel when the tax authority does not systematically match reports from buyers and sellers, as is common in situations of weak enforcement.

⁵ Negotiated collusion can also take place between registered firms but we do not represent that here.

Figure 2: Toy model of VAT system with evasion

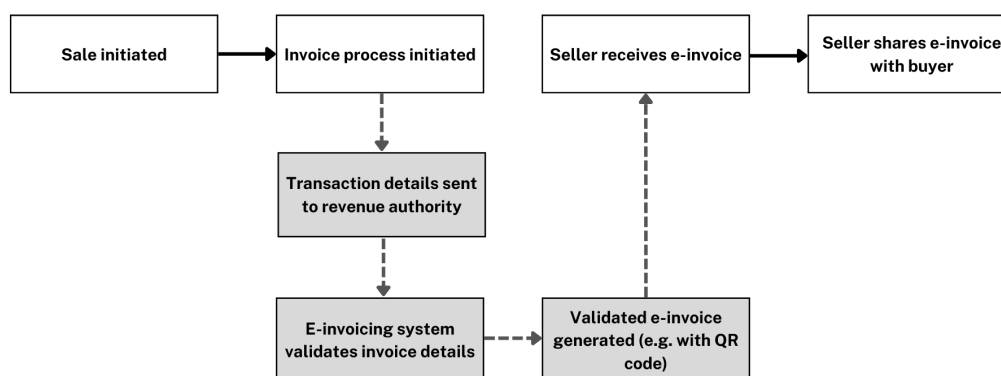


Source: Authors' own construction, based on Mittal and Mahajan (2017).

2.2 Electronic invoicing

With e-invoicing, the buyer, supplier, and tax administration all share the same details about the transaction in real time. The diagram in Figure 3 shows how this process works. Although it is represented as a series of stages here, in reality validation and e-invoice issuance would happen instantaneously. When taxpayers file their VAT returns, e-invoices from buyers and sellers should then be automatically matched to verify whether firms' reported input claims and sales are accurate. Since buyers submit validated e-invoices to claim input credits, it is more difficult for sellers to under-report sales. We would therefore expect introducing e-invoicing to increase total sales recorded on firms' VAT returns. Although collusive evasion is still possible, the greater the share of transactions covered by this digital paper trail, the greater the risk of exposure. E-invoicing is also designed to prevent buyers from claiming input VAT credits without a corresponding e-invoice submitted by a seller. Therefore, if fictitious and exaggerated input claims were previously a problem, we would expect total reported purchases to decrease once e-invoicing is introduced (with a corresponding reduction in input VAT). Conversely, if firms were under-reporting purchases prior to e-invoicing due to high compliance costs or poor tax knowledge (which Brockmeyer et al. (2024) show is common in low-income countries, particularly among smaller firms), we might expect reported purchases to increase as e-invoicing makes it easier to keep track of invoices. Overall, e-invoicing is expected to increase total VAT liabilities, by reducing the scope for misreporting.

Figure 3: Simplified diagram of the e-invoicing process



Source: Authors' own construction.

The empirical literature on e-invoicing in lower-income countries has found evidence in favour of these theoretical benefits.⁶ In Ethiopia, Mascagni et al. (2021) and Ali et al. (2021) both find strong positive effects of electronic sales registry machine (ESRM) adoption on total sales and VAT revenues. Mascagni et al. (2021) also find smaller, but still positive, spillover effects on CIT revenues, as ESRM use improved the accuracy of taxpayer records and reduced discrepancies between returns. Similarly, Bellon et al. (2022) show that e-invoicing in Peru increased reported sales, particularly among smaller firms in sectors with higher rates of suspected non-compliance, which they hypothesize is due to lower compliance costs (for smaller firms) and enhanced deterrence (for the non-compliant). Fan et al. (2025) find support for a slightly different mechanism. The authors show that digitizing China's VAT system and requiring firms to issue computer-generated invoices significantly increased VAT payments, but that this was driven by a decline in input deductions, rather than changes to declared sales.

However, there is also evidence that taxpayers respond to e-invoicing strategically. Mascagni et al. (2021) and Bellon et al. (2022) find that while taxpayers increased reported sales, they simultaneously increased reported costs, dampening the overall revenue effect of e-invoicing. This suggests that when enforcement is enhanced on one dimension, taxpayers might shift evasive behaviour to less verifiable margins. These results demonstrate the difficulties of enhancing compliance in contexts of weak administrative and enforcement capacity. Revenue authorities in low-income countries face significant structural constraints, especially in sophisticated computing and data analytics. For instance, despite the widespread adoption of electronic billing machines (EBMs) in Rwanda, researchers found large discrepancies between VAT reports from buyers and sellers, as transactions were not being automatically cross-checked by the revenue authority (Mascagni et al. 2019). However, once EBM data was integrated into tax audit processes, EBM use had a more tangible positive impact on net VAT payments (Kot-

⁶ Appendix Table A2 summarizes the methodologies followed and main results in closely related papers.

sogiannis et al. 2025). These results show that simply generating more data does not necessarily bring in more revenue, unless these data are integrated into enforcement processes.

3 Institutional context

3.1 Uganda's VAT system

VAT is an important source of revenue for the Government of Uganda, accounting for approximately 30 per cent of overall net revenue.⁷ Uganda operates a fairly standard VAT system, with a general rate of 18 per cent, in line with other countries in the East African Community, zero-rating of exports (as well as several other goods and services), a number of exemptions, and a credit-invoicing system. VAT on imports is paid at customs, and can be credited as input VAT paid. All firms with an annual turnover over UGX 150 million (USD 41,000) are required to register for VAT and file monthly declarations electronically, within 15 days of the transaction period ending.⁸ These declarations include detailed transaction-level spreadsheets (VAT schedules) documenting all sales and input purchases from other VAT-registered firms, which must be backed up with original receipts.

When VAT paid on inputs exceeds VAT charged on sales, firms are able to request a refund or carry the negative balance forward into the next period. A negative VAT liability (that is, the firm is owed money by the government) does not necessarily indicate evasion. For instance, if a large share of sales are zero-rated (as is the case for exporters) or VAT exempt, firms do not collect output VAT but pay VAT on their inputs. A negative liability can also arise if a firm makes a loss or large capital purchases in one period. Firms can only request a refund if they are owed more than UGX 5 million,⁹ however this triggers an automatic desk audit by the URA due to the potential for evasion through over-claimed input VAT credits.¹⁰ Requiring firms to apply separately for a refund and verifying input credits with third-parties add to the compliance burden and delay refund processing, even when claims are legitimate (Brockmeyer et al. 2024; Pessoa et al. 2021).¹¹ An assessment of the URA's performance in 2019 found that the funds available to pay refunds were inadequate and only six per cent of claims were pro-

⁷ This refers to the sum of domestic VAT and VAT charged on imports, net of refunds.

⁸ While the VAT threshold is applied to annual turnover, in practice, firms are required to register for VAT if their turnover for any three consecutive calendar months exceeds UGX 37.5 million. The CIT threshold is also UGX 150 million. Firms below this threshold can voluntarily register for VAT, or pay a simplified turnover tax, which replaces both VAT and CIT.

⁹ This threshold was increased to UGX 10 million in July 2024.

¹⁰ Strict controls on VAT refunds are not unusual in countries with high levels of non-compliance and limited administrative capacity, as the VAT refund mechanism is especially vulnerable to fraud (Pessoa et al. 2021).

¹¹ The impacts of delayed VAT refund payments on firms is relatively under-studied, although there is evidence from South Africa that slow refund processes are common (in this case, the average waiting time for refund payments

cessed within 30 days (Okello et al. 2019). For these reasons, taxpayers tend to prefer to offset negative liabilities in one period against future VAT, which can be done indefinitely. This feature is somewhat unusual (at least outside of South American countries where it is more common) and can be costly for taxpayers in terms of cash flow, as clearing excess credits may take many months (Pessoa et al. 2021).

In recent years, the vital signs of Uganda's tax system have indicated some cause for concern. The revenue-to-GDP ratio,¹² at 12.6 per cent in 2022, is below the sub-Saharan African and low-income country averages of 18.2 and 15 per cent respectively, and has been for some time (UNU-WIDER 2023). Between 2015 and 2020, the URA consistently failed to meet revenue targets, and the Government of Uganda has frequently relied on introducing new taxes to backstop the annual budget (Lees and Akol 2021). The gap between actual VAT collections and potential revenues based on full compliance was estimated to be 30 per cent in 2018, higher than estimates for other African countries (Lakuma and Sserunjogi 2018). While 75 per cent of VAT returns are filed on time, only approximately 47 per cent of VAT payments are made on time (CIAT et al. 2022). In addition, although the transaction-level records in the VAT schedules tend to be consistent with taxpayers' own declarations,¹³ there is substantial misreporting between trading partners. Almunia et al. (2024) find that buyers and sellers reported different amounts 79 per cent of the time, despite the fact that transaction details in the VAT schedules could be relatively easily cross-checked by the URA. The majority of this misreporting was advantageous, reducing the total VAT owed by the firm. Back-of-the-envelope calculations indicated that this misreporting reduced tax revenue by 28 per cent of total VAT collected between 2013 and 2016 (Almunia et al. 2024). Despite collecting transaction-level data from taxpayers, the URA has historically only analysed this information during audits and the cross-checking process was not automated.

3.2 The introduction of electronic invoicing in Uganda

Against this background, in 2018 the Ugandan Parliament approved legislation to introduce electronic invoicing.¹⁴ This led to the development of the Electronic Fiscal Receipting and Invoicing System (EFRIS) to track and validate transactions in real time. EFRIS was expected to increase tax revenue by reducing the scope for evasion through schemes such as claiming

was 30 days) and that speeding up refund processing had a large positive effect on firms' investment in capital goods (Brusco et al. 2024).

¹² Total revenue excluding social contributions and grants.

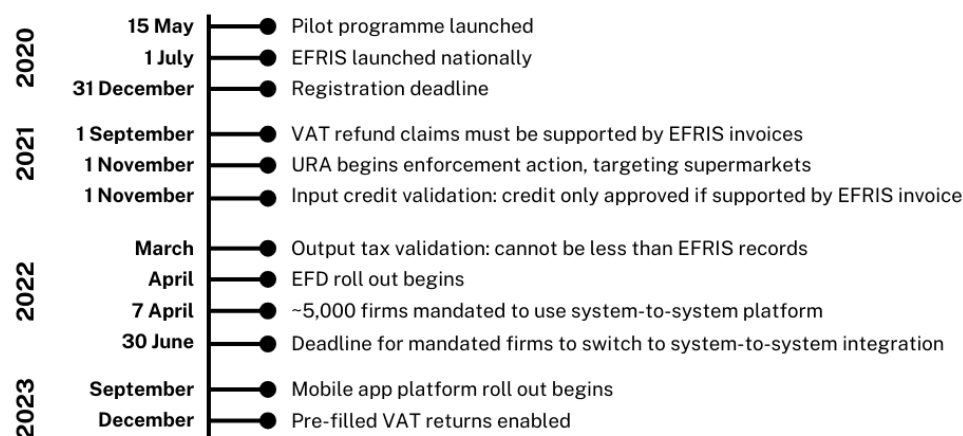
¹³ Almunia et al. (2024) show that a firm's VAT schedules were consistent with sales and purchases recorded in their VAT return in 97 per cent of cases.

¹⁴ See Section 73A and 73B of the Tax Procedures Code (Amendment) Act (Parliament of Uganda 2018).

input tax credits multiple times using the same invoice, generating fictitious ‘purchase’ claims through invoice mills, and under-reporting sales to final consumers. In addition to enhanced enforcement, the URA promoted several benefits for taxpayers: improved record-keeping as all transaction details are securely stored, shortened audit and verification times, expedited tax refunds, and reduced unfair competition from the informal sector (URA 2024b). The URA also promised lower tax compliance costs, which have been shown to be significant for Ugandan firms (Lees 2025), as the data collected through EFRIS would eventually be used to pre-populate tax returns, instead of requiring taxpayers to list each sale and purchase in their VAT schedules manually.¹⁵ Importantly, no other major changes were made to the Ugandan VAT system around this time, such as revisions to the VAT threshold or the rate.

Implementation of these new provisions was slow, partly due to practical difficulties changing administrative practices. Figure 4 shows an implementation timeline. Starting from 1 July 2020, all VAT-registered firms were instructed to register for EFRIS.¹⁶ The URA allowed firms until 1 January 2021 to adapt their processes, after which they were expected to start issuing e-invoices¹⁷ for all sales, regardless of whether the buyer is VAT-registered or whether the goods or services sold are standard-rated, zero-rated, or exempt. The key features of an e-invoice include a fiscal document number, a verification code, and a quick response (QR) code, which can be used to check that the invoice is valid (see Appendix Figure A1 for an example). The URA subsequently announced a further six-month administrative extension, during which they would focus on education and onboarding rather than enforcement.

Figure 4: EFRIS implementation timeline



Source: Authors' own compilation from URA reports and internal records.

From 1 November 2021, the URA began active enforcement, starting with a countrywide exercise to monitor the non-issuance of e-invoices by large supermarkets. This included spot

¹⁵ This feature was only enabled from December 2023, beyond the data period we examine in this paper.

¹⁶ A small number of taxpayers took part in a pilot programme starting from May 2020.

¹⁷ The URA uses the term e-receipt for invoices issued by non-VAT-registered taxpayers through EFRIS.

checks to verify whether inventory listed on the EFRIS system matched actual stock and ‘mystery shopping’ initiatives to check that supermarkets were routinely issuing proper invoices. The penalties for non-compliance were especially punitive: the fine for failing to issue an e-invoice was initially UGX 6 million (USD 1,600) *per invoice*, regardless of the transaction value, although this was amended in the 2025/26 tax bills.¹⁸ Firms are technically also permitted to issue manual invoices if they are offline (for instance, during a power cut), as long as the data is entered into EFRIS within 24 hours, though URA officials acknowledge that firms probably do not log all manually-issued invoices.

