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Excise taxes and digital tax stamps

Do digital tax stamps work?

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Excise Taxes and Digital Tax Stamps: Do Digital Tax Stamps Work?

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Abstract

To effectively administer tax policy, tax administration must adjust to manage behavioral responses by firms. Firms might respond to changes in tax policy by underreporting their taxable sales revenues– to minimize their tax liability. A policy response from the tax administration side would be to implement a track and trace mechanism to minimize leakages in Government tax revenues. In financial year 2019/20, the Government of Uganda implemented a policy that required manufactures of some excisable goods to affix Digital Tax Stamps (DTS) on their goods. In this paper, monthly excise tax returns data for four financial years are used to estimate the effect of introducing DTS on firms' ex-factory prices, sales revenues and Government excise tax revenues. While allowing for non-parallel linear time trends, treated firms respond to the introduction of DTS by decreasing their ex-factory prices relative to the comparison group firms, more so when they incur the cost for the stamps. In addition, treated firms experience a decrease in sales revenues in the first year post-DTS, however, the effects become positive in the second year post-policy intervention. With negative effects of DTS on both ex-factory prices and sales revenues in the first year post-DTS, Government excise tax revenues from treated firms decreased by 24.8 percent relative to the comparison group in that time. However, the gains in firms' sales revenues in the second year post-DTS offset the negative effects decreases in ex-factory prices. This resulted in a 29.3 percent increase in Government excise tax revenues from treated firms relative to the comparison group. These results provide suggestive evidence that firms and tax administration may take time to embrace and adopt new technologies, but eventually such policy interventions tend to improve tax revenue mobilization efforts.

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1 Introduction

Universally, excise taxes are designed to correct for negative externalities associated with the production or consumption of goods that are socially costly – sin goods and pollutants with high carbon emissions (Gruber, 2005; Junquera-Varela et al 2017). However, the Government of Uganda has shifted the policy approach to broaden the range of excisable goods to widen the tax base and generating more tax revenues (Namunane, 2021).

Over emphasis on revenue yield from excisable goods might have distortionary effects, since the scope of these goods includes non-traditional excisable goods. These goods are likely to be elastic in demand. Notably, the excise tax rates are adjusted frequently, which may not optimally balance the need to raise more tax revenue and minimize consumption. Given the scope of excisables in Uganda, frequent adjustment of tax rates may result in acts such as; smuggling of such goods, tax evasion, counterfeiting and illicit goods. To mitigate such behavior, the Government of Uganda introduced Digital Tax Stamps (DTS) as a mechanism of tracking and tracing of both locally manufactured and imported excisable goods. The objective in this paper, therefore, is to estimate the effects of introducing DTS on firms' Ex-factory prices, Sales revenues and Government excise tax revenues.

The objectives of introducing DTS were to; protect government revenues, combat trade in counterfeit goods, enhance fair competition in the market, and provide real time statistical data for both tax policy and administration. However, digital tax stamps can only be effective as a means of protecting tax revenues and curbing illegal trade if the technology can be embraced and adopted by firms in a timely manner.

In addition, the technology has to be fairly priced to encourage compliance, and minimize illicit consumption of the targeted goods. Resistance from the manufacturers can arise if firms are required to incur a significant capital expenditure to install stamping machines, which can lead to significant losses to both Government – in terms of lower tax revenues, and firms – lower sales revenues.

Introducing tax stamps with the cost being met directly by the taxpayer may be equivalent to an increase in excise tax rates, and could potentially, in the short term, increase the cost of compliance on the compliant tax payers. The extra cost imposed on firms by the policy may force them to alter their behavior by declaring relatively lower ex-factory prices. This partly passes the cost to the Government in form of lower Government tax revenues, since the ex-factory price is the taxing point for most excisable goods. In addition, firms might respond to DTS by increasing the price of the final products, which may force consumers to substitute to relatively cheaper options – substitution effect of a price change, or stop consuming the goods, because they are relatively poorer – the income effect of a price change. Any of these behavioral responses will result in relatively lower sales revenue, in response to price increases to accommodate the cost of DTS. Notably, a track and trace system must be balanced to minimize unnecessary costs to legitimate industry players. It is, therefore, important that the stamped goods remain affordable so as to minimize the consumption of illicit goods.

Empirical taxation literature from developing countries is limited because of restrictions around accessing tax returns data from most of these countries. However, the availability of these data for Uganda allows for impact assessments of policy interventions such as, the introduction of

DTS on both firms' sales revenues and Government tax revenues. The findings in this paper provide evidence that contributes to policy discussions on whether digital tax stamps have so far yielded any gains for Uganda. The lessons from Uganda's experience can further be extended to other developing countries that intend to introduce digital tax stamps as a mechanism of boosting domestic revenue mobilization efforts. The remaining sections of this paper are organized as follows; Section 2 provides a background; Section 3 describes the data; Section 4 discusses the empirical strategy; Section 5 reports the results, and conclusions are summarized in Section 6.

2 Background

In an effort to improve domestic revenue mobilization, the Government of Uganda like many developing economies has looked to excise taxes to raise more tax revenues. This shift is in line with the recommendation of the International Monetary Fund (IMF), which highlighted the potential of using the excise tax to raise additional revenue in Sub-Saharan Africa (IMF 2011). The excise tax is recommended because it is relatively easy to administer. However, compliance remains a challenge because many firms in developing economies have the flexibility to trade informally. Track and trace policy interventions are only starting to take shape in most developing countries.

