Strategic or Confused Firms?
Evidence from "Missing" Transactions in Uganda*

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Abstract

Are firms sophisticated maximizers, or do they consistently make errors? We study this question in Uganda. We show that sellers and buyers report different amounts in 79 percent of transactions subject to value-added tax (VAT), despite invoices being easily comparable. We estimate that 29 percent of firms misreport own sales and purchases such that their liability *increases*. However, 71 percent are self-advantageous misreporters. Only such firms misreport less when exposed to tighter enforcement (at customs, where exchange rate-variation-induced imports pass through). Despite the gain from firm errors, overall, unilateral VAT misreporting cost Uganda USD 446 million in revenue from 2013-2016.

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1 Introduction

In economics, firms are seen as sophisticated organizations—maximizers that make constrained but optimal decisions by carefully assessing their true costs and benefits to the firm. This assumption is the starting point of the models that guide our understanding of how firms respond to public policies, for example when deciding whether to evade taxes, the decision we consider in this paper. With some exceptions, strategic decision-making by firms is by and large taken as self-evident.[1]

There is growing evidence to suggest that firms often deviate from optimal behavior, however.[2] If a significant proportion consistently makes mistakes, the consequences for theory and policy design would be far-reaching. Consider one of the most important questions for economic development: how firms in low-income countries should be taxed (Besley & Persson, 2009; Kleven *et al.* , 2016). Economists favor the value-added tax (VAT) in part because firms are thought to generally comply with a tax that is reported by both buyers and sellers, whose invoices can be cross-checked.[3] However, this argument assumes that firms are sophisticated enough to infer that cross-checks can occur and to accurately keep track of their sales and purchases.

In contrast to firms' sophistication, *states'* sophistication is studied in-depth (see e.g. Besley & Persson, 2013). Limited state capacity is in fact at the core of the argument for use of the VAT (though capacity to cross-check some reports is assumed). However, the "self-enforcing" VAT hypothesis ultimately rests on the assumption that firms are sophisticated. Confused firms may not respond as anticipated to the incentives generated by the tax and the low-but-non-negligible level of enforcement thought to prevail in most of the 166 countries around the world that now use the VAT.

In this paper, we study the sophistication of firms' decisionmaking in a low-income country context by analyzing their tax reporting behavior. We use transaction-level data from VAT returns and customs records for all domestic and international transactions during 2013-2016 involving Ugandan VAT-registered firms. First, we document widespread VAT discrepancies at the firm-pair×month level, using an approach akin to Fisman & Wei (2004)'s cross-checking of "mirror data". Next, we develop a firm-as-buyer and firm-as-seller fixed-effects methodology that allows us to estimate what fraction of each discrepancy is due to each of the two firms. This in turn enables us to assess the extent to which misreporting firms overreport total purchases and/or underreport total sales such that the firm's overall liability decreases, as opposed to making liability-increasing reporting errors. Third, we evaluate how firms that engage in self-advantageous versus -disadvantageous misreporting change their tax behavior *when the tax authority's capacity is en-*

[1] There are of course good reasons to think that firms are more sophisticated decisionmakers than individuals, who often make mistakes (Bernheim *et al.* , 2019).

[2] See e.g. DellaVigna & Gentzkow (2017); Tourek (2018); Kremer *et al.* (2019) and references therein.

[3] The VAT is argued to be self-enforcing in firm-to-firm trade for two reasons (Ebrill *et al.* , 2001; Kopczuk & Slemrod, 2006; Pomeranz, 2015). First, transactions between VAT-registered firms generate a "double" paper trail, as both sides of the transaction must keep a copy of the invoice. Second, seller and buyer have asymmetric reporting incentives. Another reason why economists recommend the use of the VAT is that the tax in theory does not distort production decisions.

hanced. We do this by constructing an exchange rate variation-based instrument for whether input purchases pass through customs—i.e., are imported rather than acquired from domestic sellers—where a degree of monitoring happens automatically.

In the first step of our analysis, we show that, in data on all domestic trade between the 19,161 VAT-registered firms in Uganda, sellers and buyers report different amounts in 79 percent of reported firm-pair×month observations.[4] This finding suggests that Uganda's authorities have limited capacity to detect and discipline VAT misreporting. In 60 percent of mismatch transactions we find a "seller shortfall," namely the seller reporting a lower value than the buyer. In the remaining 40 percent we observe a "buyer shortfall."