The URA also updated the VAT return process in several ways. From 1 September 2021, refund claims would be granted only if the taxpayer provided supporting e-invoices. Starting in November 2021, input VAT credit claims needed to be supported by e-invoices and only e-invoices arising during the filing period could be included in the relevant return (in other words, input claims for purchases made in previous periods would have to be filed through an amendment to a previous return). The VAT return was updated to include a field capturing the fiscal document number for each e-invoice, and the transaction is then automatically verified when the return is submitted. Finally, from March 2022, a taxpayer could not report a smaller amount of output VAT than the value of VAT charged recorded in EFRIS. Taxpayers are also able to generate customized sales and purchases reports through their EFRIS account, and that data could then be transferred to their VAT return, reducing the compliance burden of transaction-level reporting (this was streamlined even further once pre-filing was enabled in December 2023).

EFRIS can be accessed through various platforms and, initially, firms were able to choose which platform to use. Options included directly integrating a firm’s existing accounting system with the URA system through an Application Programming Interface (API) connection (system-to-system integration), downloading e-invoicing software developed by the URA, logging in to the EFRIS portal via a web browser, or buying and installing an electronic fiscal device (this was only rolled out from April 2022; for more details on these platforms see Appendix Table A1).¹⁹ On 7 April 2022, the URA announced that a list of approximately 5,000 taxpayers should transition to system-to-system integration. The URA had identified these firms through three criteria: annual turnover above UGX 2 billion, or less than UGX 2 billion in turnover but making over 100 sales a day, or those already operating a computerized billing or Enterprise Resource Planning (ERP) system. Affected taxpayers were allowed a transition period until 30 June 2022 to implement the new requirement. By design, this mandate applied to larger tax-

¹⁸ The fine is now double the tax due on the goods or services sold (KPMG 2025).

¹⁹ The URA also developed a mobile app (AskURA) for taxpayers with small sales volumes, however, this took longer to develop and was only available from September 2023. The URA are currently developing a Unstructured Supplementary Service Data (USSD) code system for those with limited internet access.

payers with higher sales volumes, and as such are not directly comparable to other VAT-filers. We discuss how these mandated firms compare with others and the implications for our research design in the next section.

The compliance costs associated with the two main EFRIS platforms, system-to-system and the web portal, are markedly different. In the case of system-to-system integration, firms needed to pay for a software integrator accredited by the URA to link the systems, but then issuing e-invoices is fully automated. In contrast, the EFRIS web portal is free to use, but requires taxpayers to log in, enter the transaction details themselves, and then generate an e-invoice.²⁰ Although this still allows the URA to track sales more closely, the process is comparatively manual. Therefore, the web portal may not substantially reduce the compliance costs of VAT reporting, but shifts the timing of compliance activities, as taxpayers need to enter transaction details into the EFRIS system daily, which might simplify filling VAT returns at the end of the month. Margins for evasion are also different, as it would be easier for taxpayers to avoid reporting certain transactions or to keep two sets of books if they use the web portal, versus those whose accounting systems are directly integrated with the URA system.

4 Research design and data

4.1 Empirical strategy

Our central aim is to estimate the causal effects of the introduction of EFRIS on tax compliance. Related papers have tended to use panel difference-in-difference (DID) models, usually exploiting a staggered roll-out of e-invoicing or some plausibly exogenous cross-sectoral variation in treatment intensity to compare adopters to later-adopters or never-adopters (see Appendix Table A2 for an overview of this literature). Our setting does not lend itself to these methods, for several reasons. Firstly, all VAT-registered firms in Uganda were affected by the policy change simultaneously, in contrast to settings with staggered roll-outs. Secondly, although not all firms actually adopted or used EFRIS simultaneously, almost all of taxpayers registering after January 2021 had no previous history of filing VAT declarations (as we show in section 5.4), making a early- versus late-treated design impossible as there are no pre-treatment periods observed in the data for this group.

Since we cannot plausibly compare adopters to non-adopters, or early- to late-adopters, we instead rely on variation in the (perceived) enforcement environment generated by mandating larger taxpayers to switch to using system-to-system integration from April 2022, as discussed in the previous section. The timing of this announcement did not coincide with other important

²⁰ See Appendix Figure A2 for a screenshot of the web portal.

deadlines for the tax system, such as the end of a financial year, and firms did not have any other cause to anticipate the announcement. We would also expect this mandate to reinforce the other enforcement measures taken since November 2021, such as input credit and output tax validation, as mandated firms would have even more cause to think that the URA's enforcement capacity is enhanced as they were targeted with a more intensive version of EFRIS. In addition, the turnover threshold applied (UGX 2 billion annually) does not correspond with other relevant tax thresholds, so there is no reason for firms to manipulate sales around this threshold before April 2022.

Given the above, we set out to compare outcomes for firms mandated to use system-to-system integration against firms using EFRIS who were not affected by this mandate. However, as the mandate was specifically designed to apply to larger firms with greater sales volumes, identifying an appropriate treatment and control group is not straightforward. Not only do mandated and non-mandated firms differ substantially in their levels of outcome variables, the trends are somewhat divergent, violating the classic DID parallel trends assumption (we discuss this further in the next section). To account for this, we employ the synthetic difference-in-difference (SDID) estimator developed by Arkhangelsky et al. (2021), which combines the strengths of DID and synthetic control (SC). The SDID estimator aims to consistently estimate the causal effect of a policy change or treatment, without requiring that the parallel trends assumption holds between all treatment and control units on average, by matching units on pre-treatment trends (similar to SC) and adjusting for common time trends (similar to DID). In other words, SDID seeks to match treated and control units on pre-treatment trends, but not necessarily on trends *and* levels, allowing for constant differences between treatment and control groups (Arkhangelsky et al. 2021). Thus, the synthetic control group can be parallel to the treated group, rather than identical in pre-treatment periods.

The SDID estimator achieves this through two sets of weights: unit and time. The unit weights place more emphasis on untreated units that are similar in their past to the treated units on average, while the time weights place more emphasis on pre-treatment periods that are most similar to post-treatment periods in terms of levels among all control units. A weighted average of untreated units thus serves as the counterfactual against which the outcome in the corresponding treated unit is then compared, minimizing the variation between treatment and control units and time periods.

To see the main ideas behind the SDID estimator, and following the notation in Arkhangelsky et al. (2021), first consider a balanced panel with N units and T time periods. A DID model can be written as a TWFE regression problem, with unit (α_i) and time (β_t) averages:

$$\hat{\tau}^{did} = \underset{\mu, \alpha, \beta, \tau}{\operatorname{argmin}} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \alpha_i - \beta_t - \tau W_{it})^2 \right\}, \quad (1)$$

where the outcome for unit i in period t is given by Y_{it} , μ is the overall intercept, and W_{it} is a binary treatment exposure dummy, with $W_{it} = 1$ for some (but not all) observations if they are treated by time t and $W_{it} = 0$ otherwise. Here, the unit effects capture differences in intercepts for each unit and the time effects account for the trend across the treatment and control groups.

The traditional SC estimator of Abadie et al. (2010) can be written in a similar way, but includes unit weights ($\hat{\omega}_i^{sc}$) instead of unit fixed effects (α_i):

$$\hat{\tau}^{sc} = \underset{\mu, \beta, \tau}{\operatorname{argmin}} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \beta_t - \tau W_{it})^2 \hat{\omega}_i^{sc} \right\} \quad (2)$$

The unit weights are constructed to minimize the difference between the pre-exposure outcome for the treated units and the weighted average of the pre-exposure outcome for the control units. In other words, these weights align the pre-exposure levels and trends for the treated units and the synthetic control. Weights are constrained to be positive and sum to one.

The SDID estimator contains elements of equation 1 and equation 2, incorporating both the unit fixed effects (α_i) and unit weights ($\hat{\omega}_i$). In this case, the units weights are calculated to ensure that the average outcome for the treated group is approximately parallel to the weighted average for the control group. That is, the pre-trends for the synthetic control and treated group do not need to match perfectly; it is sufficient for the trends to be parallel.

$$\hat{\tau}^{sdid} = \underset{\mu, \alpha, \beta, \tau}{\operatorname{argmin}} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \alpha_i - \beta_t - \tau W_{it})^2 \hat{\omega}_i^{sdid} \hat{\lambda}_t^{sdid} \right\} \quad (3)$$

Notice that the SDID equation also includes time weights, denoted by $\hat{\lambda}_t$. These weights perform a similar function to the unit weights, but for time periods. They minimize the difference between pre and post-exposure periods, placing more emphasis (more weight) on periods that are on average similar to the treated periods. Taken together, these weights make the DID strategy “more plausible” by weakening the reliance on the parallel trends assumption (Arkhangelsky et al. 2021).²¹ This retains the logic of matching techniques to create a more comparable control group, but is preferable as SDID does not require arbitrary sample restrictions. Arkhangelsky et al. (2021) establish theoretic consistency and asymptotic normality, as well as show empirically that the estimator is competitive with (or dominates) both SC and DID in applications where they have been used previously.²²

²¹ For details on how these weights are calculated, see Arkhangelsky et al. (2021).

²² Recent papers have used the SDID estimator in a variety of complex settings where the assumptions for a ‘standard’ DID specification are unlikely to hold. For instance, Dench et al. (2024) study the effects of the 2022 Dobbs

We implement the SDID models in Stata using the `sdid` and `sdid_event` commands (Ciccia 2024; Clarke et al. 2024). For statistical inference, we estimate jackknife variance.²³

4.2 Data and descriptive statistics

To conduct our analysis, we merged several administrative datasets held by the URA, linked by anonymized tax identification numbers.²⁴ The VAT panel provides monthly data on firms' sales, purchases, and VAT liability calculations (URA 2024d). The CIT returns data provides detailed information on firms' total revenues, costs, profitability, and income tax liabilities (URA 2024c).²⁵ Both panels run from the 2013/2014 financial year to 2022/2023. We also use monthly PAYE returns data to create firm-level indicators of the number of employees, gross remuneration per employee, and PAYE liabilities (URA 2023).²⁶ We obtained the firms' locations²⁷ and their two-digit sector codes from the taxpayer register (URA 2025),²⁸ as well as information on whether a firm had been audited for VAT, CIT, or any other tax, and the date of the audit, from the audit records. From the EFRIS registration data we obtained the exact date each firm first registered for e-invoicing. We also use a limited set of variables drawn directly from the EFRIS system, which generates data at the transaction level.²⁹ To make this data tractable and comparable to the VAT returns, we aggregated transactions to the seller-month level by tax rate (standard, zero-rated, or exempt) and EFRIS platform (web portal, system-to-system integration, EFD, or desktop app). Finally, we have access to the list of firms mandated to switch to system-to-system integration from April 2022.

v. Jackson Women's Health Organization ruling, which reduced abortion access, on fertility, measured at the state level; Coy (2024) estimates the impact of Colombia's demobilization of paramilitaries on electoral competition across municipalities; Rauh and Shyu (2024) examine the response of high-income households to an increase in the marginal tax rate in California; and Brockmeyer and Sáenz Somarriba (2025) examine the impact of financial incentives promoting digital transactions on firms' VAT liabilities.

²³ Arkhangelsky et al. (2021) detail three procedures for inference: placebo, block (clustered) bootstrap, or jackknife. Placebo inference assumes equal variance in the error distribution for the treatment and control groups and is most suited to cases where the number of treated units is small. Bootstrap inference does not suffer from this strong homoscedasticity assumption and can be used if the treatment and control groups are sufficiently large, however, is computationally expensive, particularly in very large samples. The jackknife method provides conservative confidence intervals, but without the computational cost of bootstrapping (Clarke et al. 2024).

²⁴ See Appendix A2 for more details on data access, cleaning protocols, and the variables used.

²⁵ More information on the CIT panel can be found in Agaba et al. (2025).

²⁶ More information on the PAYE panel can be found in Agaba et al. (2023).

²⁷ Firm location is identified by the district of the tax office where the firm is registered, rather than a precise address or geolocation.

²⁸ More information on the taxpayer registration data can be found in Jousté and Ssebuyira (2025).

²⁹ The audit and EFRIS data were provided by the URA especially for this study and were accessed in the URA Research Lab.

Both the CIT and VAT panels are unbalanced, with the number of firms filing growing over time. The full VAT panel covers approximately 45,000 firms in total, with the number of firms filing at least one VAT declaration per year growing from 15,302 in 2013 to 25,987 in 2023. Roughly 60 to 65 per cent of firms filing VAT declarations in any one year also file a CIT declaration that year. Not all VAT-registered firms file every month, with small firms in particular occasionally skipping a month. This could reflect months with low or no sales, as well as the compliance costs associated with monthly filing, as shown in Lees (2025). Our main outcomes variables are total sales (i.e., the sum of standard-rated sales, zero-rated domestic sales, exports, exempt sales, and sales of capital goods), VAT charged on sales (output VAT), total purchases (i.e., the sum of standard-rated local and imported purchases, zero-rated local and imported purchases, exempt purchases, admin expenses, and capital goods purchases), VAT paid on input purchases (input VAT), net VAT (the difference between output and input VAT), adjustments for previous negative VAT liabilities (offset adjustments), and the final VAT liability after offsets and adjustments for VAT withheld (VAT due).

The SDID estimator requires a strongly balanced panel, so for our main analysis we restrict the sample to the subset of firms filing VAT returns monthly since January 2021, who issue at least one EFRIS invoice between January 2021 and June 2023. This also avoids composition bias and controls for firm entry and exit during the period. After applying these restrictions, we have 9,442 firms in the balanced panel. We loosen this restriction in several ways to test the robustness of our results, as discussed in Section 5.3. While we draw on a longer time frame for some of our descriptive statistics, the balanced panel for the SDID estimation is restricted to months from January 2021 onwards, to avoid mixing pre- and post-EFRIS worlds.

