Information, Fiscal Capacity and Tax Compliance: An Experimental Evaluation

Miguel Almunia (Warwick)    François Gerard (Columbia)
Jonas Hjort (Columbia)        Justine Knebelmann (PSE)
Dorothy Nakyambadde (URA)    Lin Tian (Columbia)

May 2017
Motivation

- **Third-party information** reporting is key for tax enforcement
  - Theory: Kopczuk, Slemrod (2006), Kleven, Kreiner, Saez (2016)

- But effectiveness of third-party information has limitations
  - Misreporting can be shifted to less verifiable margins
    - Carrillo, Pomeranz, Singhal (2017), Slemrod et al. (2017)

- Information reporting creates compliance costs for taxpayers and administrative costs for tax authorities
- Enforcement power of information trails relies on:
  - The tax authority's capacity to make use of this information
  - Taxpayers' expectations about that capacity
Motivation

- **Third-party information** reporting is key for tax enforcement
  - Theory: Kopczuk, Slemrod (2006), Kleven, Kreiner, Saez (2016)

- But effectiveness of third-party information has **limitations**
  - Misreporting can be shifted to less verifiable margins
    - Carrillo, Pomeranz, Singhal (2017), Slemrod et al. (2017)
Motivation

- **Third-party information** reporting is key for tax enforcement
  - Theory: Kopczuk, Slemrod (2006), Kleven, Kreiner, Saez (2016)
- But effectiveness of third-party information has **limitations**
  - Misreporting can be shifted to less verifiable margins
    - Carrillo, Pomeranz, Singhal (2017), Slemrod et al. (2017)
  - Information reporting creates compliance costs for taxpayers and administrative costs for tax authorities

Enforcement power of information trails relies on:
- The tax authority's capacity to make use of this information
- Taxpayers' expectations about that capacity
Motivation

- **Third-party information** reporting is key for tax enforcement
  - Theory: Kopczuk, Slemrod (2006), Kleven, Kreiner, Saez (2016)

- But effectiveness of third-party information has **limitations**
  - Misreporting can be shifted to less verifiable margins
    - Carrillo, Pomeranz, Singhal (2017), Slemrod et al. (2017)
  - Information reporting creates compliance costs for taxpayers and administrative costs for tax authorities

- Enforcement power of information trails relies on:
  - The tax authority’s **capacity** to make use of this information
Motivation

- **Third-party information** reporting is key for tax enforcement
  - Theory: Kopczuk, Slemrod (2006), Kleven, Kreiner, Saez (2016)

- But effectiveness of third-party information has **limitations**
  - Misreporting can be shifted to less verifiable margins
    - Carrillo, Pomeranz, Singhal (2017), Slemrod et al. (2017)
  - Information reporting creates compliance costs for taxpayers and administrative costs for tax authorities

- Enforcement power of information trails relies on:
  - The tax authority’s **capacity** to make use of this information
  - Taxpayers’ **expectations** about that capacity
This Project

Main goal: study the interaction between fiscal capacity and information in a developing-country context

- Long-term research collaboration with Uganda Revenue Authority (URA)

1. Use tax-return data at the transaction level to estimate VAT misreporting → cross-check reports by sellers and buyers [done]
Main goal: study the interaction between fiscal capacity and information in a developing-country context

- Long-term research collaboration with Uganda Revenue Authority (URA)

1. Use tax-return data at the transaction level to estimate VAT misreporting → cross-check reports by sellers and buyers [done]

2. Design and evaluate randomized intervention to increase effective use of information [in progress]
Main goal: study the interaction between fiscal capacity and information in a developing-country context

- Long-term research collaboration with Uganda Revenue Authority (URA)

1. Use tax-return data at the transaction level to estimate VAT misreporting → cross-check reports by sellers and buyers [done]

2. Design and evaluate randomized intervention to increase effective use of information [in progress]

3. Use VAT data and goods coding to map production and trade networks, including imports and exports [in progress]
Uganda has a tax-to-GDP ratio of 11% (lower than average in Sub-Saharan Africa)

- About 60% of revenue from domestic taxes, 40% from tariffs

The value-added tax (VAT):