In line with Section 19A of the Ugandan Tax Procedures Code Act (2014), which provides for affixation of tax stamps on excisable goods produced by local manufacturers or importers. The Government of Uganda introduced digital tax stamps on some goods that attract excise tax in Financial Year 2019/20. This implied that all manufacturers and importers of the gazetted goods were required to affix digitally traceable tax stamps on their goods. This was one of the

recommendations of the Domestic Revenue Mobilization Strategy as a mechanism to improve tax compliance and revenue collections.

Digital Tax Stamps are physical paper stamps or direct markings which are fixed on excisable goods or their packaging. The DTS contain; security features and codes to prevent counterfeiting, tamperproof features, and have track and trace capabilities. Using these features, the traders and manufacturers can track the product movement and the Government can monitor compliance by firms. The quick response code (QR code) allows, the Government, distributors, retailers and consumers to use an App on a smart phone to verify the authenticity of excisable goods on DTS. These Apps include: KAKASA Inspector, used by the tax authority officials to verify that excisable goods required to affix DTS have authentic tax stamps; KAKASA App and KAKASA Validator, used by Consumers and firms, respectively, to verify the authenticity and legitimacy of excisable goods and avoid trading or consuming counterfeits. Notably, these Apps cannot do mass-validation; their capabilities are so far limited to validating one good at a time, which may increase delivery time for businesses.

In addition, the physical paper stamps have to be manually activated for the track and trace function to work. It is, therefore, possible that there will be excisable goods on the market that have the appropriate stamps, but the tax authority officials may not be able to track and trace the goods, because an employee did not active the stamps. According to the officials at Uganda Revenue Authority, this challenge makes the process of tracing goods difficult and fails the track and trace mechanism that the DTS initiative is premised. Nonetheless, efforts are being made automate the process of activating the tracking features of the physical paper stamps.

The list of excisable goods that are required to affix digital tax stamps and the respective unit cost of the stamp are shown in Table 1.

Table 1: Unit Cost per Tax Stamp for Goods required to affix Digital Tax Stamps in FY2019/20

Excisable Good	Unit Cost of Tax Stamp in FY 2019/20 (Uganda Shillings)	Excise Tax rate changed in FY 2019/20	Excise Tax rate change in FY 2020/21
Cigarettes	110	No	No
Beer	55	No	Yes
Spirits	240	No	Yes
Wines	200	No	No
Soft drinks	20	No	Yes
Other Alcoholic beverages	55	No	No
Bottled water	15	No	No
Sugar	0	No	No
Cement	0	No	No
Cooking oil	0	No	No

Table 1 shows the unit cost per tax stamp, some excisable goods such as sugar, cement and cooking oil were not required to affix stamps until February 2022, and the unit costs for the stamps was reduced at the same time for all the other goods. The analysis in the paper, however, focuses on FY 2019/20 and FY2020/21. The FY 2021/22 is not included because the tax returns were not complete when this study was undertaken.

The government of Uganda, through Uganda Revenue Authority (URA) contracted a private firm SICPA SA to provide the DTS solution. The pricing structure agreed on by URA and SICPA SA raised concerns from tax payers because the unit cost was relatively higher, compared to Kenya, Rwanda and Tanzania. Firms raised concerns that, overly priced stamps may lead to

distortions in the market, hence negatively impacting production and excise revenues. The pricing structure in Table 1 shows different prices for the stamps, according to the responsible officers at the URA, the justifications for the differentiated unit costs included: Different products react differently to increase in prices – price elasticity; Different products attract different excise tax rates, a flat unit cost could have been higher than some tax rates; and The unit cost of stamps follows the excise tax principle of correcting for negative externalities. The higher the assumed externality, the higher the cost of the stamp. Differentiated unit rates may not be justified, but the authorities believe that the pricing structure will enable the contracted firm to recover its initial investment faster.

Even though the digital tax stamps were introduced in FY 2019/20, firms did not cover the cost of these stamps during that financial year. The Government of Uganda made a one-off payment of Uganda Shs. 62 billion for the stamps that were supplied to manufacturers and importers of gazetted products during that year. On the other hand, firms covered the cost of the stamps in FY2020/21.

Table 1 indicates that excise tax rates for Beers, Spirits and Soft drinks, were increased in FY2020/21 and yet these goods were required to affix DTS at that same time. Fortunately, the data allow for the estimation of effective excise tax rates, which allow the tax changes to be taken into account when estimating the effects of introducing DTS.

In this paper, manufacturers of excisable goods whose goods were designated to affix DTS are referred to as the treated firms. The comparison group firms are those manufacturers of excisable

goods whose goods are not required to affix stamps. The outcome variables for treated firms are compared to those of the comparison group firms, while taking into account time-invariant firm specific unobserved characteristics and changes in excise tax rates. The next section describes the data.

3 Data and Summary Statistics

The analysis in this paper uses data from monthly excise tax returns from FY 2017/18 to FY 2020/21. The data are obtained from Uganda Revenue Authority, which is a semi-autonomous Agency responsible for tax administration in Uganda. The monthly returns data include firm unique identifiers, which are critical in the identification of firms over the years. The data are disaggregated to product level such that if a firm produces multiple excisable products, it is possible to identify the excisable sales revenues and the amount of excise tax due by product. This level of detail generates variation within the data, which is critical for estimation. Note that a firm can produce some goods that are required to have DTS and others that are not. The level of detail in the data allows for the treatment of such goods as if they were produced by separate firms, since each excisable good has a record of its own. This ensures that the declared sales revenues, ex-factory prices and Government excise tax revenues are product specific.