Table 1 shows summary statistics for these variables in nominal terms for the 2020/2021 financial year (taking the sum of relevant variables from July 2020 to June 2021), separately for the full panel of VAT filers in Panel A and the balanced panel defined above in Panel B. As expected, firms in the balanced panel tend to be larger, in terms of total sales and purchases reported in their VAT returns, as well as turnover declared in their CIT returns. Despite having over 10,000 more firms in the full panel, the balanced panel accounts for 75 per cent of reported sales and 80 per cent of net VAT in 2020/2021. The share of firms based in Kampala and the sectoral split between the full VAT panel and the balanced panel are broadly equivalent.

In both panels, we see large differences between net VAT, calculated as the difference between output VAT and input VAT, and final VAT due. While mean net VAT is positive, mean VAT due is negative. This is because VAT due accounts for negative liabilities carried over from previous periods. Approximately 40 per cent of firms in both panels are in a negative VAT position over the financial year. Moreover, the share of firms in a negative VAT position far exceeds the share of firms with any export sales (which are zero-rated so firms with a large share of ex-

ports in their total sales might be expected to have a negative VAT balance) and the share of firms reporting any zero-rated domestic sales. This gives an indication of the extent to which firms take advantage of the ability to carry forward negative VAT liabilities from one period to reduce future liabilities, particularly as refunds are heavily restricted.

Table 1: Summary statistics for 2020/2021

Panel A: Full VAT panel							
	Mean	SD	Min	p50	p90	Max	N
<i>Variables from VAT return</i>							
Total sales	2,514.5	8,841.8	0	175.1	4,655.1	76,143.1	19,431
Standard-rated sales	1,641.3	5,590.3	0	129.6	3,193.8	47,773.4	19,431
Total purchases	1,752.3	6,098.7	0	85.5	3,440.9	52,368.7	19,431
Input VAT	231.5	791.8	0	11.5	459.8	6,851.2	19,431
Output VAT	289.9	982.7	0	23.2	568.3	8,524.6	19,431
Net VAT (output–input)	58.4	336.1	-	2.3	100.5	7,646.8	19,431
VAT due ¹	-34.6	349.5	3,478.4 2,956.4	0	66.6	2,160.2	19,431
Negative VAT (% of firms) ²	37.0						19,431
Zero VAT (% of firms)	14.9						19,431
Exporter (% of firms)	6.1						19,431
Has zero-rated domestic sales (% of firms)	11.4						19,431
<i>Variables from CIT return</i>							
Turnover	3,843.9	32,780.6	-50.4	225.4	4,620.9	1,648,104	12,856
Profitable before tax (% of firms)	56.63						13,757
<i>Variables from register and audit data</i>							
Based in Kampala (% of firms)	39.6						19,431
Wholesale and retail trade (% of firms)	33.6						18,759
Manufacturing (% of firms)	7.8						18,759
Agriculture (% of firms)	1.7						18,759
Services (% of firms)	36.8						18,759
Audited for any tax during FY (% of firms)	5.9						19,431
Panel B: Monthly balanced panel of EFRIS users							
	Mean	SD	Min	p50	p90	Max	N
<i>Variables from VAT return</i>							
Total sales	3,898.6	10,994.5	0	458.9	8,820.9	76,143.1	9,442
Standard-rated sales	2,504.8	6,862.0	0	338.5	5,509.8	47,773.4	9,442
Total purchases	2,675.9	7,524.1	0	264.7	6,101.3	52,368.7	9,442
Input VAT	354.2	980.1	0	39.0	813.5	6,851.2	9,442
Output VAT	451.0	1,228.8	0	61.4	991.8	8,524.6	9,442
Net VAT (output–input)	96.8	438.4	-	8.9	194.8	7,646.8	9,442
VAT due	-35.7	436.1	3,139.8 -2956.4	1.4	133.7	2,160.2	9,442
Negative VAT (% of firms)	43.0						9,442
Zero VAT (% of firms)	2.1						9,442
Exporter (% of firms)	9.3						9,442

Table 1: (continued)

Has zero-rated domestic sales (% of firms)	15.7						9,442
<i>Variables from CIT return</i>							
Turnover	5,025.8	38,223.4	-50.4	379.9	6,774.4	1,648,104	7,159
Profitable before tax (% of firms)	60.6						7,649
<i>Variables from register and audit data</i>							
Based in Kampala (% of firms)	39.5						9,442
Wholesale and retail trade (% of firms)	33.4						9,416
Manufacturing (% of firms)	9.5						9,416
Agriculture (% of firms)	1.4						9,416
Services (% of firms)	39.6						9,416
Audited for any tax during FY (% of firms)	8.0						7,521

Note: This table reports summary statistics for all VAT-filers in Panel A and the monthly balanced panel of EFRIS users in Panel B. The statistics shown are for the 2020/2021 financial year, running from July 2020 to June 2021. Variables from the monthly VAT returns data are annualized by taking the sum across the financial year, from July 2018 to June 2019. All monetary values are winsorized at the 1st and 99th percentile and displayed in millions of Ugandan shillings (1 USD = 3,580 UGX in August 2025). Data are in nominal terms and have not been adjusted for inflation.

¹Calculated as output VAT charged on goods/services sold minus VAT already paid on inputs, after offset adjustments.

²A firm would have negative VAT due if their total input VAT exceeded output VAT, after adjustments for off-sets carried forward. Negative liabilities in one period can be used to reduce VAT due in future periods.

Data source: Uganda Revenue Authority (2024c,d).

Table 1 also shows that the distributions of reported sales, purchases, and VAT liabilities are rightward-skewed, with lower medians than means and long tails to the right. In addition, these outcomes can equal zero. In such cases, it is common for researchers to use “log-like” transformations, such as $\log(Y + 1)$ or $\operatorname{arcsinh}(Y)$, to reduce the sensitivity of estimations to outliers, as these transformations behave similarly to a log-transformation when Y is very large, but are defined at zero (Chen and Roth 2024). In line with the established literature, we transform our outcome variables using the inverse hyperbolic sine (IHS) function to minimize the impact of outliers without dropping zeroes or imposing an arbitrary shift of the data, as in $\log(Y + 1)$ or other shifted log transformations using small numbers. However, since treatment effects estimated with IHS-transformed variables have been shown to be sensitive to changes in units, especially if extensive margin effects (moving from zero to a positive outcome) are large (see Chen and Roth (2024) for further explanation), we also estimate outcomes using dummy variables (e.g., an indicator equal to one if the firm declares positive VAT) and separately for firms with persistently negative VAT liabilities as robustness tests in Section 5.3. We are also somewhat reassured that our results on VAT due are not driven by the extensive margin as just 2 per cent of firms in the balanced panel reported zero VAT liabilities across the 2020/2021 financial year (while zero liabilities are much more prevalent in the unbalanced VAT panel).

As signalled in Section 4.1, firms mandated to adopt system-to-system integration and non-mandated firms are unbalanced on observable covariates, as shown in Table 2. On average, mandated firms have higher sales, purchases, and net VAT, across the calendar year before the announcement of the mandate. They were also much more likely to be audited, reflecting their greater importance to the URA in terms of enforcement. Despite these differences on average, Appendix Figures A3a and A3b show that there is still substantial overlap in total sales and VAT due between mandated and other firms. In addition, Appendix Figure A4 shows that mandated firms differ from non-mandated firms in terms of their trends, as well as levels. Once we transform outcome variables using the inverse hyperbolic sine (IHS) function, the pre-trends are more closely aligned.

Table 2: Balance tests for mandated versus all other firms, January to December 2021

	All other firms mean	Mandated firms mean	Diff.
<i>Monetary outcomes (millions of UGX)</i>			
Total sales for 2021	581.07	10,799.55	-10,218.48***
Monthly sales	48.42	899.96	-851.54***
Monthly purchases	31.62	613.41	-581.79***
Monthly input VAT	4.14	80.31	-76.17***
Monthly output VAT	5.78	103.48	-97.71***
Monthly net VAT	1.64	23.17	-21.53***
Monthly VAT due	-4.24	-8.20	3.96***
<i>Firm characteristics (% of firms)</i>			
Files CIT declarations	0.96	0.97	-0.01**
Audited before EFRIS	0.14	0.36	-0.22***
Based in Kampala	0.44	0.31	0.13***
Wholesale and retail trade	0.26	0.45	-0.19***
Manufacturing	0.08	0.13	-0.05***
Construction	0.14	0.08	0.06***
Agriculture	0.01	0.02	-0.01**
Services	0.47	0.28	0.19***
N	5,931 (62.8%)	3,511 (37.2%)	

Notes: This table reports t-test results for the strongly balanced monthly panel of EFRIS users, described in Section 4.2. Statistics are shown for the 2021 calendar year. Monthly sales, purchases, input VAT, output VAT, net VAT and VAT due are all means over the year. All monetary values have been winsorized at the 1st and 99th percentiles and displayed in millions of Ugandan shillings (1 USD = 3,850 UGX in August 2025). Data are in nominal terms and have not been adjusted for inflation.

Data source: Uganda Revenue Authority (2024c,d).

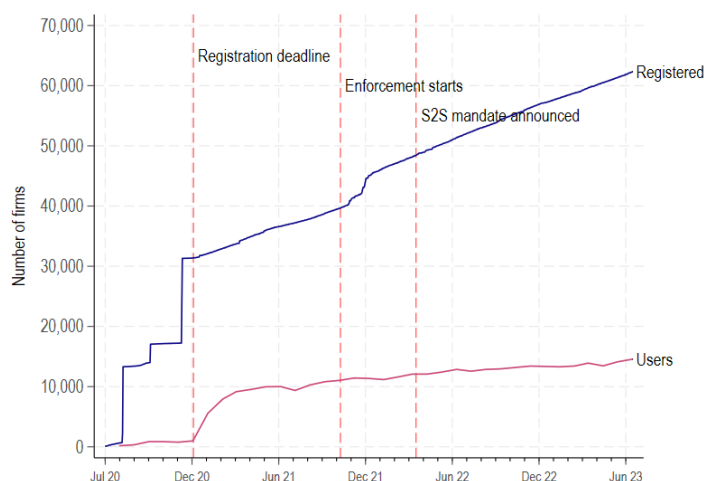
5 Results

5.1 Adoption and use of EFRIS

After EFRIS was launched in July 2020, the total number of EFRIS-registered taxpayers grew rapidly, reaching just over 13,000 by the end of August 2020, as shown in Figure 5. There was

another spike in registrations in early December 2020, when the total number of registered taxpayers almost doubled, as the URA issued several reminders, via social media and other channels, that 31 December 2020 was the deadline for registration. The URA began enforcement action from 1 November 2021, which explains the slight acceleration in registrations towards the end of 2021. From November 2021 until the end of our data period in June 2023, registrations have continued to grow at a steady pace, reaching just over 60,000 taxpayers in total. In contrast, just shy of 30,000 firms were on the VAT register in June 2023.³⁰

Figure 5: Cumulative number of taxpayers registered for EFRIS and monthly usage



Data source: Data extracted in May 2025 from the EFRIS records held by the Uganda Revenue Authority.

Since EFRIS is primarily a tool for monitoring and enforcing VAT compliance, and only VAT-registered taxpayers were required to adopt EFRIS, it is somewhat puzzling to see so many firms registering for EFRIS despite not filing VAT returns or appearing on the VAT register. This could reflect confusion among taxpayers about what EFRIS is and about who was required to register. For instance, news reports show that EFRIS was perceived as a new tax, with taxpayers complaining about “double taxation” and the URA issuing multiple clarifications that EFRIS is a tool to facilitate VAT collection, rather than a new tax (for instance, see Kiiza (2024)). Alternatively, taxpayers might have registered if their buyers had asked them to provide e-invoices, despite having no intention of filing a VAT return themselves. This reflects a misunderstanding of the VAT input claim process: VAT input claims are only valid if the supplier is VAT-registered, and therefore has charged VAT, otherwise there is no input VAT to claim back. Finally, the URA explicitly encouraged all firms, regardless of VAT registration status, to adopt EFRIS, arguing that firms can take advantage of the bookkeeping and stock management benefits.³¹ This kind of messaging from the URA could easily have been perceived as an implicit requirement or be taken as a signal of increased enforcement.

³⁰ By the end of our data period, only five per cent of taxpayers filing VAT had not registered for EFRIS. The majority of these, including diplomatic missions and international organizations, are not required to register for EFRIS.

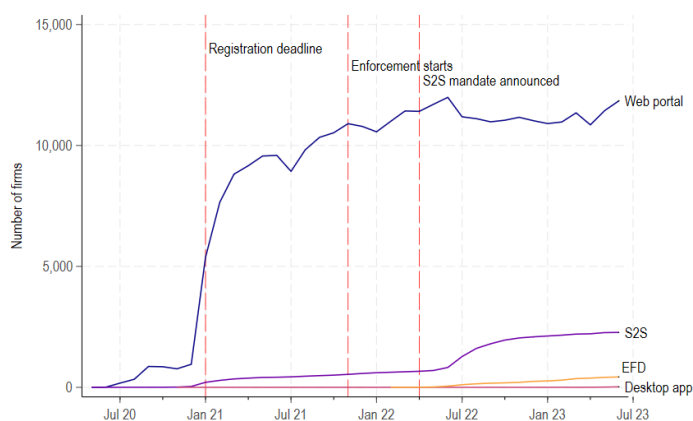
³¹ See Appendix Figure A5 for an example of the URA's communication with taxpayers on X from 8 April 2024.

Registering for EFRIS does not mean that firms actually use the system and issue e-invoices. As Figure 5 shows, very few firms were issuing e-invoices before January 2021. By the end of June 2023, the number of firms issuing at least one e-invoice per month had reached 18,600. Among VAT-registered taxpayers, a typical month sees around 60 per cent of firms issuing at least one e-invoice, with some variation by sector (see Appendix Figure A6). Across all major sectors, there was an initial increase in the number of firms using EFRIS, followed by a leveling off around May 2021.

