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

**Silver Namunane**

**Tax Policy Economist, World Bank**

# Background

- In FY2019/20 the Government of Uganda Introduced Digital Tax Stamps on some excisable goods
  - manufacturers or importers of the gazetted products to affix digitally traceable tax stamps
  - Part of the implementation of DRMS

- DTS can be physical paper stamps or markings:
  - Are fixed on excisable goods or their packaging.
  - Contain security features and codes
  - Prevent counterfeiting, tamperproof features,
  - Have track and trace capabilities

- Estimate the effect of introducing DTS on firm ex-factory prices, excisable sales revenue, and government excise tax revenues (outcome variables)
  - "Treated" firms: Manufacturers of excisable goods whose goods are designated to affix DTS
  - Comparison group firms: Manufacturers of excisable goods whose goods are not required to affix tax stamps.

- With four year of data: Allows for non-parallel linear trends to estimate the effect of introducing DTS
  - compare outcome variables of treated firms to those of the comparison group

# Goods required to affix DTS and the respective Unit Cost

| 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 |

- DTS introduced in FY2019/20, Government paid for stamps that year
  - A one-off payment of Shs. 62 billion
  - Cost of DTS implemented in the second-year post policy intervention
- Cost revised in Feb 2022
- Tax rates for some products on DTS changed – effective excise tax rate imputed and used as a control variable
- A dummy variable equals 1 for firms whose products are required to affix DTS and 0 for firms whose products are not required to affix DTS
  - Continuous treatment variable that captures the cost of DTS?
    - Was not possible : Throwing away the first year since the monetary cost to firms was zero

# Data

**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%** |

- An increase in treated returns by 4% and 34% in the first and second year post-DTS, respectively – relative to the baseline period.
  - Improved compliance, more firms filing returns.
- A decrease of 5% and an increase of 0.4% in comparison group returns in the first and second year post-DTS, respectively – relative to the baseline.
  - Attrition not a problem
  - Treated firms are actually filing more, increased compliance?

## Estimation

- The Difference –in – difference (DID) estimation method is used. The estimation equation is;

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

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,

- $time$ is a time trend that is assumed to be the same for both treated and comparison group firms;

- $\boldsymbol{X}_{it}$ is included to control for time-varying observable firm-specific characteristics, such as changes in effective excise tax rates. .
  - 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. Effects of the prolonged lockdown are captured in this variable.

- $I_i$ is a time-invariant dummy variable that equals 0 for comparison group firms, 1 for treated firms
- "*After November 2019*" is a dummy variable that equals 1 for $t = 3\ and\ 4$.
  - The coefficient on the interaction term is the impact of introducing DTS.

- $\varepsilon_{it}$ is a time-varying firm-level error term
  - assumed to be uncorrelated with all observed variables in regression. That is, $E(\varepsilon_{it=3,4}|I_i, X_{it=3,4}) = 0$.

# Estimation cont'd

- With data for four time periods, two periods before and two periods after the introduction of DTS, Glewwe and Todd (2022) suggest that,

  - the treatment effect can be estimated in the presence of non-parallel linear time trends.

  - The impact of the tax change is then estimated for each period after the tax changes were implemented – this allows the treatment effect to vary over time.

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

- The variables are the same as those in Equation (1), except that:
  - Different time trends for treated and comparison group firms

  - Treatment effect allowed to vary for periods when Government pays for DTS and when firms pay .