At face value, while seller shortfall is consistent with a standard model of VAT evasion in which the tax authority has low cross-checking capacity, the extent of buyer shortfall we observe points towards firm reporting errors. This is because buyer (seller) shortfall implies an *increase* (decrease) in the firm pair's combined tax liability, other things equal. However, Carrillo *et al.* (2017) point out that a firm that underreports its value-added may strategically choose to underreport *both* its sales and purchases if e.g. the firm believes that the audit probability increases with firm size. Such "looking small" behavior can potentially explain buyer shortfall while simultaneously benefiting the responsible firm, as can "looking big" behavior (i.e., overreporting both sales and purchases).

To distinguish between strategic misreporting and reporting errors, we first quantify the contribution of seller- and buyer-specific factors towards each discrepancy, using a firm-as-buyer and firm-as-seller fixed effects model. Summing up a firm's two estimated fixed effects allows us to categorize the firm as an Advantageous or a Disadvantageous misreporter depending on whether its *net* misreporting position decreases or increases the firm's overall tax liability.

We find that 71 percent of VAT-registered Ugandan firms are *Advantageous* misreporters and 29 percent *Disadvantageous* misreporters. The proportion of firms we categorize as making errors is likely an underestimate.[5] Among Advantageous misreporters, only 2 percent "look small" by underreporting both sales and purchases (and the firm's value-added). Another 77 percent are "Conspicuous" Advantageous misreporters that underreport their sales and overreport their purchases. The remaining 21 percent "look big" by overreporting both sales and purchases. The year-to-year correlation of a firm being categorized as engaging in advantageous misreporting is 0.77, while that of the firm being categorized as engaging in disadvantageous misreporting is 0.62.

The estimated government revenue *gain* due to reporting errors by Disadvantageous misreporters is large—around USD 131 million during 2013-2016. However, the revenue loss due to misreporting by Advantageous misreporters is even larger, at around USD 577 million. On net, unilateral VAT misporting cost the Ugandan government around USD 446 million, or 4 percent of total tax revenue collected, during our data period. This occurs despite the characteristics of the

[4]To avoid false discrepancies, we allow for firms aggregating individual transactions in a given month; errors in the reported transaction month; and rounding errors.

[5]This is because we classify firms whose reporting errors happen to decrease their liabilities as Advantageous misreporters. We show in the Appendix that potential underreporting of sales to final consumers (which cannot be cross-checked) has little impact on the proportion of firms classified as Disavantageous misreporters.

VAT that were thought to make the tax self-enforcing.

In the third and final part of our analysis, we show that Advantageous misreporters respond to enhanced tax authority capacity by misreporting less, while Disadvantageous misreporters do not. To do so, we take advantage of the fact that imported goods pass through customs and hence are "automatically" observed by authorities, making tax evasion riskier (Riezman & Slemrod, 1987; Keen & Lighart, 2002; Emran & Stiglitz, 2005; Keen & Lighart, 2005; Baunsgaard & Keen, 2010; Cagé & Gadenne, 2018). To generate exogenous variation in how exposed transactions involving a given firm are to oversight, we interact real exchange rate shocks with baseline import shares at the firm-country of origin level, akin to Bastos *et al.* (2018). This allows us to estimate how month-to-month changes in the share of a firm's initial inputs that are imported (versus purchased domestically) affect the firm's misreporting in *domestic* transactions. We find that a one standard deviation increase in import share leads to a 16 percent decrease in the firm's seller shortfall. This response is entirely driven by firms classified as Advantageous misreporters.

Overall, our findings suggest that, in Uganda, the majority of firms are sophisticated enough to respond to weak tax enforcement by considerably underreporting their tax liability, as conventional models of firm behavior assume. Such firms also respond to higher monitoring "rationally"– that is, by evading less. However, a non-negligible proportion—almost one third—of Ugandan firms consistently make costly tax reporting errors. Such "confused" firms also do not change their behavior when tax authority oversight increases.