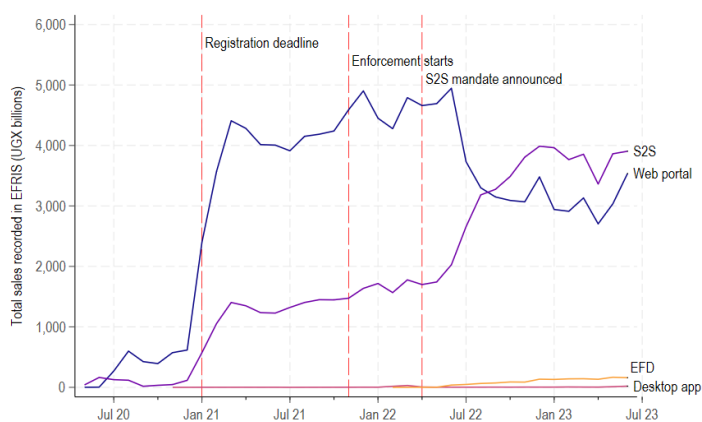
The dominant platform in terms of number of users has consistently been the web portal, though there is a notable increase in the number of firms using system-to-system (S2S) integration from April 2022, shown in Figure 6a. Given that the vast majority of firms initially choose to use the web portal, it is unsurprising to see that this platform accounts for the greatest share of total sales recorded through EFRIS, shown in Figure 6b. However, this trend starts to shift after the system-to-system mandate was issued. Taken together, these trends indicate that the mandate did have some effect on which platform firms used.

Figure 6: EFRIS use by platform

(a) Number of users by platform



(b) Total sales recorded by platform



Note: Both figures are constructed using the unbalanced panel of all VAT-registered taxpayers filing returns. A firm's main platform is defined as the platform with the largest share of total sales in any given month.

Data source: Data extracted in May 2025 from the EFRIS records held by the Uganda Revenue Authority.

5.2 Impact on existing taxpayers' compliance

Table 3 shows intent-to-treat (ITT) effects from the SDID models, where treated firms are those mandated to switch to system-to-system integration, compared against a weighted counterfactual of non-mandated firms using EFRIS. We consider all mandated firms as “treated” after April 2022, the month in which the announcement was made. As described in Section 4, we are not able to measure the effect of EFRIS on its own in this setting, so instead we estimate the effect of increased enforcement of the EFRIS requirements, as a subset of firms experienced stricter enforcement. All outcome variables are measured at the monthly level.

Panel A of Table 3 shows results for various dummy variable outcomes, which are defined as equal to one if a firm records the majority of their sales through the system-to-system (S2S) platform, declares positive VAT liabilities, declares positive total sales, or claims a VAT refund. Firstly, we find that the probability of using system-to-system integration increases by 20 percentage points for mandated firms, relative to the weighted counterfactual of non-mandated firms. This indicates that the policy had ‘bite’ and effectively shifted firms into using system-to-system integration. Secondly, we find that the probability of a firm reporting positive VAT increases by 1.4 percentage points, against a pre-treatment mean of 52 per cent for treated firms. This is an important shift, as the share of firms declaring negative VAT is large in Uganda, and many firms remain in an offset position (i.e. their input VAT exceeds their output VAT) for long periods of time (see Table 1). In addition, the probability of declaring positive sales decreases by 2.3 percentage points, against a pre-treatment mean of 92 per cent. The probability that a firm claims a VAT refund from the URA increases very marginally (by less than one per cent), against a pre-treatment mean of just two per cent of mandated firms claiming a refund in any one month before April 2022.

Panel B of Table 3 shows the results for monetary outcomes, which have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), winsorized at the first and ninety-ninth percentiles, and transformed using the inverse hyperbolic sine (IHS) function to reduce the sensitivity to outliers while retaining zeroes and negative values, without requiring arbitrary adjustments (as would be the case with shifted log transformations, for instance).³² Firstly, we find a positive and significant effect on VAT due. This result is also economically meaningful: a 0.909-point increase in IHS-transformed VAT due corresponds to an increase in VAT due of 148 per cent on average for treated firms, relative to the weighted counterfactual of non-mandated firms. To unpack this effect, we break VAT due down into its various components. The second and third columns show that treated firms *reduce* both reported sales and reported purchases, by 39 per cent and 43 per cent on average, respectively. Mechanically, the effects on output VAT and input VAT are of similar magnitudes. In line with these

³² Appendix Figure A7 shows the corresponding graphical output.

results, we see similar effects on total sales and VAT charged recorded in the EFRIS invoice data (shown in Appendix Table A3).

Table 3: Synthetic difference-in-differences estimates of the impact of mandating system-to-system use

Panel A: Dummy variable outcomes							
	Uses S2S	Positive VAT	Positive sales	Refund claimed			
ITT	0.201*** (0.007)	0.014*** (0.005)	-0.023*** (0.004)	0.003*** (0.001)			
Panel B: Monetary outcomes							
	VAT due	Sales	Purchases	Output VAT	Input VAT	Net VAT	Offset adj.
ITT	0.909*** (0.161)	-0.496*** (0.067)	-0.555*** (0.065)	-0.426*** (0.062)	-0.515*** (0.060)	0.281** (0.114)	-0.708*** (0.092)
N treated	3,511						
N control	5,931						

Note: The reported coefficients are the estimated intent-to-treat effects on treated firms relative to a weighted counterfactual of control firms using a synthetic difference-in-differences model from Arkhangelsky et al. (2021) and implemented in Stata using commands developed by Clarke et al. (2024). All outcome variables are measured at the monthly level. Monetary variables have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), are winsorized at the 1st and 99th percentiles by month, and are transformed using the inverse hyperbolic sine (IHS) function to reduce the sensitivity to outliers while retaining zeroes and negative values. The models are run on a strongly balanced monthly panel from January 2021 until June 2023, with treated firms defined as those mandated to switch to system-to-system integration from April 2022. Standard errors are reported in parentheses and are obtained through jackknife inference.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Data source: Uganda Revenue Authority (2024d).

Since the effect size for purchases is larger than for sales, this accounts for part of the effect on VAT due: a decline in sales would reduce VAT due, but a larger decline in purchases would increase the final liability. We therefore see a positive coefficient on net VAT, calculated as the difference between output and input VAT. However, since the ITT on net VAT is smaller than for VAT due, this does not explain the full effect on VAT due. Instead, we find that a large share of the effect on VAT due comes from changes in the size of offset adjustments (negative VAT liabilities carried forward from previous periods). The final column of Table 3 shows that treated firms reduce offset adjustments by approximately 50 per cent on average, relative to the weighted counterfactual, which implies an increase in final VAT due.

Our results show that the effect on VAT liabilities is driven by changes in input credit behaviour in the Ugandan context. The introduction of e-invoicing enhanced the URA's ability to cross-check firms' input VAT claims. If the buyer does not submit a validated e-invoice, the corresponding input VAT claim is automatically blocked. This reduces the scope for three types of misreporting: submitting claims without a proper receipt, submitting claims without paying VAT on the purchase (for instance, if the seller is unregistered but the buyer pretends that VAT was paid), and more sophisticated VAT fraud schemes involving fictitious invoices to claim back VAT

on non-existent or exaggerated purchases (Keen and Smith 2006). These schemes are often linked to invoice mills, companies which buy real invoices from firms whose customers do not require them (for instance, because they are unregistered firms or final consumers) and sell them on to firms looking to exaggerate their input costs. They have attracted considerable media interest in Uganda³³ and evidence from other countries suggests that invoice mills result in substantial revenue losses (Waseem 2023). The system-to-system mandate might have made firms more wary of filing erroneous VAT input claims: the announcement could be interpreted as a signal that the URA is stepping up enforcement for these firms, and maintaining a certain level of evasion would have required active interference with computerized accounting records and the generation of a false paper trail.

The related literature has found some support for reducing inputs as a key margin of response to e-invoicing. For instance, Fan et al. (2025) find that digitalizing invoices and linking transactions in China led to a decline in deductible inputs among large manufacturing firms, resulting in an increase in VAT payments. Bellon et al. (2023) examine the spillover effects of e-invoicing reforms in Peru, finding that firms whose trading partners were mandated to adopt e-invoicing reduced both reported sales and reported purchases, as well as VAT input credits carried forward. The authors argue that this is consistent with a reduction in the practice of filing false purchase invoices to lower VAT obligations, due to the increased probability that evasion would be detected. Finally, Kotsogiannis et al. (2025) show that, while adopting e-invoicing alone did not affect reported purchases in the Rwandan context, when this was paired with an audit, firms reduced reported input VAT, as e-invoicing data enhanced the capacity of audits to detect non-compliance.³⁴

Our results on total sales are more counter-intuitive, as part of the rationale behind introducing e-invoicing is to curb firms' abilities to under-report sales and evade on the output VAT margin, as discussed in Section 2.2. In addition, studies close to ours have typically found that increases in reported sales drive the effects of e-invoicing on VAT liabilities (Ali et al. 2021; Bellon et al. 2022; Mascagni et al. 2021). There are several possible explanations for the effects we find. Firstly, sales might have decreased in reality, for instance if firms lose market share as they are less able (or willing) to collude with customers and can no longer sell a certain percentage 'under-the-table'. To test this, we ran the same SDID regression as in our main specification for the subset of firms filing CIT declarations — 3,680 firms filed CIT declarations for the three financial years covered by our data period. If the decrease in sales is a real effect, we should see a decline in reported total sales in firms' CIT declarations after the system-to-

³³ For instance, see [this article](#) from 2021 in the Monitor, one of Uganda's most prominent papers.

³⁴ In the literature on invoice mills, Carrillo et al. (2023) show that challenging deductions claimed by the clients of suspected 'ghost' firms resulted in large reductions in reported purchases and increased VAT liabilities. Similarly, Waseem (2023) shows that when the incentives for firms to misreport purchases declined, in this case due to the zero-rating of certain industries in Pakistan, firms responded by significantly reducing reported purchases.

system mandate was introduced. We find no significant effect of the mandate on total sales (results shown in Appendix Table A3), although since there is just one period post-treatment in the CIT data, we are only powered to detect very large effects.³⁵ Using PAYE declarations data, which we have for 6,303 firms in the monthly balanced panel, we are also able to test whether mandated firms reduced their reported number of employees or the gross income per employee. This might reflect a contraction in production capacity, as well as a reduction in PAYE liabilities, which could compensate for increased VAT liabilities. We find no significant effects on either gross income per employee or total PAYE payable, and a significant increase in the reported number of employees for mandated firms: the coefficient on the number of employees is 6.5, with a pre-treatment mean of 74 employees.³⁶ We take this as indicative evidence that the effect of EFRIS enforcement on firm sales is unlikely to be a real effect.

An alternative hypothesis is that firms might be artificially suppressing reported sales to keep their VAT liabilities manageable under stricter enforcement of input VAT claims. Since input credits are now only permitted if accompanied by a validated e-invoice, firms are less able to either over-claim input credits or claim input credits for purchases where they do not have a receipt. Consequently, they may have responded by under-reporting sales by a similar magnitude to the reduction in purchases, to prevent their VAT liabilities from rising excessively. This is in line with earlier evidence from Uganda documenting widespread discrepancies between buyer and seller VAT returns before the introduction of EFRIS. Buyers and sellers reported identical values in only 21 per cent of buyer–seller–month observations. Of the firms that mis-reported to lower their VAT liabilities, 78 per cent did so conspicuously, both under-reporting sales and over-reporting purchases (Almunia et al. 2024). When the URA notified firms that such discrepancies had been detected, sellers corrected the discrepancies by increasing the reported amounts sold to another business, but partially offset this by reducing reported final sales (Almunia et al. 2025). The authors argue that firms exploit the fact that final sales are not covered by a paper trail. This is not just a ‘last mile’ problem, as firms throughout the supply chain report final sales and Almunia et al. (2025) find evidence of this re-classification across all firms. This gives some support to our hypothesis that if firms can no longer exaggerate input costs, they resort to reducing reported sales, particularly final sales.

³⁵ The 95 per cent confidence interval is wide, including effects ranging from -24 per cent to +64 per cent, so our estimate of “zero” effect on total sales is not very precise.

³⁶ The URA’s PAYE data does not include a taxpayer identification number (TIN) for all employees as the URA was not enforcing the requirement for a TIN or validating the provided TINs during the years covered by the panel. When the employer does not include an employee’s TIN, the return only contains the employee’s name and the URA creates a pseudo-TIN for the employee, which could be the same for many employees. Consequently, although the PAYE data contains some duplicates with respect to employer TIN, employee TIN, and salary, we cannot confidently drop these duplicated observations as they could be different employees with the same salary. More information about this feature is discussed in Agaba et al. (2023).

Figure 7 shows event-study style plots of the treatment effects over time. Pre-treatment coefficients are generally not significantly different from zero, indicating that the SDID method was successful in building a weighted control group on a parallel trend to the treatment group. Following the mandate to adopt system-to-system integration, we see a somewhat steady rise in VAT due as well as steady falls in total sales, purchases, and offset adjustments. This indicates that the treatment effects are growing over time, although they are potentially levelling off towards the end of our data period. Finally, we also tested whether firms respond to increased enforcement by shifting reported sales to non-taxable categories, but see no significant effect on either the share of non-taxable domestic sales (zero-rated and exempt goods and services) or total amounts declared as exported, which are zero-rated (reported in Appendix Table A3).

Heterogeneity analysis

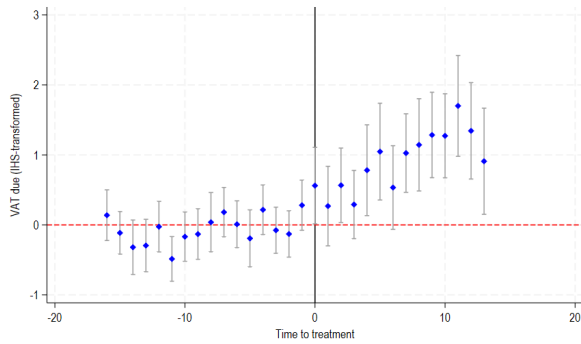
To unpack the drivers of these effects further, we split the sample into different sub-groups and re-estimated the SDID models.³⁷ The results are shown in Table 4. Panel A divides the sample into firms registered in Kampala and those outside of Kampala, as Kampala-based firms were more exposed to the URA's enforcement efforts. Panel B divides the sample based on sector, where we define consumer-facing sectors as retail trade, accommodation, and food service. We concentrate on this split as consumer-facing sectors have a larger share of final sales, while non-consumer-facing sectors are more likely to engage in business-to-business transactions. Finally, Panel C splits the sample into firms with a 'chronic' negative VAT liability versus those with a positive VAT liability, based on their total VAT due for the year to April 2022. That is, if the sum of a firm's monthly VAT due for May 2021 to April 2022 is negative, they would be categorized as having a chronic negative liability. For brevity, we concentrate on the main reporting margins: final VAT due, total sales, total purchases, and offset adjustment amounts.