- Introduced in 1996
- Standard design, e.g. zero-rated exports
- General rate 18%, with some exemptions
- VAT raises 1/3 of domestic tax revenue
- VAT compliance gap around 60% (IMF 2014)
- Rules to restrict refunds (automatic audit + must have negative liabilities > USD 1,370)
Monthly VAT declarations filed electronically since 2012 (about 15,000 registered firms)

VAT declaration (Form DT-2031) has two components:

- **Monthly VAT summary (MS):** total output tax charged, total input tax paid, filing date
- **VAT Schedules:** transaction-level information (tax ID number (TIN) of counterpart, date, amount, description of goods)
  - Schedule 1 (VS1): sales
  - Schedule 2 (VS2): input purchases
  - Schedule 3 (VS3): imports
  - Schedule 4 (VS4): admin expenses
Compliance and Administration Costs

- Availability of transaction level data is good for enforcement and *great* for research

- However, firms face potentially high **compliance costs** due to these monthly reporting requirements
  - Cost proportionally higher for smaller firms
  - Very small firms are not required to register for VAT

- Making full use of this information requires investing in IT systems and human capital ⇒ **administrative costs**

- Welfare analysis should consider all costs & benefits of the policy
VAT Misreporting: Basic Framework

Notation:
- Let $S_{ij}$ be the sales reported by firm $i$ to firm $j$
- Let $B_{ij}$ be the purchases reported by firm $j$ from firm $i$

Basic framework of VAT reporting:
- Sellers want to underreport $S$, buyers want to overreport $B$
- Observe $S_{ij} < B_{ij}$ if anyone misreports (detectable)
- Observe $S_{ij} = B_{ij}$ if both report truthfully
- Self-enforcing property of VAT only breaks at the final stage
VAT Misreporting: High-Evasion Framework

- In context of high evasion, buyers may choose to *underreport* purchases to “look small”:
  - Collusive evasion: \( S_{ij} = B_{ij} \) with both firms underreporting
  - Buyer underreporting: \( S_{ij} > B_{ij} \). Most likely by retailers who evade VAT on their final sales
    - Some evidence in Carrillo et al. (2017)
In context of high evasion, buyers may choose to *underreport* purchases to “look small”:

- **Collusive evasion:** $S_{ij} = B_{ij}$ with both firms underreporting
- **Buyer underreporting:** $S_{ij} > B_{ij}$. Most likely by retailers who evade VAT on their final sales
  - Some evidence in Carrillo et al. (2017)

**Assumptions:**

- A.1: Both seller and buyer may underreport
- A.2: Only the buyer may overreport
In context of high evasion, buyers may choose to underreport purchases to “look small”:

- Collusive evasion: $S_{ij} = B_{ij}$ with both firms underreporting
- Buyer underreporting: $S_{ij} > B_{ij}$. Most likely by retailers who evade VAT on their final sales
  - Some evidence in Carrillo et al. (2017)

Assumptions:
- A.1: Both seller and buyer may underreport
- A.2: Only the buyer may overreport

At the pair level, we can observe:

- $S_{ij} = B_{ij} \iff$ Truthful reporting or Collusive evasion
- $S_{ij} < B_{ij} \iff$ Unilateral evasion (seller, buyer, or both)
- $S_{ij} > B_{ij} \iff$ Buyer underreporting
Collusive Evasion Chains

How do collusive evasion chains arise?

- Retailer (downstream) reports only a fraction of sales to final consumers → Needs to report lower input purchases to avoid looking suspicious
- Supplier is asked to report lower sales, such that misreporting not detectable through cross-checking → Report lower input purchases as well
- Supplier’s supplier is asked to report lower sales...
- ... and so on

Collusion more likely to be sustained if:

- Repeated interactions between trading partners
- Downstream firms have market power
Monthly Reporting Discrepancies at Pair Level

Cases with $S_{ij} > B_{ij}$

Cases with $S_{ij} < B_{ij}$

Note: share greater than 5mil: .023; share less than -5mil: .031
Aside: VAT Reporting by Level of Development

This figure is reproduced from IMF (2015).