The product description is important as it is used to identify excisable goods that are required by the Government of Uganda to have digital tax stamps. A treated firm is a manufacturer or importer of an excisable good that is required to have a tax stamp before accessing the market. On the other hand, a comparison group firm is a manufacturer or importer of an excisable good that is not required to have a tax stamp before accessing the Ugandan market.

Table 2 shows the number of tax returns for treated and comparison group firms that are used for analysis in this paper.

Table 2: Number of Excise Tax Returns and the Percent of Treated

Financial Year	Treated tax returns	Comparison group tax returns	All returns	Percent of treated
2017/18	4,258	7,895	12,153	35.0%
2018/19	4,363	8,777	13,140	33.2%
2019/20	4,539	8,340	12,879	35.2%
2020/21	5,846	8,812	14,658	39.9%
Total	**19,006**	**33,824**	**52,830**	**35.8%**

Table 2 shows that the total tax returns are 52,830, of which 19,006 (36%) belong to treated firms and 33,824 (64%) returns belong to the comparison group firms. Recall that firms were required to affix tax stamps in FY 2019/20, however, the Government of Uganda paid for the stamps in that financial year. Treated firms then had to meet the cost in the subsequent financial year. In the first year post-policy intervention, returns from treated firms increased from 4,363 at baseline (FY 2018/19) to 4,539 returns, which is a growth of 4 percent, on the other hand, returns from comparison group firms decreased by 5 percent in the same time. In the second year post-policy intervention, when the treated firms paid for the stamps, tax returns from treated firms increased by 34 percent, relative to the baseline. Comparison group returns increased only by 0.4 percent during the same time. These numbers suggest that the filing rates increase more among treated firms post-policy intervention, relative to the filing rates observed in the comparison group firms. The numbers are indicative of increased compliance rates among treated firms post-policy intervention, since there is no attrition instead more tax returns are observed.

At baseline, it is desirable that the comparison group firms do not significantly differ in their baseline characteristics from the treated firms. A sample t-test is used to check for the differences in the observable characteristics, and the results are shown in Table 3.

Table 3: Difference between Treated and Comparison Group Means at Baseline

	Treated returns mean	Comparison group mean	Difference	t	Pr(T>t)
Log Ex-factory Prices	7.48	7.44	0.043	1.05	0.294
Log Excisable Sales Revenues	17.02	15.64	1.376	36.76	0.000***
Log Excise tax revenues	15.64	13.29	2.352	58.49	0.000***
Log Effective excise tax rates	-1.38	-3.60	0.835	60.79	0.000***

At baseline, Treated returns = 8,621; Comparison group returns = 16,672; All returns (N) = 25,293. Means and t-test are estimated by linear regression. The P-values show the extent to which the differences between the treated and comparison group means are significant at baseline ***, **, and * denote the significance at the 1, 5 and 10 percent levels, respectively. Effective excise tax rates refer to the portion of excisable sales revenues that are spent on the excise tax liability. These rates change as a result of changes in excise tax rates, which can be either specific per unit of output, advorem – expressed as percent of ex-factory prices, or both.

Table 3 shows that there are not significant differences in the ex-factory prices declared by both the treated and comparison group firms. This is because the p-value is greater than 5 percent. The ex-factory prices are critical since they capture the factory gate price of excisable goods, as declared by firms. It is the taxing point for excisable goods that have an advorem excise tax rate. Firms may respond to policy changes that alter their profit margins by adjusting the ex-factory prices down wards such that their excise tax liability is much lower.

Excisable sales revenues are a share of the total sales revenues that are subject to excise tax revenues. Firms that export some of the final excisable products, do not pay excise tax on the exported portion, a refund of excise duty will be provided by tax administration after a desk audit to minimize abuse. Table 3 shows that there are statistically significant differences between the treated and comparison group excisable sales revenues at baseline. With the difference-in-

difference estimation method, differences in levels of outcome variables (ex-factory prices, excisable sales revenues and excise tax revenues) are not problematic for estimation since it is the change in these variables over time that matters. The details of the underlying assumptions are discussed in the empirical strategy section of this paper. The observed differences in Effective excise tax rates result from changes in the excise tax rates of some excisable goods, which consequently affect the outcome variables. These observable differences are considered during estimation. The summary statistics and a description of all variables are provided in Table 8. The next section discusses the empirical strategy.