This paper contributes to three related but distinct strands of literature on firm behavior and taxation. First, we provide what to our knowledge are the first direct estimates of the extent of strategic behavior-vs.-errors among firms. We can do so because the methodology we develop allows us to classify individual firms' behavior as self-advantageous or not, and because we observe the behavior of the entire population of formal, non-micro firms in Uganda's economy. Our analysis builds on an emerging body of evidence of seemingly erroneous behavior among firms (see among others DellaVigna & Gentzkow, 2017; Tourek, 2018; Kremer *et al.* , 2019).

Second, we provide new evidence on how tax evasion in a low-income country responds to the state's enforcement capacity, and in particular how firms characterized by different degrees of sophistication respond. In this sense, our analysis builds most closely—methodologically and thematically—on Fisman & Wei (2004)'s mirror data approach to measuring how tariff evasion responds to the size of the tariff. We also build on existing studies of more-vs.-less attentive taxpayers' response to tax rates (Chetty & Looney, 2009; Akcigit *et al.* , 2018; Rees-Jones & Taubinsky, 2018).[6] However, our focus is on variation in enforcement capacity, linking this paper with existing work on the causes and consequences of state capacity (Besley & Persson, 2009, 2010; Acemoglu *et al.* , 2015; Best *et al.* , 2018; Page & Pande, 2018).

Finally, we show that the VAT is far from self-enforcing in low state capacity settings. Building

[6] Chetty & Looney (2009); Akcigit *et al.* (2018); Benzarti (2018); Gillitzer & Skov (2018); Rees-Jones & Taubinsky (2018) provide direct evidence of tax-reporting mistakes by *individuals*. Like this paper, Akcigit *et al.* (2018) show evidence that more sophisticated taxpayers tend to react as theory predicts to tax incentives, while less sophisticated taxpayers do not.

on a recent body of work studying how policy should be tailored to context (Laffont, 2005; Best *et al.* , 2015, 2018; Duflo *et al.* , 2018; Hansman *et al.* , 2019), our analysis—especially in combination with other evidence that third-party reporting may not in itself generate tax compliance (Carrillo *et al.* , 2017; Almunia & Lopez-Rodriguez, 2018; Waseem, 2018b)—qualifies the common argument that developing countries are especially likely to benefit from use of the VAT (see, e.g., Bird & Gendron, 2007).[7] The massive magnitude of the revenue loss from VAT evasion we document in Uganda—and the corresponding cross-country patterns documented by Cagé & Gadenne (2018)—suggest that the production efficiency benefits of VATs relative to tariffs are at least in part offset by capacity-constrained governments' ability to raise revenues on international versus domestic transactions.

2 Background

2.1 The Value-added Tax (VAT) in Uganda

Uganda's tax-to-GDP ratio, at 13 percent in 2016, is below the African and OECD averages of 18 and 34 percent (OECD, 2018), while the ratio of its tax administration costs to tax revenues (2.4 percent) is comparable to the average in other low-income countries (IMF, 2013; Lemgruber *et al.* , 2015).

The VAT was introduced in 1996 and in 2016 contributed 32 percent of Uganda's total tax revenue (excluding revenue from tariffs), similar to elsewhere in Africa (OECD, 2018). The Ugandan VAT follows a relatively standard design with a general rate of 18 percent, a credit-invoice system and standard exemptions (e.g., financial services) and zero-rating (e.g., exports). See Appendix A.1 for more details.

Since 2012 all Ugandan VAT firms must file their monthly VAT declarations electronically, within 15 days after the transaction month ended.[8] As a result, the Uganda Revenue Authority (URA) has detailed data in electronic format for all VAT firms in recent years. Additionally, VAT firms are required to submit detailed transaction-level records—spreadsheets listing each sale and purchase to/from other VAT-registered firms. This implies that, every month, the URA receives two reports for each transaction between any two VAT firms—one from the seller and one from the buyer.

[7] Tax evasion research has demonstrated the importance of third-party reporting in developed countries (Slemrod *et al.* , 2001; Kleven *et al.* , 2011; Kleven, 2014), but also its limitations (Slemrod *et al.* , 2017; Almunia & Lopez-Rodriguez, 2018). The existing literature shows that in middle-income countries whose enforcement capacity significantly exceeds Uganda's—Brazil, Chile, Ecuador, India, and Pakistan—authorities' ability to cross-check VAT records tends to reduce evasion (Ebrill *et al.* , 2001; Pomeranz, 2015; Carrillo *et al.* , 2017; Mittal & Mahajan, 2017; Waseem, 2018a).