Fourth, the VAT is among the tax instrument contributing the most to tax revenues, amounting to 34% of total taxes in Uganda (slightly above the Sub-Saharan Africa average), and divided almost equally between domestic VAT and VAT collected on imports (URA, 2014). Finally, the IMF estimates that the VAT compliance gap – the sum of a “collection gap” and an “assessment gap” – is very large, at around 60% of potential VAT and 6% of GDP in Uganda (somewhat higher than in other countries of similar income levels). As a comparison, for Latin American countries, the highest VAT compliance gaps are estimated to be around 30% (IMF, 2014).

The VAT was introduced in Uganda in 1996, during the same big push that led to the adoption of VAT systems across many LICs. Nowadays, it works as follows. Tax-registered firms with turnover over 50 million UGX ($13,700), hereafter VAT firms, are subject to a VAT of 18%, while firms with turnover below 50 million UGX are exempt from the VAT. As in other countries, a small set of goods – mostly necessities – and exports are zero-rated, but the VAT applies to imports. VAT firms are required to make monthly VAT declarations to the Uganda Revenue Authority, hereafter URA, for the domestic part of their businesses, and remittances of positive tax liabilities are due within 15 days of the declaration.

1 Firms with turnover below 50 million UGX are subject to a simplified turnover tax replacing both the VAT and the CIT. They may apply to enter the VAT system on a voluntary basis. The threshold for mandatory VAT registration was increased from 50 million to 150 million UGX ($41,100) in fiscal year 2015-16, although we don't use data from this fiscal year in our analysis.
Uses of Misreporting Measure

- Evidence on VAT misreporting can be used by the URA to guide the audit selection process
  - Focus on certain sectors
  - Focus on firms of a certain size
- We can also exploit the nature of the data and firms’ connections to improve compliance through spillover effects
  - Study them using a randomized evaluation
VAT Misreporting by Firm Size (% of firms)
VAT Misreporting by Sector (% of firms)
VAT Misreporting by Sector (% of revenue loss)
Intentional Misreporting or Sloppy Reporting?

- What if (some) discrepancies were due to honest mistakes?
  - We match by transaction date and aggregate at monthly level to avoid mismatches, but some could remain.
  - Some sales to small firms are reported as sales to final consumers (which are not disaggregated) \( S_{ij} < B_{ij} \).
  - Mistakes not ruled out, but cross-checking method likely to give a lower bound on misreporting, because we miss final sales.

- Potential approach to correct aggregate misreporting estimates:
  - Mistakes should be symmetric, while intentional misreporting should always go in the direction of lower tax liability.
  - Mistakes more likely in small vs large transactions.
Experimental Design

- **Treatment**: randomly select a subset of firms to receive notifications from the URA
  - Letter #1: announce that URA has acquired a new cross-checking technology
    - Increases taxpayers’ perception of URA’s capacity
  - Letter #2: list 2-3 firm-specific examples of discrepancies
    - Adds a concrete threat + focus on specific trading partners
    - Randomize examples or choose largest discrepancies?

- Logistical issues:
  - Delivery channel: email + phone + regular mail (sequential)
  - Credibility of threat: does URA have enough audit resources?
  - Sample size: how to estimate power given the existence of spillovers?
Experimental Design: Timing

- Pilot is currently under way
  - Letters 1 & 2 sent to 50 firms
  - Some feedback from taxpayers, esp. large firms
- URA has incorporated this intervention in their National Audit Plan for fiscal year 2017/18
  - Rollout of actual experiment in mid-July 2017
  - (Impact!)
- Trade-off between short-term revenue targets and long-term behavioral change and research findings
Experimental Design: Spillovers and Power

- Calculating statistical power is challenging due to network structure
  - Existence of spillovers implies that most firms treated, at least indirectly (Aral 2016)
  - For a network of size $n$, there are $2^n$ distinct treatment types (Breza 2016)
- To reduce dimensionality, need to model the nature of spillovers
  - Pomeranz (2015) finds that spillovers work upstream, i.e. towards suppliers, but not downstream
  - Re-evaluate the theoretical argument
Pomeranz’s (2015) Spillovers Argument

Table 1—Responses to Increase in Audit Probability: Collusive and Unilateral Evasion