4 Empirical Strategy

In this paper, the difference-in-difference (DID) is used to estimate the effect of introducing digital tax stamps on firm ex-factory prices, sales revenue and government excise tax revenues in Uganda. The DID estimation equation is:

$$\ln(Y_{it}) = f_i + \tau time + \boldsymbol{X}_{it}\beta + \delta(I_i * After\ November\ 2019) + \varepsilon_{it} \qquad (1)$$

where $\ln(Y_{it})$ is the log of the outcome variables (firm ex-factory prices, sales revenue and government excise tax revenues) for firm i at time t, f_i is a firm-level fixed effect that controls for unobserved time-invariant firm-specific characteristics, $time$ is a time trend that is assumed to be the same for both firms that are required, by law, to affix digital tax stamps on their products (treated firms) and comparison group firms. The common time trend captures the effect of macroeconomic shocks that would affect all firms' ex-factory prices, sales revenue and government excise tax revenues in the same way, $\boldsymbol{X_{it}}$ is included to control for changes in the effective excise tax rates, which result from changes in some excise tax rates for excisable products over the period under study. $\boldsymbol{X_{it}}$ also includes a dummy variable for period $t = 4$ to

control for any time-specific shocks that affect both treated and comparison group firms in the same way at that time, this includes the scaring effects of the prolonged lockdown of Uganda's economy to mitigate the spread of COVID-19 and its subsequent variants.[2] Finally, I_i is a time-invariant dummy variable that equals 0 for comparison group firms, 1 for treated firms for all time periods and "*After November 2019"* is a dummy variable that equals 1 for t = 3 and 4. The interaction term is therefore an indicator for treatment and equals 1 for treated firm i only after the digital tax stamps were implemented in November 2019. The coefficient on this interaction term is the impact of introducing digital tax stamps on the outcome variables. Finally, ε_{it} is a time-varying firm-level error term that captures unobserved time-varying factors that vary over firms and is assumed to be uncorrelated with all observed variables in Equation (1). That is, $E\left(\varepsilon_{it=3,4}\middle| I_i, X_{it=3,4} \text{ for all } i\right) = 0$.

The DID estimator relies on the parallel or common trends assumption. This is because it is not possible to observe how treated firms' ex-factory prices, sales revenues and Government excise tax revenues would have changed without the requirement to affix digital tax stamps. The change in the outcome variables in the absence of the policy intervention is the missing counterfactual trend. The parallel trends assumption implies that the observed trend in the outcome variables for the comparison group will be same as the missing counterfactual trend (Angrist and Pischke, 2008; Namunane, 2021; Glewwe and Todd, 2022). The DID estimator from equation (1) will be biased if the parallel trends assumption does not hold. The assumption is tested later in paper by regressing pretreated outcome variables on the indicator for treatment. The estimates in this paper may also be biased if firms could self-select into treatment (Heckman and Smith, 1999).

[2] Uganda's economy was in lockdown from 2020 to late February 2022, which implies that the economy was in lockdown for the entire financial year 2020/21. The effects of such a shock on the firm ex-factory prices, sales revenue and government excise tax revenues are captured in the dummy variable for period t=4.

However, that the decision to introduce digital tax stamps resulted from an exogenous process, and firms that manufacture designated excisable goods do not have an option to select-self into affixing digital tax stamps. This implies that selection bias may not be a problem for the analysis in this paper.

To address concerns with the possible violation of the parallel trends assumption, Glewwe and Todd (2022) propose that, with multiple periods of data, the treatment effect can be estimated in a more flexible way by allowing for non-parallel linear time trends. In addition, the impact of introducing digital tax stamps is allowed to vary overtime. While considering the modifications suggested by Glewwe and Todd (2022), equation (1) can be rewritten as:

$$\ln(Y_{it}) = f_i + \tau_0 time + \tau_1(time * I_i) + \boldsymbol{X}_{it}\beta + \delta_1(Govment\ pays\ for\ DTS * I_i) + \delta_2(Company\ pays\ for\ DTS * I_i) + v_{it} \quad (2)$$

where $Govment\ pays\ for\ DTS$ is a dummy variable that equals 1 for $t = 3$, a period when the Government of Uganda paid a one-off lump sum fee for the digital tax stamps that treated firms used during that year and $Company\ pays\ for\ DTS$ is a dummy variable that equals 1 for $t = 4$, a period when the cost of digital tax stamps was met by the company. The other variables in equation (2) are the same as those in equation (1). The time-varying firm-level error term $v_{it=3,4}$ is assumed to be uncorrelated with all observed variables in equation (2), which is written more formally as $E(v_{it=3,4}|I_i, X_{it=3,4} \text{ for all } i) = 0$. Note that equation (2) is similar to equation (1), however, in equation (2) the parallel trends assumption is relaxed and the treatment effect is allowed to be different for the time when the Government of Uganda paid for the digital tax stamps and when the treated firms incurred the cost of the stamps.

The decision by the Government of Uganda to pay for digital tax stamps, in the first year of implementation, allows the treatment effect to be estimated when there is a policy in place, but treated firms do not incur any additional cost to implement the policy. However, the treated firms were aware that they would incur an extra cost in the subsequent financial year. This may result in some behavioral responses by firms in anticipation of meeting the cost the stamps. Firms may alter their behavior such that the cost of the stamps is shared among the Government – firms adjust their ex-factory prices down wards, the treated firms, and the final consumer – through higher product prices. Some of these behavioral responses are explored in the next section of this paper. The next section discusses the results.

5 Results and Discussion

As discussed in earlier sections, the main goal in this paper is to estimate the effect of introducing digital tax stamps on firms' ex-factory prices, sales revenues and government excise tax revenues – outcome variables. The results from Equation (1) are shown in Table 4. The results in all three specifications of Table 4 include firm-level fixed effects that controls for unobserved time-invariant firm-specific characteristics, a common time trend for both treated and comparison group firms to capture the effects of any macro-economic shocks, such as the scarring effects of the global pandemic and the prolonged lockdown of Uganda's economy, which affect all outcome variables in the same way. The specifications also include a dummy variable for $t = 4$, which controls for any shocks that affect the outcome variables, for all firms, in the same way at that time.