[8] In the data, about 80 percent of VAT returns are reported within 15 days of the return month and another 9 percent within the next month.

2.2 Data

Our analysis exploits the complete administrative data from VAT-registered firms' monthly electronic declarations between fiscal years 2013 and 2016.[9] The monthly VAT data contains information at the firm level, including a scrambled firm Tax Identification Number (TIN), the declaration date, total sales (amount and the corresponding VAT charged), total purchases (amount and the corresponding VAT paid), and total VAT liabilities. The tax return also contains data from the spreadsheets detailing each transaction, including the transaction date, the seller and buyer TINs, transaction value, and the VAT charged or paid. Sales to final consumers and to non-VAT firms are recorded only as monthly aggregates. Importantly, the transaction-level information reported in the VAT schedules is consistent with the aggregate data.[10] This suggests that the transaction-level records constitute meaningful paper trails for firms' VAT declarations and liabilities.

Our dataset contains 22,388 unique VAT-registered firms submitting at least one monthly VAT return between 2013 and 2016, and the transactions data cover 15,569 sellers and 19,421 buyers, leading to 3,373,183 seller-buyer-month observations.[11]

The data on imports comes from customs declarations submitted to the URA between 2012 and 2016. These declarations are transaction-specific and submitted electronically. The data includes information on the number and type of items imported, the value of the goods, and the date of import. The TIN of the importer allows us to directly match the customs data to the domestic transactions. 8,672 VAT-registered firms import at least once. Further data description can be found in Appendix A.1.

3 Discrepancies in VAT Declarations

3.1 Conceptual background

For a transaction between a seller s and a buyer b on date j, let y^S_{sbj} and y^B_{sbj} denote the output VAT charged (as reported by the seller s) and the input VAT paid (as reported by the buyer b). In the analysis, we aggregate transactions at the monthly level, so we define $Y^S_{sbt} \equiv \sum_{j \in J_t} y^S_{sbj}$ and $Y^B_{sbt} \equiv \sum_{j \in J_t} y^B_{sbj}$, where t denotes the transaction month. We define "seller shortfall" as a situation in which the total VAT charged is *lower* than the total VAT paid, i.e., $Y^S_{sbt} < Y^B_{sbt}$, and "buyer shortfall" as $Y^S_{sbt} > Y^B_{sbt}$.

Seller shortfall may be due to the seller underreporting output VAT or the buyer overreporting input VAT (or both). In either case, it implies a potential revenue loss for the government, as the reported tax liability is lower than the true liability. Symmetrically, buyer shortfall may be due to the seller overreporting output VAT or the buyer underreporting input VAT (or both), which implies a potential revenue *gain* for the government. Other things equal, buyer shortfall thus

[9] We refer to fiscal year 2013/14 as 2013.

[10] The aggregate firm-level VAT data match the sum of individual transaction data for 97 percent of the cases.

[11] Out of 22,388 firms, 19,161 have non-missing firm-as-buyer and/or firm-as-seller fixed effect estimated as described in Section 4 and therefore make up our main sample of analysis.

points towards errors by firms.

However, it might be rational for buyers to understate their purchases if they are simultaneously understating their sales, e.g. because this allows them to report a less suspicious (say, non-negative) VAT liability. Carrillo *et al.* (2017) provide evidence of such "looking small" behavior in Ecuador. In theory, buyer shortfall cases could also be due to sellers engaging in liability-reducing "looking big" behavior by overstating both their purchases and sales while underreporting their value added. These observations underscore that transaction-pair level discrepancies do not in themselves allow us to distinguish between sophisticated, self-advantageous tax evasion and systematic reporting errors.

3.2 Discrepancies

In this subsection, we quantify the VAT reporting discrepancies in Uganda at the seller-buyer-month level for the 2013-2016 period. The average monthly reported VAT liability is slightly negative, and the median is zero, as is common in developing countries (Lemgruber *et al.* , 2015; Pomeranz, 2015). 56 percent of monthly VAT returns report a nil or negative tax liability.