The treatment effects on VAT due and offset adjustments appear larger for firms based in Kampala, in consumer-facing sectors, and in a chronic negative VAT position. However, the differences between the majority of these point estimates are not statistically significant at conventional levels. This suggests that the treatment effects are broad-based and do not differ substantially between sub-groups. One exception is the effect on VAT due and offset adjustments for firms in a persistently negative VAT position, which are significantly larger than for firms with positive VAT liabilities for the year to April 2022. This adds support for our main results that the system-to-system mandate was particularly effective in shifting firms away from maintaining perpetually negative liabilities.

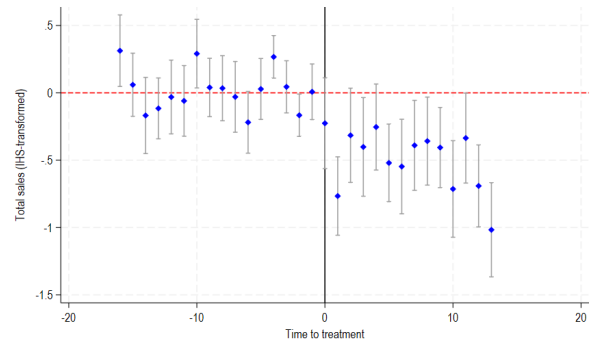
³⁷ The `sdid` command does not allow for the direct inclusion of interaction effects. Instead, we estimate the model for each subgroup and use a Wald test of the difference between treatment effects within each subgroup (i.e. Kampala vs non-Kampala; consumer-facing vs other sectors; and chronic negative VAT vs positive VAT). This approach assumes that the subgroup estimates are independent, which is reasonable as the subgroups are mutually exclusive (for instance, a firm cannot appear in both the Kampala and the non-Kampala groups).

Figure 7: SDID results: Dynamic effects

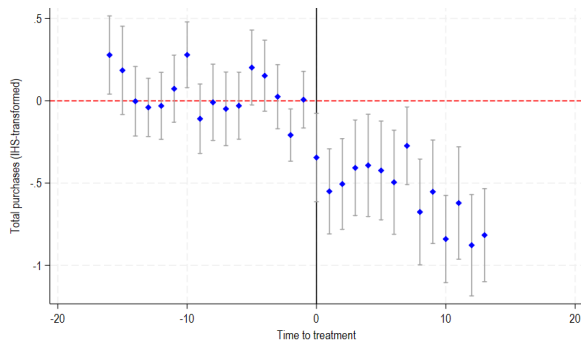
(a) VAT due



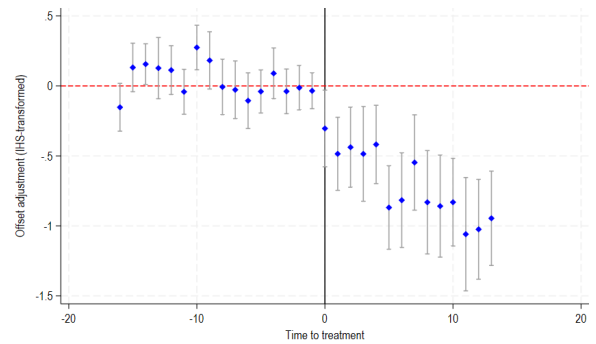
(b) Total sales



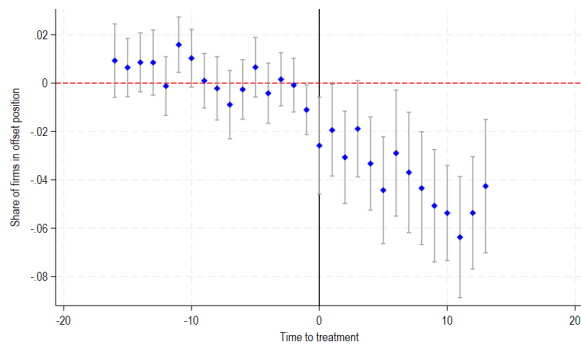
(c) Total purchases



(d) Offset adjustment amounts



(e) Probability of negative VAT liability



Note: Figures show event-study-like dynamic treatment effects, estimated using a synthetic difference-in-differences model from Arkhangelsky et al. (2021) and implemented in Stata using the `sdid_event` command from Ciccia (2024). All monetary outcome variables are measured at the monthly level, have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), are winsorized at the 1st and 99th percentiles by month, and are transformed using the inverse hyperbolic sine (IHS) function to reduce the sensitivity to outliers while retaining zeroes and negative values. The models are run on a strongly balanced monthly panel from January 2021 until June 2023, with treated firms defined as those mandated to switch to system-to-system integration. Treatment time is taken as April 2022.

Data source: Uganda Revenue Authority (2024d).

Table 4: Heterogeneity in treatment effects

	VAT due	Sales	Purchases	Offset adj.	N treated	N control
<i>Panel A: Registered in Kampala</i>						
=1	0.916*** (0.280)	-0.503*** (0.117)	-0.455*** (0.111)	-0.712*** (0.159)	1,100	2,626
=0	0.876*** (0.199)	-0.533*** (0.084)	-0.654*** (0.082)	-0.713*** (0.114)	2,411	3,305
Difference	0.039 (0.344)	0.030 (0.144)	0.199 (0.138)	0.001 (0.195)		
<i>Panel B: Operates in a consumer-facing sector</i>						
=1	1.234*** (0.371)	-0.339*** (0.142)	-0.540*** (0.138)	-0.822*** (0.204)	715	949
=0	0.837*** (0.180)	-0.529*** (0.075)	-0.564*** (0.072)	-0.670*** (0.103)	2,788	4,964
Difference	0.397 (0.412)	0.190 (0.161)	0.024 (0.156)	-0.152 (0.229)		
<i>Panel C: Chronic negative VAT liability</i>						
=1	1.161*** (0.238)	-0.590*** (0.107)	-0.434*** (0.101)	-0.738*** (0.148)	1,808	2,665
=0	0.133 (0.201)	-0.407*** (0.084)	-0.621*** (0.081)	-0.395*** (0.103)	1,703	3,266
Difference	1.028*** (0.311)	-0.183 (0.136)	0.187 (0.130)	-0.343* (0.180)		

Note: The reported coefficients are the estimated intent-to-treat (ITT) effects on treated firms relative to a weighted counterfactual of control firms using a synthetic difference-in-differences model (Arkhangelsky et al. 2021; Clarke et al. 2024). All monetary outcome variables are measured at the monthly level, have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), are winsorized at the 1st and 99th percentiles by month, and are transformed using the inverse hyperbolic sine (IHS) function. The models are run on a strongly balanced monthly panel from January 2021 until June 2023, separately for each subgroup in Panels A, B, and C. In Panel A, firms are classified as Kampala-based depending on their district of tax registration. In Panel B, consumer-facing sectors are defined as the retail sector, accommodation, and food service. In Panel C, we split the sample into firms with a 'chronic' negative VAT liability and those with a positive VAT liability, based on their total VAT due for the year to April 2022. Standard errors are reported in parentheses and are obtained through jackknife inference.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Data source: Uganda Revenue Authority (2024d).

5.3 Robustness tests

In Table 5 we demonstrate the robustness of our results to various alternative specifications. In columns one and two, we test two different top-coding approaches, first winsorizing the outcome variables more conservatively (at the ninety-fifth percentile) and then dropping the top five per cent of firms from the sample to check whether the results are driven by the largest firms. We determine the largest firms based on their total sales reported in their VAT returns for 2019, to avoid classifying firms based on their sales during the COVID-19 period, which may not accurately reflect the distribution. The results in both cases are similar in magnitude and significance to our main specification. In columns three and four, we test looser sample restrictions, first taking a quarterly balanced panel (requiring firms to file at least once per quarter since January 2021, with treatment ‘switching on’ from quarter two in 2022) and then including all firms registered for EFRIS, rather than restricting the sample to EFRIS users only. Again, the results are comparable to our main specification, with some larger effects on VAT due and offset adjustments for the quarterly balanced panel, which could be explained by the inclusion of more smaller firms which tend to file less regularly and are likely more responsive to (perceived) increased monitoring.

In columns five and six, we test tighter sample restrictions. In column five, we only consider a firm as treated if they complied with the system-to-system mandate. In this case, treatment adoption is staggered and ‘switches on’ in the month when firms switched to using the system-to-system integration platform to record the majority of their sales. Just under half of mandated taxpayers actually shift to system-to-system integration by the end of June 2023 — 1,694 out of 3,511 mandated firms in the balanced panel. While we see larger effects on VAT due for these compliers, the effect on total sales is no longer significant and the purchases effect is smaller. In column six, we drop any non-mandated firms using system-to-system to record the majority of their sales in any month from the control group. Again, the results are comparable to our main specification. In summary, our results are robust to alternative top-coding approaches and sample restrictions, with broadly small differences in the point estimates.

5.4 Effects on the extensive margin

Despite the strong effects on VAT liabilities for the subset of firms targeted by the system-to-system mandate, the URA has not seen the hoped-for improvements in VAT performance overall. While collections spiked towards the end of the 2022/23 financial year, the introduction of EFRIS in January 2021 has not been accompanied by substantial increases in VAT collections.³⁸ Part of the explanation is that many firms have large positive balances with the URA

³⁸ Appendix Figure A8 shows monthly domestic VAT collections from July 2018 to November 2023.

Table 5: Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)
VAT due (ITT)	0.920*** (0.161)	0.954*** (0.172)	1.464*** (0.196)	0.917*** (0.156)	1.387*** (0.222)	0.909*** (0.161)
Total sales (ITT)	-0.496*** (0.067)	-0.469*** (0.072)	-0.445*** (0.071)	-0.408** (0.064)	0.075 (0.059)	-0.478*** (0.068)
Total purchases (ITT)	-0.553*** (0.064)	-0.552*** (0.069)	-0.540*** (0.068)	-0.489*** (0.061)	-0.124** (0.055)	-0.548*** (0.065)
Offset adjustment amount (ITT)	-0.708*** (0.091)	-0.750*** (0.098)	-0.997*** (0.103)	-0.663*** (0.089)	-0.754*** (0.121)	-0.706*** (0.092)
Treated firms (N)	3,511	2,867	4,388	3,511	1,694	3,511
Control firms (N)	5,931	5,887	8,249	6,767	7,748	5,774
Winsorize at p95	Y	–	–	–	–	–
Winsorize at p99	–	Y	Y	Y	Y	Y
Drop top 5% of firms	–	Y	–	–	–	–
Monthly balanced	Y	Y	–	Y	Y	Y
Quarterly balanced	–	–	Y	–	–	–
Include all EFRIS-registered firms	–	–	–	Y	–	–
Treated only if compliant with mandate	–	–	–	–	Y	–
Exclude non-mandated S2S users	–	–	–	–	–	Y

Note: The reported coefficients are the estimated intent-to-treat (ITT) effects on treated firms relative to a weighted counterfactual of control firms using a synthetic difference-in-differences model from Arkhangelsky et al. (2021) and implemented in Stata using commands developed by Clarke et al. (2024). All monetary outcome variables are measured at the monthly level, have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), are winsorized at the 1st and 99th percentiles by month (except for column 1), and are transformed using the inverse hyperbolic sine (IHS) function. The models are run on a strongly balanced monthly panel from January 2021 until June 2023, except for column 3 where we use a strongly balanced quarterly panel. Treated firms defined as those mandated to switch to system-to-system integration from April 2022, except for column four where treated firms are only those mandated firms which actually do switch (compliers). In all specifications, treatment time is taken as April 2022, except for column four where treatment switches in the month after April 2022 when system-to-system is the platform used for the largest share of total sales. Standard errors are reported in parentheses and are obtained through jackknife inference.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Data source: Uganda Revenue Authority (2024d).

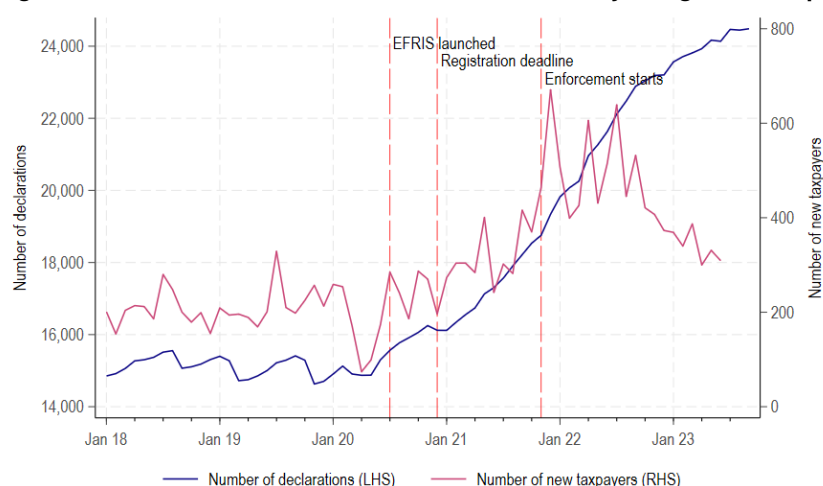
(i.e., the URA owes firms money), so even eliminating all misreporting would not lead to large, immediate revenue gains, as firms slowly draw down their balances. This is also linked to the difficulties firms face obtaining VAT refunds in Uganda, described in Section 3.1. Indeed, the average mandated firm still has negative VAT due in June 2023 (see Appendix Figure A4g) and the results in the previous section showed a very small increase in the probability that firms claim a VAT refund, against a pre-treatment mean of around two per cent of firms each month.