Specification (1) of Table 4 shows that firms whose products were gazette to affix digital tax stamps – treated firms, reduced their ex-factory prices by about 8.4 percent as compared to the comparison group firms. This result is only statistically significant at the 10 percent level. Treated firms experienced a 13 percent decrease in excisable sales revenues relative to the comparison group firms, as shown Specification (2).

Table 4: The Effect of Digital Tax Stamps on Firms' Ex-Factory Prices, Excisable Sales Revenues and Excise Tax Revenues

	(1) Log Ex-factory Prices	(2) Log Excisable Sales Revenues	(3) Log Excise Tax Revenues
Product has Digital Tax Stamp* After November 2019	-0.084*	-0.131	-0.111
	(0.046)	(0.127)	(0.128)
Time trend	0.004	-0.031	-0.020
	(0.019)	(0.045)	(0.047)
Dummy variable for FY2020/21 (t=4)	Yes	Yes	Yes
Firm-level fixed effects	Yes	Yes	Yes
Log effective excise tax rate	No	No	No
Observations	52,830	52,830	52,830
R-squared	0.001	0.001	0.001
Number of clusters/firms	517	517	517

Robust standard errors in parentheses and are clustered at a firm level. Note that one firm can produce both excisable goods that are required to affix DTS and those that are not, the data are detailed enough and provide a different record for each excisable good; ***, **, and * show the statistical significance at the 1, 5 and 10 percent levels, respectively. Effective excise tax rates refer to the portion of excisable sales revenues that are spent on the excise tax liability.

Specification (3) shows that the excise duty liability for treated firms decreased by 11 percent relative to the comparison group firms. However, the results in both Specifications (2) and (3) are not statistically significant. Table 4 shows that treated firms may have responded to the introduction of digital tax stamps by shifting some of the cost of the stamps to Government. The mechanism through which the cost is shifted is a reduction the ex-factory prices, which is the base or taxing point for excise tax. This consequently means that the tax liability from treated firms will decrease, even if sales revenues do not change much. The effects on Government

excise taxes may be aggravated if treated firms further experience a decrease in sales revenues, relative to the comparison group. Irrespective of the results in Specifications (2) and (3) not being statistically significant, the sign of the effects and the magnitude may not be ignored.

In FY 2020/21, which is the second year post introduction of digital tax stamps, excisable products that are required to affix stamps such as beer, spirits/liquors and soft drinks, experienced an increase in the excise tax rates. The effect of the increase in tax rates on the outcome variables may bias the treatment effect on the treated. To that effect, a control variable that captures the effective excise tax rate is added to all the three specifications in Table 1 and these results are shown in Table 5.

Table 5: The Effect of Digital Tax Stamps on Firms' Ex-Factory Prices, Excisable Sales Revenues and Excise Tax Revenues while Controlling For Changes in Excise Tax Rates

	(1) Log Ex-factory Prices	(2) Log Excisable Sales Revenues	(3) Log Excise Tax Revenues
Product has Digital Tax Stamp* After November 2019	-0.086*	-0.145	-0.107
	(0.044)	(0.121)	(0.129)
Time trend	0.008	-0.003	-0.028
	(0.018)	(0.038)	(0.049)
Dummy variable for FY2020/21 (t=4)	Yes	Yes	Yes
Firm-level fixed effects	Yes	Yes	Yes
Log effective excise tax rates	Yes	Yes	Yes
Observations	52,830	52,830	52,830
R-squared	0.011	0.060	0.004
Number of clusters/firms	517	517	517

Robust standard errors in parentheses and are clustered at a firm level. Note that one firm can produce both excisable goods that are required to affix DTS and those that are not, the data are detailed enough and provide a different record for each excisable good; ***, **, and * show the statistical significance at the 1, 5 and 10 percent levels, respectively. Effective excise tax rates refer to the portion of excisable sales revenues that are spent on the excise tax liability. This variable captures the effects of any changes in excise tax rates.

The layout of results in Table 5 is the same Table 1 with the Log Effective Excise Tax rates included as a control variable. Specification (1) of Table 5 shows that treated firms reduced their ex-factory prices by 8.6 percent relative to the comparison group firms. This result is only

significant at the 10 percent level. Note that relative to the effect shown in Specification (1) of Table 4, this effect is higher by 0.2 percentage points, which suggests that not control for effective excise tax rates may underestimate the effect of digital tax stamps on firm ex-factory prices. The effect on excisable sales revenues is possibly underestimated by 1.4 percentage points. However, the effects on excisable sales revenues and excise tax revenues are not statistically significant, even after controlling for changes in excise tax rates.

One way to test if the parallel trends assumption may have been violated, is to regress the indicator for treatment on pre-treated outcome variables. If indeed the introduction of digital tax stamps causes firms to change their ex-factory prices, declare correct sales revenues, and pay the right amount of excise tax, then the indicator for treatment should not have any significant effect of the outcome variables pre-digital tax stamps. The results from the test are shown in Table 6.