<table>
<thead>
<tr>
<th>Position in supply chain</th>
<th>Collusive evasion</th>
<th>Unilateral evasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier</td>
<td>Sales ↑</td>
<td>VAT ↑</td>
</tr>
<tr>
<td></td>
<td>Sales ↑</td>
<td>VAT ↑</td>
</tr>
<tr>
<td>Treated firm</td>
<td>Inputs ↑</td>
<td>VAT (↑)</td>
</tr>
<tr>
<td></td>
<td>Inputs ↓</td>
<td>VAT ↑</td>
</tr>
<tr>
<td></td>
<td>Sales ↑</td>
<td>VAT ↑</td>
</tr>
<tr>
<td></td>
<td>Sales ↑</td>
<td>VAT ↑</td>
</tr>
<tr>
<td>Client</td>
<td>Inputs ↑</td>
<td>VAT ↓</td>
</tr>
<tr>
<td></td>
<td>Inputs ↓</td>
<td>VAT ↑</td>
</tr>
</tbody>
</table>

Notes: “Collusive evasion” stands for the type of evasion where a transaction is omitted from the books of both the seller and the buyer firm. “Unilateral evasion” stands for the type of evasion where the books of the seller and the buyer reveal discrepancies. Buyers, for whom inputs represent a tax deduction, will tend to overstate the value of the transaction, while sellers, for whom the transaction represents a tax liability, will tend to_understate its value. The arrows indicate the expected direction of change for the line item in question resulting from an increased audit probability on the treated firm.
Advantages of the Ugandan setting:

- Observe the entire network of transactions both before and after the treatment
  - Pomeranz observed only top 2-3 trading partners ex-post
- Can stratify randomization by number of trading partners
- Access to the universe of Ugandan firms, not a small subset
- Study differential spillover effects on partners mentioned in the letter vs those not mentioned
**Experimental Design: Network Measures**

- **Stratify treatment by:**
  - Firm size (e.g., number of employees)
  - Number of suppliers
  - Number of clients
  - Measures of network centrality

- **Optimal injection points (Zenou 2016)**
  - Experiment will inform us about optimal firms to treat in order to maximize impact, given a limited enforcement budget
Number of Clients - Raw Distribution

Mean: 32.39; Median: 7
Mapping Trade and Production Networks

- Micro-level shocks can have large macro-level consequences
  - Acemoglu et al. (2012, 2015), Carvalho (2014)
- Our dataset provides a unique opportunity to study production networks in a developing country
  - Merging import & export transactions to VAT data in progress
- Analysis at the level of goods, not only firms
  - Use machine learning to assign HS codes from trade data to verbal goods descriptions in VAT data
Mapping Trade and Production Networks

Research questions:

- Are supply chains shorter in developing countries?
- Do shocks spread faster/slower than in advanced economies?
- Do firms misreport at Customs by re-classifying products (Fisman and Wei 2004)?

Work in progress

- Current algorithm allows us to code goods in about 50% of VAT transactions
Thanks for your comments!
Which Side Is Misreporting?

Potential method: Reporting reliability index ($R_i$)

- For each pair-month, we observe $S_{ij} = B_{ij}$ or $S_{ij} \neq B_{ij}$
- For each firm $i$, construct a reliability index

$$R_i = \sum_{j} \frac{P_i}{P_i} 1(S_{ij} = B_{ij}) \in [0, 1]$$

- where $P_i$ if the number of trading partners of firm $i$
- Algorithm: starting with firms with $R_i = 0.5$
- For each pair-month obs, assume that firm with highest $R_i$ reports truthfully
When tax liability $R_i < 0$, firms should receive a credit reimbursement ($C_i$).

However, URA only gives reimbursement if $\sum_{t=0}^{T} R_{it} < \bar{Q}$, where $-\bar{Q} = \text{UGX } 5m \approx \$2,000$.

In addition, firms claiming for a reimbursement must agree to a full audit.

If $R_{it} < 0$ but the firm does not claim a reimbursement, it can offset negative liability against future liabilities.
Reimbursement Claims: Low Take-up

![Graph showing the relationship between negative VAT liability and share requesting for VAT refund.](image)

- Negative VAT liability in a given month (in absolute values)
- Share requesting for VAT refund

Almunia et al. Information, Fiscal Capacity & Compliance May 2017 32 / 32