Table 1 displays the average proportion of *firms* that in a full fiscal year report respectively a positive, zero, and negative (i) value-added and (ii) VAT liability. The reported value-added is negative or zero for around 15 percent of firms. However, the reported VAT liability is zero or negative for 45 percent of firms. This number varies from 44 percent among smaller VAT-registered firms to 50 percent among the largest firms.[12]

Figure 1 provides a graphical illustration of the discrepancies between seller and buyer-declared amounts. The vertical axis measures the inverse hyperbolic sine transformation of the total monthly amounts declared by sellers, and the horizontal axis that of the total monthly amounts declared by buyers. Each dot represents a seller-buyer-month observation and the solid straight line is the 45-degree line. Sellers and buyers report the same amount in 21 percent of the observations. We observe seller shortfall in 47 percent of the cases and buyer shortfall in the remaining 32 percent.

We observe these widespread discrepancies despite taking a number of steps to avoid detecting false discrepancies. First, we use transaction dates (the month in which a transaction took place) rather than filing dates to account for the fact that sellers and buyers may not file a given transaction in the same month. Second, we minimize mismatched transactions by (i) identifying discrepancies using firms' aggregate monthly records rather than individual transactions and (ii) not labelling as discrepancies cases where the seller and buyer declare the same amount with only a one or two-month lag. Finally, we allow for a rounding of 1,000 Ugandan Shillings (about USD 0.30).

The dashed curve in Figure 1 is a binned scatter plot showing the average amounts reported by sellers for different values of the buyer-reported amounts. The curve lies systematically below the

[12]Zero or negative reported VAT liabilities occur in combination with positive reported value-added because the VAT liability includes offsets carried over from the previous month. Since it is difficult to claim refunds, many firms choose to carry-over offsets instead.

45-degree line, implying that seller shortfall is quantitatively more important than buyer shortfall in aggregate terms. Additionally, the distance to the 45-degree line appears to be increasing with the transaction amount, suggesting that the fraction of the transaction amount being unreported gets relatively larger as the amount of transaction increases.

4 Classifying Firms' Reporting Behavior

In this section we evaluate the extent to which Ugandan firms underreport their value-added—sales minus purchases—such that their liability falls, as opposed to making reporting errors that increase the firm's liability. To do so we first estimate what share of each discrepancy is due to each of the two firms.

4.1 Assigning the blame: two-way fixed-effects analysis

We allocate a share of the responsibility for each discrepancy to the seller and the buyer based on the aggregate reporting accuracy of each firm in all their transactions, i.e., across all periods and with all trading partners. The starting point is a two-way fixed-effects model inspired by Abowd *et al.* (1999, 2002). We define the discrepancy between buyer f, and seller f' in month t as $d_{ff't} \equiv Y^B_{ff't} - Y^S_{ff't}$, such that $d_{ff't} > 0$ implies seller shortfall and $d_{ff't} < 0$ implies buyer shortfall. Then, we estimate the following regression:

$$d_{ff't} = \delta^b_f + \delta^s_{f'} + \delta_t + r_{ff't}, \tag{1}$$

where δ^b_f and $\delta^s_{f'}$ denote buyer and seller fixed effects (defined at the firm level), respectively; δ_t is a month fixed effect; and $r_{ff't}$ is an error term. Since $d_{ff't}$ is the nominal value of the discrepancy, δ^b_f (respectively $\delta^s_{f'}$) can be interpreted as a firm's average contribution to discrepancies as a buyer (seller), in monetary terms.[13]

As shown in Abowd *et al.* (1999, 2002), the two-dimensional fixed effects are separately identified only within a "connected set" of firms, which in our context refers to firm-pairs that are linked by transaction and all of such firms' trade-partners. The largest connected set observed during our 2013-2016 data period covers over 99 percent of all observations, 90 percent of sellers, and 94 percent of buyers. Following the existing literature, we thus restrict our analysis to this largest connected set of firms. Appendix A.2 provides technical details on the two-way fixed-effects estimation and the firm classification procedure that follows in the next subsection.

[13] In Appendix A.2 we show results from running (1) with various controls included. These are generally very similar.

4.2 Firm-level reporting behavior

We next construct a firm-level discrepancy measure, Q_f, adding up the two estimated fixed effects for f weighted by the relative values of its sales (Y_f^s) and purchases (Y_f^b) over the study period:

$$Q_f \equiv \left(\frac{Y_f^s}{Y_f^s + Y_f^b}\right)\hat{\delta}_f^s + \left(\frac{Y_f^b}{Y_f^s + Y_f^b}\right)\hat{\delta}_f^b. \tag{2}$$

With the Q_f measure in hand, we can formalize our classification of a firm's aggregate reporting behavior. A firm engages in *Advantageous* misreporting behavior if $Q_f > 0$, meaning that it reports, at the aggregate level, in a way that *reduces* its VAT liability. Symmetrically, a firm engages in *Disadvantageous* misreporting behavior if $Q_f < 0$, which implies that it reports in a way that *increases* its overall VAT liability.