Table 6: A Test for Pre-Trends before the Introduction of Digital Tax Stamps

	(1) Log Ex-factory Prices	(2) Log Excisable Sales Revenues	(3) Log Excise Tax Revenues
Product has Digital Tax Stamp* Fiscal Year 2018/19 (t=2)	-0.031	-0.075	-0.048
	(0.044)	(0.093)	(0.107)
Financial Year = 2018/19 (t=2)	0.016	0.165***	0.139*
	(0.024)	(0.050)	(0.075)
Firm-level fixed effects	Yes	Yes	Yes
Log effective excise tax rates	Yes	Yes	Yes
Observations	25,293	25,293	25,293
R-squared	0.009	0.072	0.002
Number of clusters/firms	307	307	307

Robust standard errors in parentheses and are clustered at a firm level; ***, **, and * show the statistical significance at the 1, 5 and 10 percent levels, respectively. Effective excise tax rates refer to the portion of excisable sales revenues that are spent on the excise tax liability. This variable captures the effects of any changes in excise tax rates.

Table 6 shows that pre-digital tax stamps, the treatment indicator does not have any statistically significant effects on firms' ex-factory prices, excisable sales revenues and excise tax revenues. These results suggest that there are no statistically significant pre-trends, hence the parallel

trends assumption might hold. Notably, the results in Tables (4) and (5) will be biased if the parallel trends assumption is violated. To scrutinize the pre-trends assumption further, graphical evidence is shown in Figure 1. Figure 1 provides some contrary suggestive evidence that the parallel trends assumption might be violated since the trends in outcome variables for treated firms are somewhat different from those for the comparison group firms. The take away from the contrary evidence, is that pre-trends might exist, but they are not statistically significant. Nonetheless, this might bias the results shown in Tables (4) and (5).

Figure 1: Trends in Ex-factory Prices, Excisable Sales Revenues and Excise duty Revenues

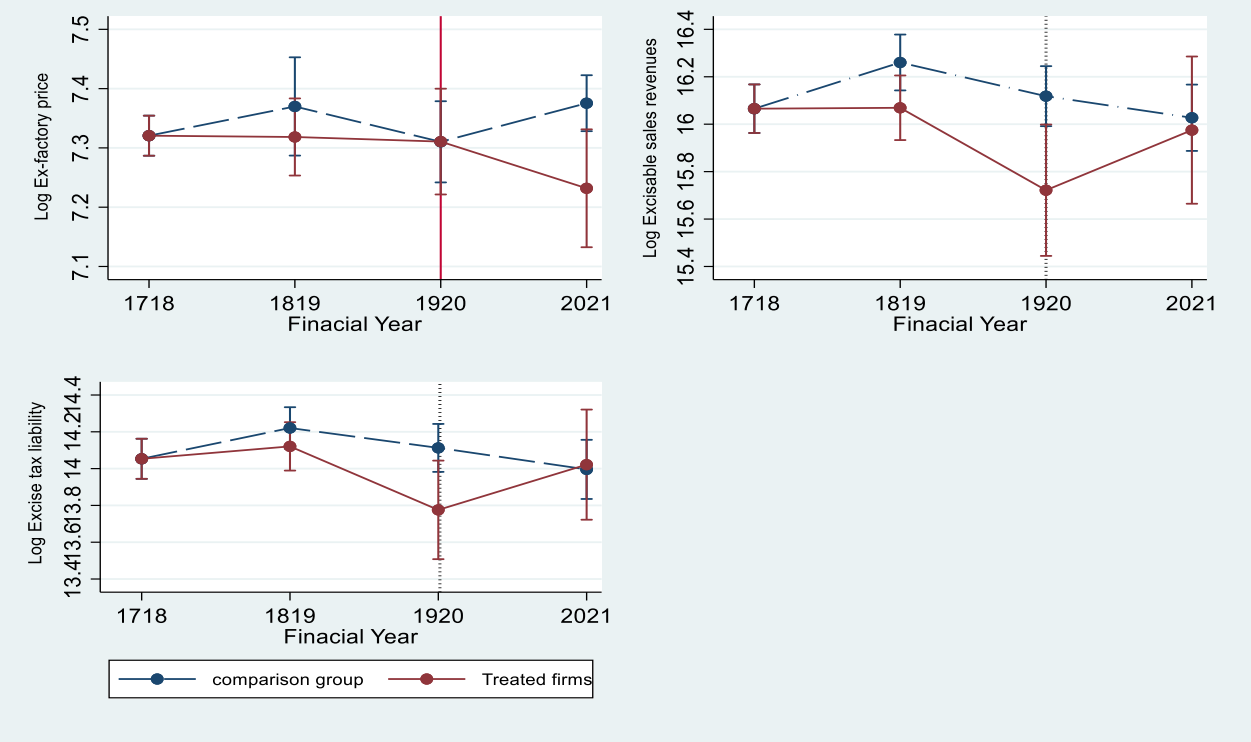

Figure 1 is a graph of the averages of firms' ex-factory prices, excisable sales revenues and excise tax revenues for treated and comparison group firms. The bars around the point estimates are 95 percent confidence intervals, and the reference line corresponds to the financial year when digital tax stamps were introduced.

The graphical evidence in Figure 1 suggests that it is worthwhile allowing for non-parallel linear trends. Consequently, the effect of digital tax stamps on firms' ex-factory prices, sales revenues and government excise tax revenues is estimated using Equation (2). Notably, when the digital

tax stamps were introduced in FY2019/20, the Government of Uganda covered the cost of implementation for the first year of implementation. This implies that the estimates for the first year post-policy introduction capture the effect of introducing digital tax stamps with firms not incurring any direct monetary costs. In the second year post-policy introduction, the firms are then required to meet the direct cost of the stamps. However, there were responses by firms in the first year post policy change. The responses to the policy innervation under the two scenarios, while allowing for non-parallel linear trends as stated in Equation (2), are shown in Table (7).