However, the overall effect of e-invoicing depends not only on the compliance effects among existing taxpayers (the intensive margin), but also the effects on the tax base (the extensive

margin). On the one hand, stricter enforcement might shrink the tax base by encouraging firms to shift to the informal sector, which would further dampen overall VAT revenue collection. On the other hand, if more accurate reporting and more even enforcement across firms decreases incentives to suppress operations and ‘look small’ to avoid taxes, e-invoicing might expand the tax base by bringing in new taxpayers.

Figure 8 shows that the introduction of EFRIS and related enforcement activities coincided with a sharp acceleration in the number of VAT declarations filed per month, as well as the number of taxpayers filing VAT declarations for the first time. Firms with a history of filing VAT declarations before the introduction of EFRIS largely registered before the 31 December 2020 deadline. In contrast, almost all of the taxpayers registering for EFRIS from January 2021 onwards had no prior history of filing VAT declarations. Approximately 12,000 firms start filing VAT declarations after adopting EFRIS, or in the month directly before adoption (shown in Appendix Figure A9). Importantly, this is not a purely mechanical effect: even if firms were using EFRIS, these records are not used to auto-populate a VAT return. Firms would still need to compile and submit their monthly VAT declarations, possibly using their EFRIS records to support this process. The sectoral composition of these new VAT-filers is broadly comparable to the existing stock of VAT-filers: nearly 40 per cent are in the wholesale and retail trade sector, 12 per cent are in construction, and five per cent are in the manufacturing sector. Just under half of new filers are located in Kampala, in line with the proportion among existing VAT-filers.

Figure 8: The number of VAT declarations filed monthly has grown sharply



Data source: Uganda Revenue Authority (2024d).

Looking at the declarations, we see a higher rate of nil returns compared to ‘older’ taxpayers, consistent with existing evidence that nil-filing is particularly prevalent among new filers (Mascagni et al. 2025). Between January 2021 and June 2023, 35 per cent of returns filed by new taxpayers were nil, versus 22 per cent of returns filed by older taxpayers, shown in Ap-

pendix Figure A11.³⁹ Older taxpayers are more likely to report positive sales and VAT amounts. Among those reporting non-nil returns, older taxpayers report significantly higher total sales and total purchases, as well as larger offset adjustments — rendering the difference in VAT due between older and new taxpayers statistically insignificant. Once new taxpayers start filing, the vast majority continue to file regularly: 83 per cent file every month and a further eight per cent skip just one return. New taxpayers also have slightly lower EFRIS usage rates: approximately 45 per cent of new filers issue at least one EFRIS invoice in any given month, against 60 per cent of older taxpayers.

Finally, we examined whether the new VAT-filers have a history of filing CIT declarations. We find that 36 per cent of new VAT-filers filed their first CIT return before starting to file VAT returns, with 3 per cent filing a return every year from 2014. Among those CIT returns filed before taxpayers started filing VAT, 20 per cent filed nil returns. However, many declare total sales in their CIT declarations exceeding the VAT registration threshold of UGX 150 million: approximately 20 per cent of CIT returns filed by new VAT-filers between 2016 and 2020 reported total sales above the VAT threshold.⁴⁰ This might indicate that introducing EFRIS has brought some previously non-compliant taxpayers into the VAT net.

6 Conclusion and policy implications

This paper presents the first evidence on the effect of introducing electronic invoicing to enhance VAT compliance in Uganda. In particular, we examine the effects of mandating a subset of VAT-registered firms to adopt a more intensive version of e-invoicing, which entailed integrating their computerized accounting or enterprise resource planning system directly with the URA system. Using a synthetic difference-in-difference approach, we compare outcomes for these firms against a weighted counterfactual group of firms using e-invoicing that were not affected by this mandate. Our results show that when taxpayers were subjected to stricter enforcement of the e-invoicing requirements, they responded by significantly reducing their input VAT claims and the size of negative VAT liabilities carried forward, thus increasing their overall VAT due. However, we also find that firms reduced their total reported sales, possibly through intentional under-reporting or suppression of sales. Taken together, these results suggest that stricter enforcement has reduced the scope for firms to exaggerate their input claims and engage in VAT fraud schemes, although firms appear to find new ways to manage their VAT liabilities.

³⁹ In this context, we define a nil return as one with zeroes reported across all sales and purchases categories, zero input VAT, zero output VAT, and zero VAT due.

⁴⁰ Appendix Figure A10 shows total sales reported by new VAT-filers in their CIT declarations before starting to file VAT.

On the extensive margin, we show that the introduction of e-invoicing, and the associated enforcement action taken by the URA, coincided with a large and sustained increase in the number of VAT declarations filed monthly, primarily driven by an increase in the number of taxpayers filing VAT for the first time. Many of these ‘new’ taxpayers were not entirely new to the tax system: just over a third had previously filed CIT returns, and among this subset of taxpayers, 20 per cent had reported total sales above the VAT threshold in their CIT returns. While ‘new’ VAT payers tend to be smaller than existing filers, they are also much less likely to claim large offset adjustments. In addition, they appear to develop a habit of regularly filing VAT. Therefore, we would expect these new entrants to have a positive impact on overall VAT collections over time.

The key implication of our study is that e-invoicing is not a quick and easy fix for vulnerabilities in the VAT system. A successful e-invoicing policy requires careful policy design and implementation, including appropriate taxpayer sensitization and penalties for non-compliance. As noted in Section 5.3, not all firms mandated to adopt system-to-system integration actually switch to using this platform to record the bulk of their sales. Since system-to-system integration is clearly a stronger tool for VAT monitoring and enforcement than the web portal, the URA should adopt measures to monitor the compliance of mandated firms with this requirement, including introducing consequences for firms that do not comply. It is naturally easier to check whether a firm is using the appropriate EFRIS system, and issuing e-invoices, than to check whether their VAT returns are filed accurately. Consequently, this could serve as a strong signal to taxpayers that the URA’s enforcement capacity has been enhanced.

However, our results do not imply that the URA should mandate all VAT-registered firms to adopt this version of e-invoicing. Indeed, pursuing universal system-to-system migration might backfire, as smaller, less technologically-enabled businesses are unlikely to manage the concomitant compliance costs (Mascagni et al. 2023; Roy and Khan 2021). To minimize risks, the URA could consider developing a point-of-sale software or device that would bridge the gap between the high-cost system-to-system integration option and the manual, basic web portal. This should be offered to taxpayers free-of-charge, eliminating the need to hire specialized third-party integration experts and bypassing compatibility issues with firms’ own accounting systems, thus reducing the large financial and technical barriers mid-sized firms face in using EFRIS.

Moreover, EFRIS continues to spark tensions between the URA and taxpayers. For example, protests spread among traders in Kampala who temporarily closed their shops in April 2024, citing concerns that implementing EFRIS amounts to “double taxation” and would make their businesses uncompetitive, as well as the steep penalties for non-compliance, which have since been waived (Jouste 2024). Confusion about EFRIS requirements has also led non-registered firms to register for EFRIS unnecessarily, as their buyers mistakenly demand e-invoices from

them. Addressing these misunderstandings, as well as the deficit in digital skills necessary to operate EFRIS, through targeted taxpayer education and sensitization will be crucial for the successful implementation of this policy.

Finally, our study provides further evidence that digital information trails are “an insufficient condition for tax capacity” (Jensen and Weigel ming). To realize the potential of third-party information, revenue administrations need to invest in analytical and enforcement capacity, using these data to automatically cross-validate the information reported by firms, while reducing the scope for firms to shift evasion to margins not covered by third-party reporting. The URA has already introduced automated checks that disallow input claims not backed by a valid e-invoice and enabled pre-filled VAT returns in December 2023. These checks could go further, for instance, by using EFRIS data to validate firms’ CIT reports and to enhance tax audits.

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A1 Supplementary tables and figures

Table A1: EFRIS usage by platform, June 2024

Platform type	Description	Users	Invoices issued
URA Web Portal	Accessed via the URA website, without an offline mode. Only available for taxpayers with less than 100 daily transactions and annual sales below UGX 2 billion.	25,391	26 million
System-to-system integration	A firm's invoicing system is directly integrated with EFRIS via an API. Suitable for businesses with high transaction volumes and computerized accounting systems. Supports both online and offline mode.	4,257	468 million
Desktop software	Free download available from URA website, to be installed directly on the taxpayer's own computer or tablet. This can be used offline for up to five days. Suitable for taxpayers with moderate sales volumes.	324	343,000
Electronic fiscal device (EFD)	This is a physical, portable device connected to the URA system, used to produce e-receipts and e-invoices. It can be used offline and data is transmitted to the URA automatically when it is connected to the internet. Suitable for traders and retail shops. EFDs were initially available from one accredited supplier, at a cost of UGX 1.1 million (VAT inclusive, tax deductible). URA expect to expand the number of accredited suppliers in 2024/25. In early 2024, URA began a small trial programme offering free EFDs to small traders.	1,623	5 million
URA mobile app	Installed on a cellphone and can be operated offline for up to five days. Not yet launched.		
Electronic dispenser controller	Relevant for fuel stations only. The controller automatically transmits information to a connected EFD to generate e-receipts.	450	28,000

Source: Authors' compilation based on Uganda Revenue Authority (2024a).

Table A2: Summary of related literature on e-invoicing systems

Author(s)	Country	Methods	Results
Ali et al. (2021)	Ethiopia	Difference-in-differences (DID) comparing early-adopters to never-adopters or later-adopters; DID interacting treatment with downstream sector dummy; matched DID comparing adopters to non-adopters	↑ in reported sales ↑ in VAT liabilities No evidence of decrease in formal employment ↓ entry into downstream sectors
Bellon et al. (2022)	Peru	DID exploiting staggered roll-out based on firm size and sector, comparing earlier-mandated firms to not-yet-mandated	7.4% ↑ in reported sales 5.5% ↑ in reported purchases 8.2% ↑ in VAT liabilities No significant effect on VAT payments Positive impacts driven by small firms
Bellon et al. (2023)	Peru	Study focussed on spillover effects, DID exploiting staggered roll-out, comparing firms with trading partners that have been mandated to adopt e-invoicing relative to those without such partnerships	26% more likely to voluntarily adopt if a buyer is mandated 7% more likely to voluntarily adopt if a seller is mandated ↓ in purchases and VAT input credits for firms with mandated trading partners
Eissa and Zeitlin (2014)	Rwanda	DID comparing users of electronic billing machines (EBMs) against non-users	6.5% ↑ in VAT payments Impacts greater for smaller firms, firms in previously low-compliance sectors
Fan et al. (2024, 2025)	China	Nationwide reform with no pure control group. DID exploits variation in the intensity of treatment within the manufacturing sector based on sectoral-level shares of non-deductible input costs: firms with higher non-deductible shares had stronger incentives to falsify claims	↑ in VAT payments ↓ input VAT, consistent with pre-reform evasion strategy of exaggerating inputs ↓ in sales, but smaller in magnitude and only significant at 10%
Fjeldstad et al. (2018)	Tanzania	Checked customers' receipts to observe actual EFD compliance by businesses; surveyed businesses and customers to capture factors influencing compliance	Businesses are more likely to comply if their customers are aware of legal obligation to obtain a VAT receipt and fear enforcement; views of competitors' compliance shape own compliance
Hakizimana and Santoro (2023)	Rwanda	DID comparing first-time users of a new EBM system against earlier adopters of older system	↑ VAT due, reported sales, input VAT No significant effects on 'shifters'
Heinemann and Stiller (2025)	Italy	DID comparing products not affected by e-invoicing to remaining products (treatment intensity)	↓ in cross-border VAT fraud
Kotsogiannis et al. (2025)	Rwanda	Stacked DID exploiting staggered roll-out, comparing treated firms to those never treated during entire period. Matched treated and untreated firms with Coarsened Exact Matching based on their audit risk score.	US\$11,000 ↑ in VAT liability from e-invoicing alone VAT liability effect is 3x larger if paired with audit ↑ in output VAT ↓ in input VAT, only if paired with audit

Table A2: (continued)

Author(s)	Country	Methods	Results
Lee (2016)	South Korea	Perceptions survey of taxpayers and tax practitioners (n=332)	↓ tax compliance costs associated with issuing and receiving invoices + 've effect on perceived accuracy of filing + 've effect on perception of taxpayer service
Mascagni et al. (2021)	Ethiopia	DID comparing adopters to later-adopters (roll-out was not randomized), restricting to firms in Addis Ababa; triple differences estimation to account for firm-specific trends	100% ↑ in reported sales 190% ↑ in input VAT 48% ↑ VAT revenue 12% ↑ income tax revenue (increased reported turnover offset by increase in deductible expenses)
Mittal and Mahajan (2017) ¹	Pakistan	DID comparing wholesale versus retail firms (treatment intensity) exploiting exogenous timing of policy introduction	9.5% ↑ in output VAT No significant effect on input credit 29% ↑ in VAT remitted
Shah (2026) ²	Pakistan	DID comparing non-exporting firms (treated) to exporting firms (already subject to the reform)	50% ↓ in input VAT claims 10% ↑ in net VAT collection 13% of treated firms stop claiming any input credits
Ván et al. (2025)	Hungary	Fixed-effects panel and event study models for firms using Online Cash Registries, comparing adopters to not-yet-adopters	↑ in turnover among smaller firms ↑ in purchases

Note: ¹ This study examines the introduction of detailed, firm-level reporting on all purchases and sales with tax identification numbers for each trading partner, enabling the tax authority to cross-check buyer and seller information without an audit. While this is not an e-invoicing system, it operates in a similar way, by digitizing the paper trail.

² This study does not examine e-invoicing but rather examines a related digital reform which authorized a risk analysis software to automatically reject suspicious input tax claims, based on an assessment of VAT returns and in-built risk parameters. It therefore automated the invoice cross-checking process, and could go back several steps in the VAT chain to verify whether a transaction actually took place.