We further classify Advantageous misreporters into three subcategories. First, a firm engaging in *Conspicuous* advantageous behavior is one for which $\hat{\delta}_f^s \geq 0$ and $\hat{\delta}_f^b \geq 0$. This implies that the firm both underreports its sales and overreports its purchases, and hence appears not to be concerned with hiding its tax evasion from the tax authorities. Second, a firm engaging in *Looking-small* advantageous behavior is one for which $\hat{\delta}_f^s \geq 0$ and $\hat{\delta}_f^b < 0$. This implies that the firm underreports its sales and underreports its purchases. Finally, a firm engaging in *Looking-big* advantageous behavior is one in which $\hat{\delta}_f^s < 0$ and $\hat{\delta}_f^b \geq 0$. This implies that the firm overreports its sales and overreports its purchases.

The results are shown in the first row of Table 2. We find that only 85 out of 19,161 Ugandan VAT-eligible firms report consistently on average, while 13,528 or 71 percent are *Advantageous* misreporters. These estimates suggest that when the VAT is implemented in a low-state capacity context, where systematic cross-checks appear not to occur, the majority of firms misreport so as to lower their VAT liability.

However, we also find that 5,548 or 29 percent of firms misreport in a *Disadvantageous* way. A substantial share of firms thus simply make reporting errors. This result underscores the importance of accounting for heterogeneity in firm sophistication in theory and policy design. It also foreshadows our results in Section 5, where we study how firms respond to increased oversight by the tax authority.

Of the 13,528 Ugandan firms that misreport in an advantageous way, 77 percent are Conspicuous advantageous misreporters, only 2 percent are Looking-small advantageous misreporters, and the remaining 21 percent are Looking-big advantageous misreporters. The high proportion of Conspicuous advantageous misreporters suggests that the majority of Ugandan firms believe that the tax authority is unlikely to detect evasion by monitoring firms' reported value-added.[14]

As seen in Figure 2, the average Q_f measure is similarly distributed across most of the distribution of firm size, suggesting that advantageous and disadvantageous misreporting occurs with

[14]The more surprising set of firms engaging in Looking-big behavior may for example be due to such firms believing that the tax authority pays more attention to small than big firms (see e.g. Amodio *et al.* , 2019), or misclassifying sales to final consumers as sales to other VAT-eligible firms, while simultaneously overreporting their purchases.

comparable frequency among smaller, medium-sized, and somewhat larger VAT-registered firms. However, Figure 2 also shows that the average Q_f measure markedly increases among the largest firms, suggesting that the largest firms are more sophisticated tax (mis)reporters than other firms. A more detailed comparison of the observable characteristics of the two types of firms is in Appendix A.2.

4.3 Robustness analysis

Our methodology, starting with the two-way fixed effects regression (1) and thereafter classifying firm types using the resulting Q_f measure, is one particular way to characterize Ugandan firms based on "missing" transactions. While allowing us to shed new light on the sophistication of firms' decisionmaking, our method has potential limitations.

First, we cannot distinguish truthful reporting from collusive evasion in which both seller and buyer misreport the transaction by the same amount. This implies that we may underestimate the total extent of VAT evasion in Uganda.

Second, our definition of disadvantageous behavior may be too conservative, as some errors may lower the firm's VAT liability, leading us to underestimate the true extent of firm errors. One way to shed light on the frequency of such "idiosyncratic but advantageous" errors relative to systematic flaws in a firm's tax reporting is to investigate the consistency of firm behavior over time. Doing so also allows us to probe the prediction accuracy of our classification method. We thus re-do the estimation of (1) and the classification of firms via (2) separately for each year in our sample. As shown in Appendix A.2, we find that 77 (resp., 62) percent of firms classified as Advantageous (Disadvantageous) misreporters in year t stay within that classification also in the subsequent year. This suggests that we primarily capture *systematic* components of firms' reporting behavior. It also suggests that disadvantageous behavior not surprisingly is somewhat less consistent over time than advantageous behavior.