Table 7: The Effect of Digital Tax Stamps on Outcome Variables for Times Government Pays for the Digital Tax Stamps (t=3) and When Firms Meet the Cost (t=4)

	(1) Log Ex-factory Prices	(2) Log Excisable Sales Revenues	(3) Log Excise Tax Revenues
Product has Digital Tax Stamp * Government pay for DTS (t=3)	-0.049	-0.249***	-0.248***
	(0.037)	(0.069)	(0.069)
Product has Digital Tax Stamp * Companies pay for DTS (t=4)	-0.174*	0.307*	0.293*
	(0.098)	(0.157)	(0.160)
Time trend	-0.003	0.050*	0.019
	(0.021)	(0.030)	(0.047)
Time trend * Product has Digital Tax Stamp	0.017	-0.115	-0.087
	(0.037)	(0.086)	(0.093)
Dummy variable for FY2020/21 (t=4)	Yes	Yes	Yes
Firm-level fixed effects	Yes	Yes	Yes
Log effective excise tax rates	Yes	Yes	Yes
Observations	52,830	52,830	52,830
R-squared	0.012	0.061	0.005
Number of clusters/firms	517	517	517

Robust standard errors in parentheses and are clustered at a firm level. Note that one firm can produce both excisable goods that are required to affix DTS and those that are not, the data are detailed enough and provide a different record for each excisable good; ***, **, and * show the statistical significance at the 1, 5 and 10 percent levels, respectively. Effective excise tax rates refer to the portion of excisable sales revenues that are spent on the excise tax liability. This variable captures the effects of any changes in excise tax rates.

Specification (1) of Table (7) shows that treated firms might have decreased the ex-factory prices of their products by 4.9 percent relative to the comparison group firms. However, this result is not statistically significant. This is not surprising because the Government of Uganda cover the cost of stamps during the first year of implementation, to that effect firms are less likely to make any major adjustments to the ex-factory prices. In the second year post-policy intervention, when firms paid for the stamps, treated firms reduced the ex-factory prices for their products by 17.4 percent relative to comparison group firms. This result is only statistically significant at the 10 percent level. The ex-factory price is the taxing point for most excisable goods in Uganda, a reduction in this price implies the expected amount of excise tax revenues will be relatively lower. This provides some suggestive evidence that in response to the policy intervention, treated firms reduced the ex-factory prices, which partly shifts the cost of the stamps to Government, inform of reduced taxing values, which may result in lower tax revenues.

Specification (2) of Table 7 shows that, when the Government paid for digital tax stamps, treated firms experienced a 24.9 percent decrease in excisable sales revenues relative to comparison group firms. This result is statistically significant at the 1 percent level. Given that the Government of Uganda was adopting a new technology to track and trace production and sales volumes, it is likely that implementation challenges might have contributed to the decrease in the sales revenues for treated firms in that time. In the second year post-policy intervention, when firms paid for he stamps, treated firms experienced an increase in excisable sales revenues by 30.7 percent relative to comparison group firms. This result is only significant at the 10 percent level. Even though treated firms reduced the ex-factory prices of their products relative to the comparison group is this price, there are higher sales revenues from these treated firms. This is

suggestive evidence that digital tax stamps might have actually compelled treated firms to correctly declare their excisable sales revenues. With the decrease in treated firms' ex-factory prices and potential increase in excisable sales revenues, the effect of the policy intervention on excise tax revenues will depend on whether decrease in ex-factory prices outweighs the gains in excisable sales revenues.

The effects of the policy intervention on Government excise tax revenues are shown in Specification (3). The excise duty revenues from treated firms decreased by 24.8 percent relative to the comparison group firms when Government paid for tax stamps. This result is statistically significant at the 1 percent level. The result is consistent with expectations for that time given that, treated firms might have reduced ex-factory prices and also experienced a decrease in excisable sales revenues relative to comparison group firms. It therefore follows naturally that excise tax revenues will decrease. The evidence generated in this paper suggests that, if there are costs to adopting new technologies, the adopting party may expect some short-term losses, in this case, less excise tax revenues. In the second year post-policy intervention, when firms paid for the stamps, excise tax revenues from treated firms increased by 29.3 percent relative to the comparison group firms. This result is only statistically significant at the 10 percent level. As discussed in the previous paragraph, the effect of the policy intervention on excise tax revenues in this period would depend on whether decreases in ex-factory prices outweighed the gains in excisable sales revenues. With the positive effects on excise tax revenues, the results provide suggestive evidence that gains in excisable sales revenues, as a result of the policy intervention, outweighed the treated firms' response to the policy intervention by reducing ex-factory prices.

The results in Table 7 are the main results in this paper, and they provide suggestive evidence that digital tax stamps might have had negative effects in the first year of implementation, due to adaptive challenges, as is the case with new technologies. The Officials from Uganda Revenue Authority indicated that, goods are produced, stamped and sent to the market without activation of stamps, thus the agency cannot get data on the actual production volumes. This implementation challenge may partly explain the negative effects in the first year post-DTS.