**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**
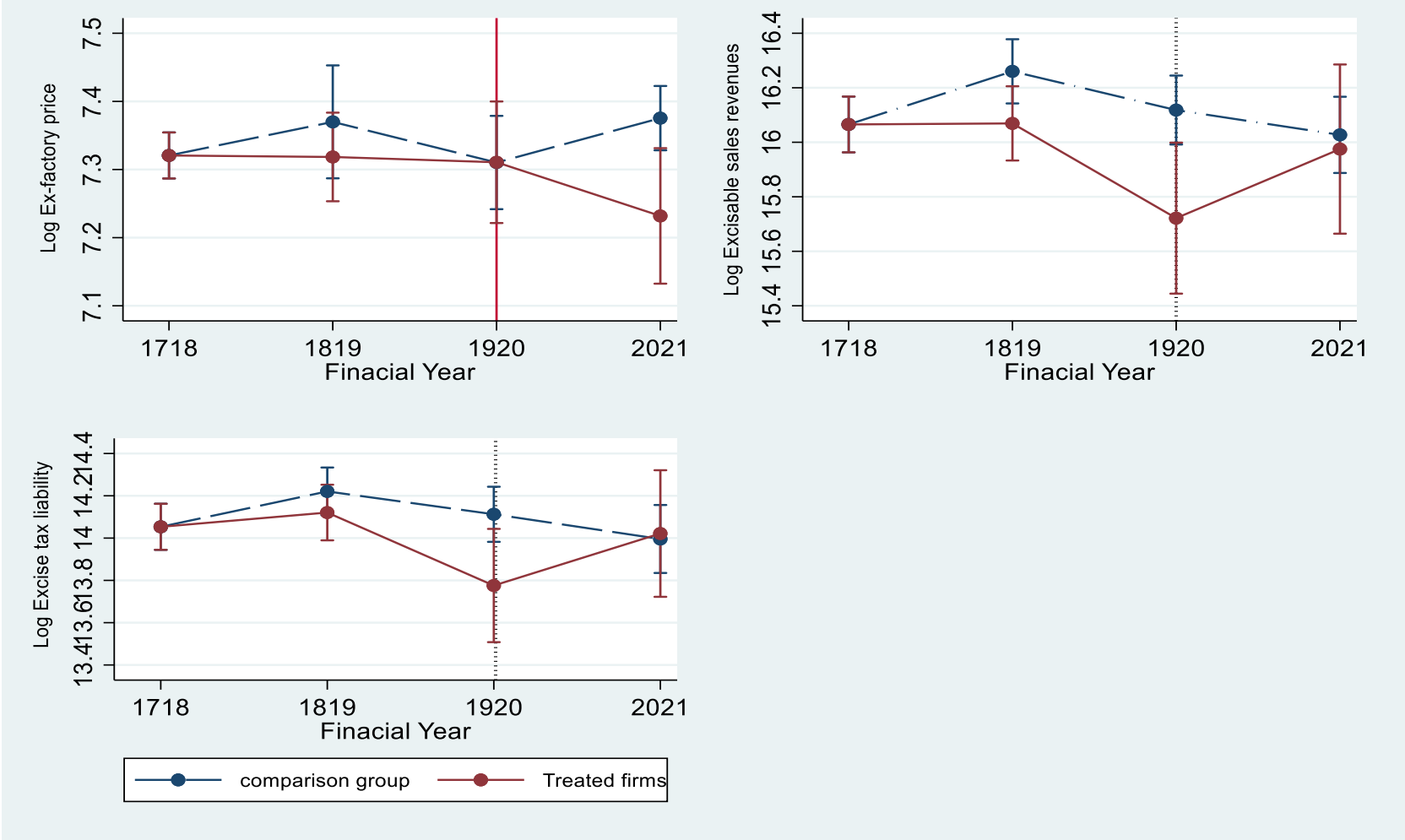
| | (1) Log Ex-factory Prices | (2) Log Excisable Sales Revenues | (3) Log Excise Tax Revenues |
|---|---|---|---|
| Product has Digital Tax Stamp* After November 2019 | -0.086* (0.044) | -0.145 (0.121) | -0.107 (0.129) |
| Time trend | 0.008 (0.018) | -0.003 (0.038) | -0.028 (0.049) |
| Dummy variable 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; ***, **, 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.

- Results differ in magnitude, but no differences in the level of statistical significance

# What is observed graphically?

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



- May be the parallel trends assumption not reasonable?

- Can one allow for non-parallel linear trends?
  - Can test if there are non-parallel trends?

- Can one allow for the treatment effect to be different over time?

# Allowing for non-parallel trends and varying treatment effect

**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 (0.037) | -0.249*** (0.069) | -0.248*** (0.069) |
| Product has Digital Tax Stamp * Companies pay for DTS (t=4) | -0.174* (0.098) | 0.307* (0.157) | 0.293* (0.160) |
| Time trend | -0.003 (0.021) | 0.050* (0.030) | 0.019 (0.047) |
| Time trend * Product has Digital Tax Stamp | 0.017 (0.037) | -0.115 (0.086) | -0.087 (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 |
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- Main results of this study:
  - Firms responded to DTS by decreasing ex-factory prices, partly shifts the cost to government
  - More sales revenues declared in the second-year post tax change, firms gradually embracing the technology
  - Gains in declared sales offset the negative effects of decreased ex-factory prices, hence positive effects on excise tax revenues

# Conclusion

- Estimate the effect of introducing DTS on firms' ex-factory prices, sales revenue, and government tax revenues;

  - Treated firms' ex-factory prices decreased by 5% and 17.4% percent in the first and second years post-DTS, respectively.

  - Firms' excisable sales revenues decreased by 24.9 percent for the time that government paid for DTS relative to the comparison group firms
  - Increased by 30.7 percent when firms paid for DTS, relative to comparison group firms-second year post policy-intervention

  - Government Excise tax revenues decreased by 24.8 percent for the time that government paid for DTS, relative to comparison group firms
  - Increased by 29.3 percent when firms paid for DTS-second year post policy-intervention

- DTS might have posted negative effects in the first year of implementation
  - adapting new technologies takes time
  - Implementation challenges
  - Issues around pricing
- Maybe a uniform and relatively lower price for the stamps,
  - minimizes tax avoidance responses by firms
  - leave issues of influencing consumption, minimizing externalities to the main excise law
- Improve implementation to minimize the downtime by firms, mitigates the negative effects of the track and trace mechanism

# Thank you!