A third limitation of our methodology is that we do not observe the level of misreporting of sales to final consumers. If firms engaging in buyer shortfall underreport a large enough share of sales to final consumers, their total misreporting may in principle be advantageous.[15] To address this concern, we repeat the original estimation assuming that all firms underreport a fixed proportion of their sales to final consumers. As seen in Appendix Table A.7, the proportion of Advantageous firms increases to 75 percent when we assume that all firms underreport final sales by 10 percent. Even assuming an extreme and arguably implausible degree of misreporting of sales to final consumers—40 percent—the share of Disadvantageous firms is about 16 percent.[16]

[15] If firms are underreporting their sales to final consumers, it might be rational to also underreport their input purchases to follow a Looking-small strategy.

[16] Assuming that the entire VAT compliance gap estimated for Uganda is due to evasion on sales to final consumers—which this paper shows is far from the case—would imply that firms misreport sales to final consumers by 50 percent (IMF, 2014).

4.4 Revenue consequences

We documented in Sub-section 3.2 that Ugandan sellers and buyers report different values in 79 percent of VAT transactions, and that 40 percent of such mismatch transactions involve a "buyer shortfall" and 60 percent a "seller shortfall". This suggests that, in aggregate, the revenue consequences of VAT misreporting for the Ugandan government—which gets about 32 percent of its total tax revenue from the VAT—are likely adverse and potentially large, but also that there may be significant positive revenue consequences from the observed disadvantageous misreporting.

An increased (or decreased) liability attributed to one firm may have different revenue consequences from one attributed to the other firm involved in a given transaction (see Appendix A.3). To proceed, we thus divide up the "blame" for a given reporting discrepancy $d_{ff't}$ using the relevant seller and buyer fixed effect estimated in Sub-section 4.1. If the two fixed effects have the same sign, we assign shares of the discrepancy proportionally, based on the relative size of each firm's fixed effect. If, instead, the two fixed effects have opposite signs, we assign the entire discrepancy to the firm whose fixed effect matches the sign of the discrepancy. Details are in Appendix A.3.

The results are reported in the bottom rows of Table 2. Our estimates imply that the Ugandan government would have lost USD 131 million in tax revenues during 2013-2016 if (only) disadvantageous misreporting were eliminated. If (only) advantageous misreporting were eliminated, our estimates imply a revenue *gain* of about USD 577 million. If both forms of misreporting were eliminated, our estimates imply a revenue gain of USD 446 million, or about 33 percent of the total VAT collected.[17] These estimated revenue consequences are very similar if we use an alternative way to apportion discrepancies based on the estimated fixed effects, and also if we naively assume that all instances of seller shortfall are entirely due to sellers and all instances of buyer shortfall due to buyers, as shown in Appendix A.3.

5 Enhanced Tax Authority Capacity and VAT Evasion by Strategic and Confused Firms

In this section we study how Ugandan firms change their reporting behavior when the tax authority's capacity is enhanced. To do so we leverage the fact that imported goods are subject to greater oversight at customs, making tax evasion riskier than in domestic transactions (Riezman & Slemrod, 1987; Keen & Lighart, 2002, 2005; Emran & Stiglitz, 2005; Baunsgaard & Keen, 2010; Cagé & Gadenne, 2018). We use exchange rate variation to construct an instrument that shifts firms into or out of importing. We then compare the reporting response to higher tax authority oversight of firms that are sophisticated enough to systematically underreport their tax liability under mini-

[17] The fact that many Ugandan firms have positive outstanding balances with the URA helps explain why the revenue consequences of eliminating disadvantageous misreporting are smaller (in absolute value) relative to those of eliminating advantageous misreporting than the estimated relative size of the magnitude of the two forms of misreporting themselves. This, in combination with the correlation between individual firms' buyer and seller shortfalls (see Subsection 4.2), also helps explain why the revenue gain from eliminating all VAT misreporting is smaller than the sum of the revenue gain from eliminating respectively disadvantageous and advantageous misreporting.

mal tax enforcement in the domestic economy and that of firms whose misreporting in domestic transactions appears to be due to systematic errors.