However, the Uganda Revenue Authority partly started some tax administration initiatives such as: increased reconciliations to ensure that produced volumes match what is declared as sales; increased enforcement to mitigate circumventing behavior by firms; launch and market the KAKASA App to discourage the consumption of counterfeit goods and goods without DTS. These initiatives partly explain the gains realized in the second year post-DTS. The evidence discussed so far suggests that, irrespective of some implementation challenges and delays in adopting the technology, digital tax stamps might actually work. The initiative might help Governments improve their domestic revenue mobilization efforts. The next section discusses conclusive remarks.

6 Conclusion

In an effort to minimize underreporting and misclassification by firms that manufacture excisable goods, the Government of Uganda introduced Digital Tax Stamps. These tax stamps were intended to guard against revenue leakage and improve tax compliance by firms. The main goal in this paper was to estimate the effect of the DTS on firms' ex-factory prices, sales revenues and

Government excise tax revenues. The findings in this paper suggest that DTS had negative effects on firm sales revenues and Government excise tax revenues in the first year post-DTS. This was due to implementation challenges and delays in embracing the new technology. However, in the second year post-implementation, the gains in terms of increased firms' sales revenues exceeded the firms' behavioral response of decreasing ex-factory prices, hence an increase in Government excise tax revenues by 29.3 percent. Note that the confidence intervals around these estimates are relatively wide due to low statistical power, and caution should be exercised when applying these results.

The continued use and success of DTS will depend on good licensing practices, high quality and timely information capture, robust supply chain controls and a well-resourced Revenue Authority. In addition, there is need to launch and market the KAKASA App and modify the KAKASA Validator to carryout mass-validations of tax stamps, these actions will improve the effectiveness of DTS, hence improved compliance. A relatively lower and uniform price for DTS will make it easier for firms to adopt the new technology and minimize tax avoidance responses by firms. Issues of influencing consumption and minimizing externalities should be taken care of in the Excise Duty Act. Notably, the prices for the DTS were reduced in February 2022, and more excisable goods were required to fix these DTS. The changes might have generated behavioral responses from firms, and their effects are being considered for future research.

Table 8: Summary Statistics and Description of Variables

Variables	Description		Mean	Std. Dev.	Min	Max	Observations
Log Ex-factory Prices	This variable captures the factory gate price of excisable goods. It is the taxing point for excisable goods that have an advorem tax rate.	overall	7.325	3.115	0	17.100	N = 52830
		between		3.936	0	15.829	n = 517
		within		0.615	0.932	12.618	
Log Excisable Sales Revenues	Captures the sales revenues that are liable to excise tax. This variable does not include revenues that are earned from exports, since excise duty is not applicable to exports.	overall	16.061	2.969	0	28.067	N = 52830
		between		3.105	1.609	26.125	n = 517
		within		1.926	1.996	25.064	
Log Excise tax revenues	The variable captures the excise tax liability that firms face at any given time period. Tax liability data are used because the actual payments data are not well aligned to the months when the tax liability is due.	overall	14.059	3.289	-0.580	23.425	N = 52830
		between		2.790	-0.511	22.528	n = 517
		within		2.279	-1.335	25.304	
Log Effective excise tax rates	This variable captures changes in excise tax rates. It is portion of excisable sales revenues that are spent on the excise tax liability.	overall	-1.883	1.174	-6.569	5.845	N = 52830
		between		1.450	-4.381	5.298	n = 517
		within		0.580	-7.559	4.511	
Digital Tax Stamps	This is a dummy variable that equals to 1 for excisable products that are required to affix digital tax stamps and zero for those excisable products that are not required to affix these stamps	overall	0.360	0.480	0	1	N = 52830
		between		0.494	0	1	n = 517
		within		0	0.360	0.360	
After November 2019	This is a dummy variable that equals to 1 for periods after November 2019, which includes most of FY2019/20 and FY 2020/21	overall	0.521	0.500	0	1	N = 52830
		between		0.338	0	1	n = 517
		within		0.473	-0.448	1.480	
Government pay for Digital Tax Stamps	This is a dummy variable that equals to 1 for the time when the Government of Uganda paid for digital tax stamps, which FY2019/20.	overall	0.160	0.367	0	1	N = 52830
		between		0.153	0	1	n = 517
		within		0.362	-0.540	1.131	
Firms pay for Digital Tax Stamps	This is a dummy variable that equals to 1 for the time when the Firms paid for digital tax stamps, which FY2020/21	overall	0.277	0.448	0	1	N = 52830
		between		0.381	0	1	n = 517
		within		0.419	-0.694	1.257	

The summary statistics include both the treated and comparison group firms. The firm-level returns data are from the electronic returns filed with Uganda Revenue Authority. Restrictions apply to these data's availability and are not publicly available. However, data can be accessed with permission from the Uganda Revenue Authority or the Ministry of Finance.

Tax Stamps and their specific features

KAKASA

PAPER TAX STAMP

This is a mark / label applied to goods and their packaging and contains security features and codes to prevent counterfeiting of goods and enable track and trace capabilities.

- Colour shift
- Invisible Data Matrix
- Visible Data Matrix
- Human readable code

KAKASA

DIRECT MARK

This is a mark / code applied to goods and their packaging and contains QR code and human readable code to enable track and trace capabilities.

- Colour shift
- Invisible Data Matrix
- Visible Data Matrix
- Human readable code

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