Table A3: Additional outcomes

	ITT	SE	N treated	N control
<i>Panel A: VAT declarations</i>				
Total sales recorded in EFRIS (IHS-transformed)	-0.499***	(0.075)	3,511	5,931
Total VAT charged recorded in EFRIS (IHS-transformed)	-0.443***	(0.067)	3,511	5,931
Share of total reported sales recorded in EFRIS	-0.021***	(0.004)	3,511	5,931
Share of non-taxable sales	0.001	(0.002)	3,511	5,931
Total exports (IHS-transformed)	-0.028	(0.038)	3,511	5,931
<i>Panel B: CIT declarations</i>				
Total sales reported in CIT declarations (IHS-transformed)	0.095	(0.204)	1,217	2,463
<i>Panel C: PAYE declarations</i>				
Number of employees	6.499***	(1.654)	2,974	3,329
Gross income per employee (IHS-transformed)	-0.018	(0.038)	2,974	3,329
PAYE payable (IHS-transformed)	-0.022	(0.041)	2,974	3,329

Note: The reported coefficients are the estimated intent-to-treat effects on treated firms relative to a weighted counterfactual of control firms using a synthetic difference-in-differences model from Arkhangelsky et al. (2021) and implemented in Stata using commands developed by Clarke et al. (2024). All monetary outcome variables in Panel A are measured at the monthly level, have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025), are winsorized at the 1st and 99th percentiles by month, and are transformed using the inverse hyperbolic sine (IHS) function. Total sales in Panel B is measured annually and have been adjusted for inflation, winsorized, and transformed using the IHS function. The outcomes in Panel C are measured monthly, are winsorized, and transformed using the IHS function (except for the number of employees). The models in Panel A and Panel C are run on a strongly balanced monthly panel from January 2021 until June 2023, with treated firms defined as those mandated to switch to system-to-system integration from April 2022. The model in Panel B is run on a strongly balanced annual panel, covering the three financial years ending June 2021, June 2022, and June 2023. Standard errors are reported in parentheses and are obtained through jackknife inference.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Data source: Uganda Revenue Authority (2023, 2024c,d).

Figure A1: Example of an EFRIS receipt



Source: X: <https://x.com/URAuganda/status/1458356998836195334>.

Figure A2: Screenshot of the EFRIS web portal

EFRRIS

efristest.ura.go.ug/efrrisite/canvas/site_index

Fiscal Document Validation

Fiscal Document Management

Stock Management

Create Sub Account

Device Management

Reports

Section A: Seller's Information

Seller's Information

Headquarter/Branch * Currency * UGX

Operator * Seller's Reference ...

Section B: Buyer's Details

Buyer's Details

Customer Type ☒ Business ☐ Consumer ☐ Foreigner

Is the buyer a non-resident? ☐ Yes ☒ No

NIN/BRN Search TIN Search

Legal Name Business Name

Email Address Contact Number

Address

Fiscal Document Management / Receipts/Invoices

Issue

Section C: Goods/Services Details

+ Add

NO.	Item	Unit of Measure	Unit Price	Quantity	Total
Remarks					

Section D: Payment Details

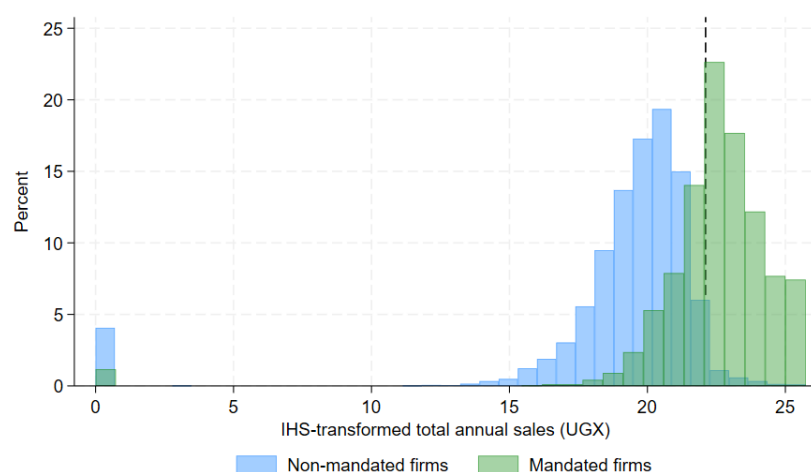
Payment Mode Please Select

Section E: Summary (UGX)

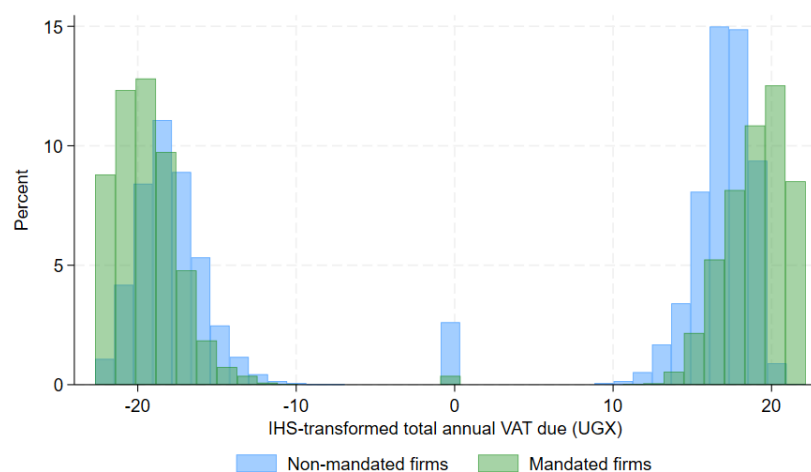
Gross Amount (Total)

Figure A3: Distribution of total sales and VAT due for mandated and all other firms

(a) Total sales for 2021



(b) Total VAT due for 2021

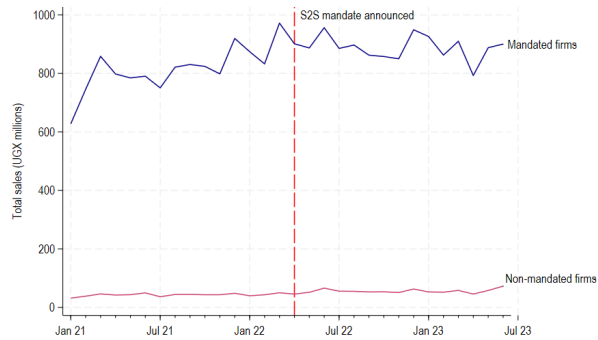


Note: The dotted line in Panel (a) shows the annual sales threshold applied by the URA in determining which firms would be mandated to adopt system-to-system integration. Total sales and VAT due have been winsorized at the 1st and 99th percentiles and are displayed in nominal terms.

Data source: Uganda Revenue Authority (2024d).

Figure A4: Trends in outcome variables for mandated and non-mandated firms

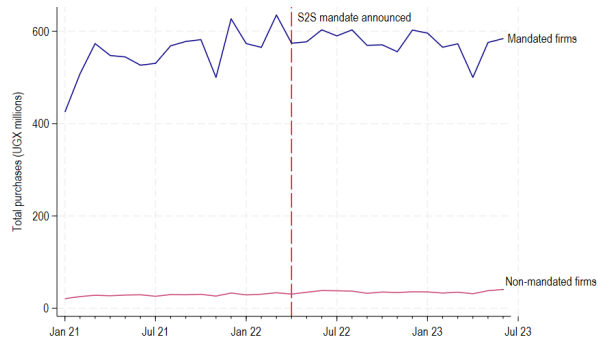
(a) Mean monthly sales



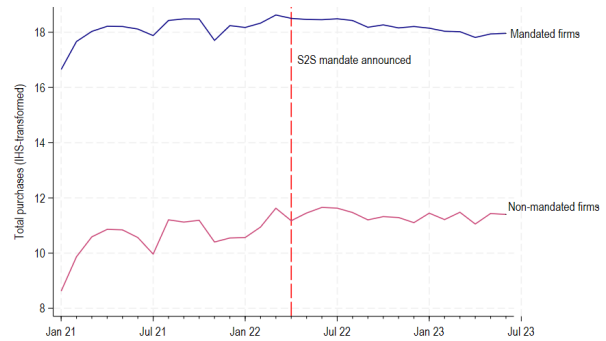
(b) Mean monthly sales (IHS-transformed)



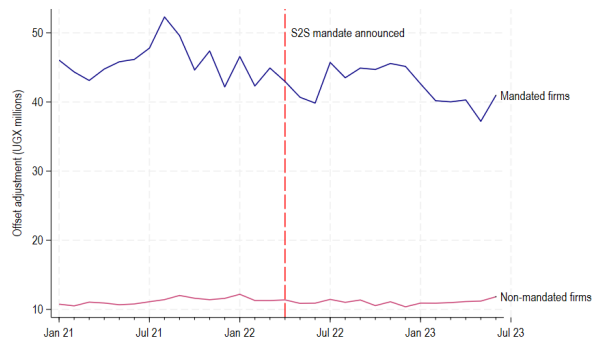
(c) Mean monthly purchases



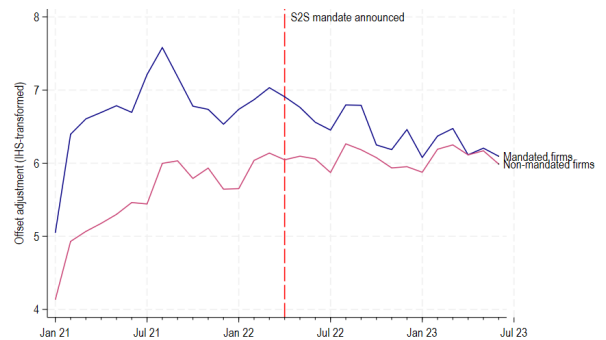
(d) Mean monthly purchases (IHS-transformed)



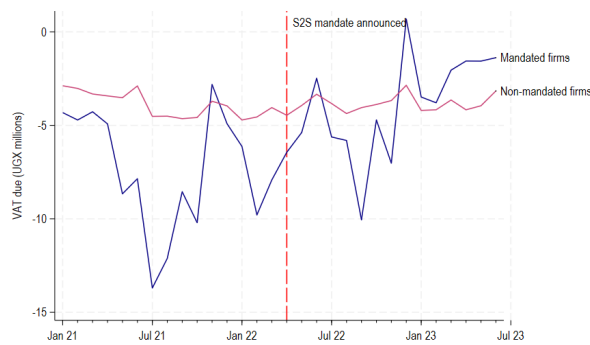
(e) Mean monthly offset adjustments



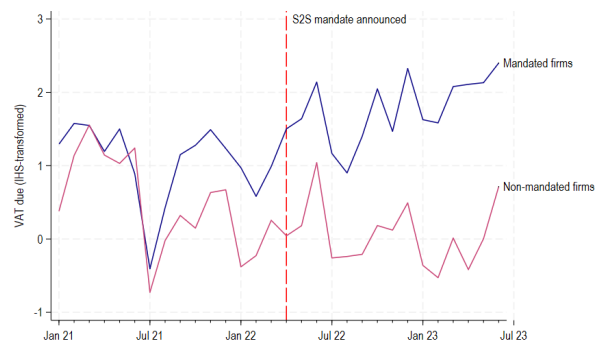
(f) Mean monthly offset adjustments (IHS-transformed)



(g) Mean monthly VAT due



(h) Mean monthly VAT due (IHS-transformed)



Note: Figures are constructed using the same strongly balanced monthly panel of EFRIS users described in Section 4.2 and used for the analysis in Section 5.2. Monthly sales, purchases, offset adjustments, and VAT due have been winsorized at the 1st and 99th percentiles and adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025).

Data source: Uganda Revenue Authority (2024d).

Figure A5: Example of URA's communication with taxpayers



Hello @Ssempijjastanle , EFRIS is NOT a tax, and yes, you can issue an e-receipt "without VAT."

This is because VAT is in three categories namely zero rated, exempt and standard rated of 18% which should be remitted to URA once collected.

So its very possible and okay to issue an e-receipt for a VAT zero rated product and no tax is collected or required to be remitted.

Also, please note that for a business to be mandated eligible to use the EFRIS, you must be VAT registered and dealing in Vatable products.

However, a business that is not eligible but keen to benefit from the seamless book keeping and other benefits that EFRIS provides, is free to use the system on their own accord but are not mandated to.

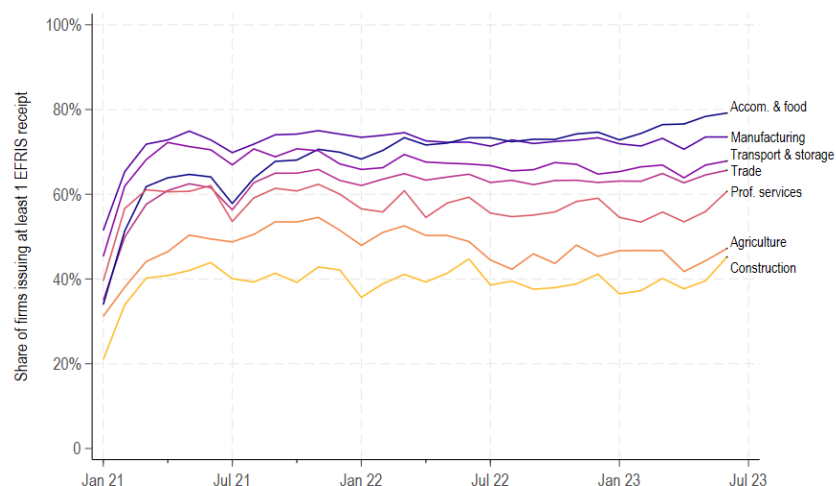
#FfeBanno
#DevelopingUgandaTogether

stan ⚡ @Ssempijjastanle · Apr 8, 2024
The people saying Efris is not a tax,
Can you issue an efris receipt without VAT ?

Last edited 6:55 PM · Apr 8, 2024 · 66.5K Views

Source: X: <https://x.com/URAuganda/status/1777394791107428666>.

Figure A6: EFRIS usage by sector

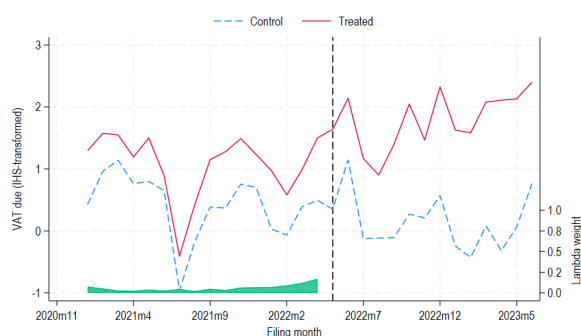


Note: The graph shows usage rates for the largest six sectors by total sales, as well as the accommodation and food service sector, since this sector has the highest use rate by the end of the data period. The figure was constructed using the unbalanced panel of all firms filing VAT declarations.

Data source: Data extracted in May 2025 from the EFRIS records held by the Uganda Revenue Authority.

Figure A7: SDID results: Trends

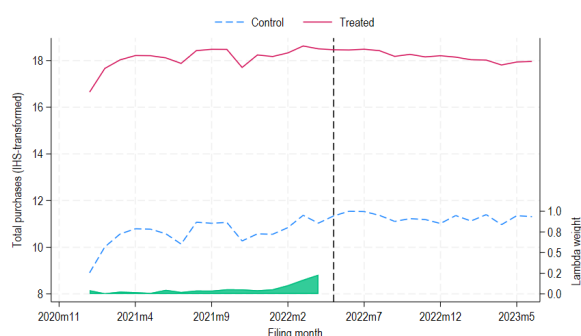
(a) VAT due



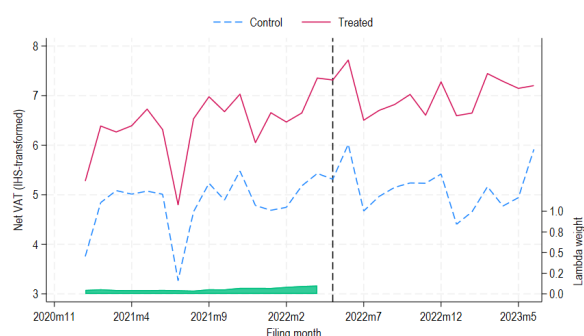
(b) Total sales



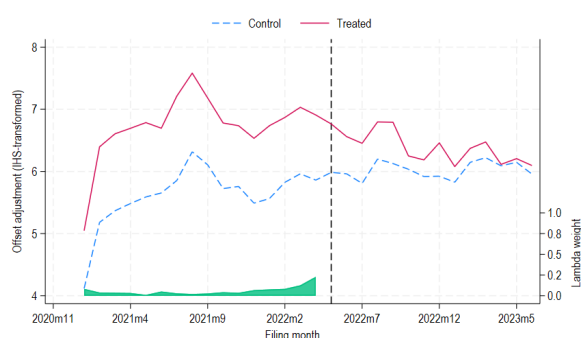
(c) Total purchases



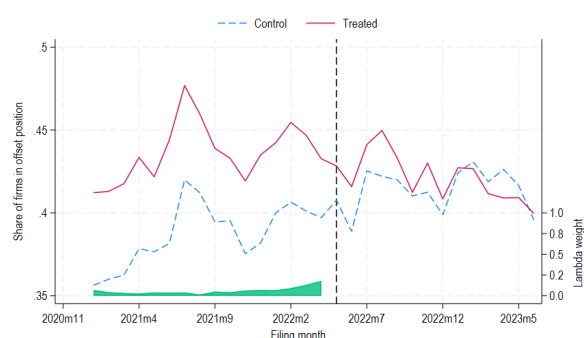
(d) Net VAT



(e) Offset adjustment amount



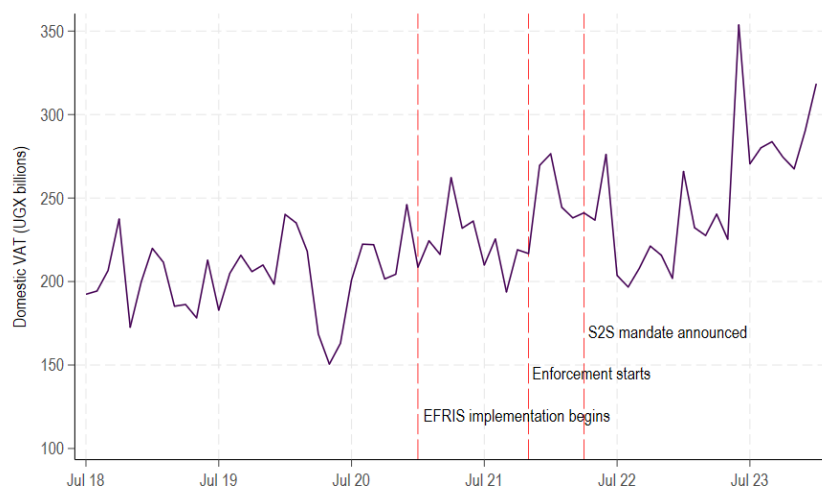
(f) Probability of negative VAT liability



Note: Figures show the trends in outcome variables for the treated and control groups, where the treated group is firms mandated to use system-to-system integration from April 2022 and the control group is a weighted counter-factual of non-mandated firms. The green area, with the right-hand axis, depicts the time-specific weights given to pre-treatment periods.

Data source: Uganda Revenue Authority (2024d).

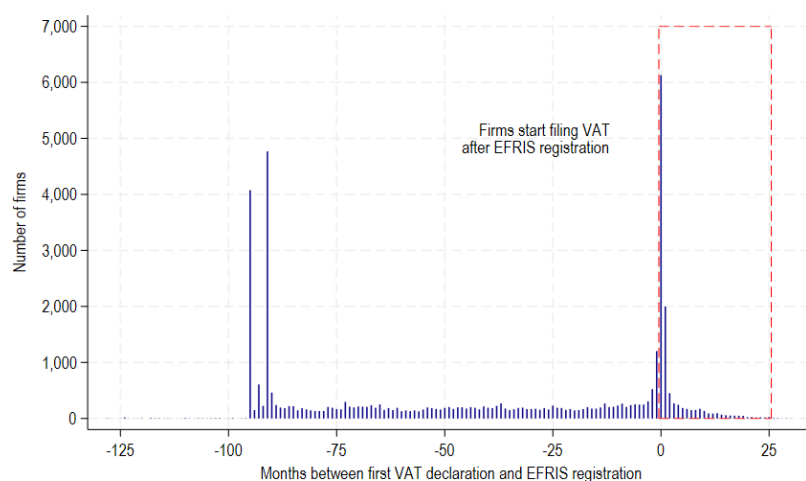
Figure A8: Total domestic VAT collections



Note: Total domestic VAT collections excludes VAT charged on imports. Data have been adjusted for inflation using monthly Consumer Price Index data from the Bank of Uganda (2025) and are reported in billions of Ugandan shillings.

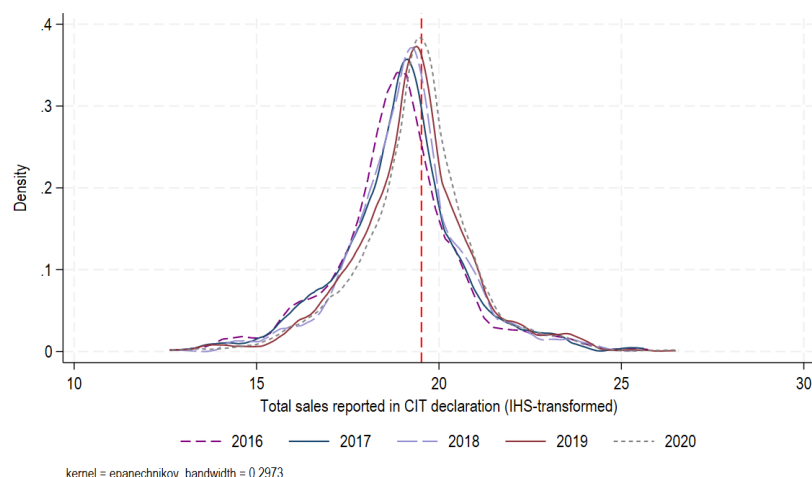
Data source: Monthly collections data shared by the URA.

Figure A9: Months between first VAT declaration and EFRIS registration



Data source: Uganda Revenue Authority (2024d)

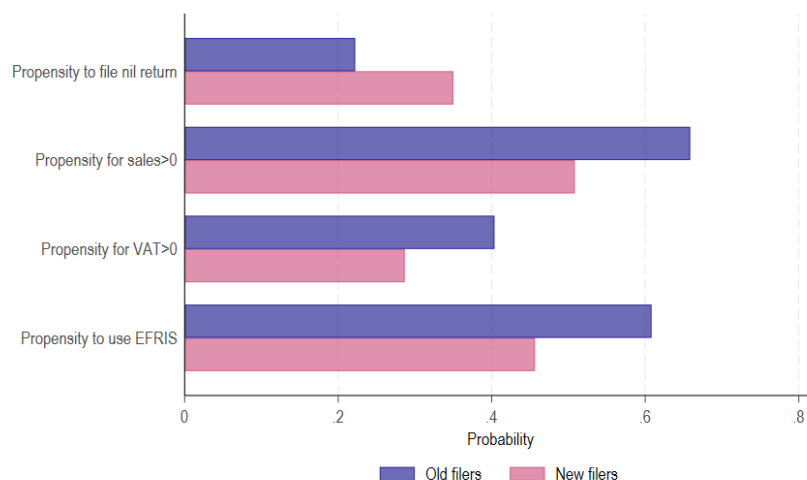
Figure A10: Total sales reported by new VAT-filers in their CIT returns



Note: The figure shows a kernel density plot for total sales reported each year between 2016 and 2020 for the subset of firms that start to file VAT returns after EFRIS was introduced, excluding firms reporting zero total sales. The red dashed line indicates the VAT registration threshold of UGX 150 million. The year reflects the financial year, e.g. 2016 corresponds to the financial year from July 2015 to June 2016. The total number of firms filing non-zero total sales each year grows from 313 in 2016 to 850 in 2020. Total sales have been winsorized at the 1st and 99th percentiles, are transformed using the inverse hyperbolic sine (IHS) function, and are displayed in nominal terms.

Data source: Uganda Revenue Authority (2024c).

Figure A11: Filing behaviour: Old versus new VAT-filers



Data source: Uganda Revenue Authority (2024d).

A2 Data appendix

Data access

The data used for this study were accessed from the Research Lab at the Uganda Revenue Authority headquarters in Kampala. The datasets held in the Research Lab are all anonymized by masking the true Taxpayer Identification Number (TIN) using a secure encryption key. URA staff also supported in running code remotely. Output was checked by URA staff to ensure that the anonymity of firms was preserved.

Software

The analysis was conducted using StataNow/SE 19.5.

Cleaning and sample restrictions

We started with the full sample of all VAT returns filed between January 2013 and June 2023. At the time of analysis, this dataset was named `VAT_panel_v2.dta`. We identified duplicate declarations at the month-TIN level and kept the most recently filed return within each month-TIN pair — this accounts for cases where returns are amended after their original submission. The VAT panel was merged with the tax register (`Register 2024 with MNC.dta`) using the anonymized TINs to link the two datasets. Similarly, we then merged the VAT panel with the EFRIS register to obtain the date of EFRIS registration and with the list of firms mandated to use system-to-system integration (shared as an Excel spreadsheet of anonymized TINs).

The EFRIS invoice data was extracted on 15 May 2025 from eHub, with the transaction-level data aggregated to the seller TIN-month-tax rate-platform level, to match the monthly nature of the VAT panel and to make the data extraction manageable. This is merged with the VAT panel (including the variables from the tax register and the EFRIS register) using the anonymized TINs. At this point, we dropped observations with EFRIS sales data but no VAT declaration filed in the corresponding month. We then added variables from the CIT panel (`CIT PANEL 2014–2023.dta`), for those firms filing a CIT return in the tax year corresponding to the monthly VAT return. Finally, we matched this combined panel with the audit records (using an extraction done specifically for this study) to obtain an indicator for whether a firm had been audited for any tax type, audited for VAT, and the type of VAT audit. To do this, we collapsed the audit data to the month-TIN level, using the month in which an audit was started or created.

To create the strongly-balanced monthly panel, we used our merged panel and kept only data from January 2021 to June 2023 (inclusive). We dropped observations with missing values

for total input VAT, total output VAT, and total VAT due. We also dropped firms which did not appear in the EFRIS invoice data (and therefore do not use EFRIS) by the end of June 2023. We then kept only those firms which file a return every month between January 2021 and June 2023. This generated a panel of 9,442 firms.

Further details on variables created for the analysis are available in the Stata do-files.

Variables

- We used the following variables from the **VAT panel**: amount_s_ZRSEXP_0, amount_s_STDRS_18, amount_s_CAPGDS_18, amount_s_ZRSLOC_0, amount_p_STDRPLOC_18, amount_p_ZRSLOC_0, amount_p_STDRPIMP_18, amount_p_ZRSIMP_0, amount_p_EXMPTPUR_0, amount_p_ADMEXP_18, amount_p_CAPGDS_18, sech_tot_input, sech_tot_output, sech_vat_payable, sech_vat_due, sech_is_amt_claim_offset, sech_is_amt_claim_refund, sech_less_offset
- We used the following variables from the **tax register data**: c_currentstationname, c_current_sector_main_activity, c_activity_division
- We used the following variables from the **CIT panel**: sch1_incm_bsns_actvty, sch1_loss_prvs_year, sch1_loss_crdt_frwd, sch1_profit_loss_before_tax, pl_y_totalsales, pl_x_totempcompensation
- We used the following variables from the **PAYE panel**: sch1_gross_income, sch1_tax_on_total_income
- For descriptive statistics, we also used the following variables from the **audit records**: taxtypename, audittypename, auditstartdate, auditcreationdate, statusname, auditeffort