5.1 Exchange rate fluctuations and imports

To account for endogeneity in firms' importing decisions, we instrument for the proportion of a firm's inputs that are imported by interacting the firm's baseline import shares from different countries and fluctuations in monthly real exchange rates (RER), following Bastos *et al.* (2018). To maximize power in the first stage, we restrict the list of countries of origin to the 10 countries from which Ugandan firms as a whole import the most in 2012 (baseline year). Our first stage specification is:

$$ImportShare_{it} = \sum_{c=1}^{10} \beta_c log(RER)_{ct} * S_{ic} + \beta_{11} sales_{it} + \beta_{12} inputs_{it} + \gamma_i + \gamma_t + \epsilon_{it}, \quad (3)$$

where $ImportShare_{it}$ is the share of inputs that firm i imports from any country of origin in month t, $log(RER)_{ct}$ is the log of the RER between the Ugandan shilling and the currency of country c in month t, and S_{ic} is the share of inputs that i imports from country c in 2012. γ_i and γ_t are firm and year-month fixed effects, and $sales_{it}$ and $inputs_{it}$ dummies that control for respectively the firm's sales and inputs decile.

The first stage results are reported in Table A.10 in Appendix A.4. In both the full sample and the two subsamples consisting of Advantageous and Disadvantageous misreporters, the first stage analysis generates large Kleibergen-Paap rk Wald F statistics and estimates of β_1 to β_{10} are all negative, as expected, and significant for the most part.

5.2 Results

In the second stage we regress the domestic VAT misreporting that our estimates from Section 4 indicate that (potentially) importing firm i is responsible for in month t and that is costly to the tax authority—$SellerShortfall_{it}$—on the instrumented share of its initial inputs that are imported and hence exposed to enhanced oversight $\widehat{ImportShare}_{it}$.[18] We run:

$$SellerShortfall_{it} = \delta_1 \widehat{ImportShare}_{it} + \delta_2 sales_{it} + \delta_3 inputs_{it} + \gamma_i + \gamma_t + \epsilon_{it}. \quad (4)$$

The results are shown in Table 3. In the IV specifications shown in columns 1-3, we see that a one standard deviation increase in the share of imported inputs leads to a decrease in seller short-

[18] The shortfall amounts are computed using only domestic transactions so that, with controls for the firm's total level of sales and inputs included, we avoid any mechanical or circular relationship between the share of imports and shortfall amounts. Specifically, we add up the shares that firm i is estimated to be responsible for of all discrepancies the firm is involved in during the relevant month that display a seller shortfall, the form of VAT misreporting that in general reduces the firm's tax liability and revenues collected by the URA. To do so we use the firm's two estimated fixed effects from Section 4 and those of its domestic trade partners. $SellerShortfall_{it}$ is the inverse hyperbolic sine transformation of total seller shortfall amounts for firm i in month t.

fall of 16.2 percent in the full sample and 21.3 percent in the sample of Advantageous misreporters. The effect is close to zero in magnitude and not statistically significant for Disadvantageous misreporters. In Appendix A.4, we show that these results are robust to various alternative approaches.

In sum, our results in this section suggest that sophisticated firms—those that tend to respond to minimal general tax enforcement in domestic trade by underreporting their tax liability—also strategically respond to enhanced monitoring by misreporting less. On the other hand, "confused" firms—firms that consistently make reporting errors—also appear to respond less to variation in the state's enforcement capacity.

6 Conclusion

In this paper we study the sophistication of firms' decisionmaking, using tax reporting behavior in a low enforcement setting—Uganda—as a lab for analyzing the extent to which firms make decisions that appear to benefit themselves. Exploiting transaction-level data from VAT returns, we document widespread discrepancies between seller and buyer reports, with dramatic consequences for tax revenue collected. By comparing a given firm's misreporting of sales and purchases over time, we show that, while a majority of firms misreport in a way that reduces their tax liability, a non-negligible fraction—29 percent—misreports such that the firm's tax liability increases. We also show that when exchange-rate variation induces firms to import a higher share of their imports, implying stricter oversight, firms classified as self-advantageous misreporters choose to misreport less in onward trade, while firms whose misreporting appears to be due to errors do not. We interpret our findings as indicating that (i) the proportion of firms that appear not to engage in sophisticated optimization as usually assumed is high—which has important implications for theory and policy—but (ii) the majority of firms nevertheless respond to low state capacity by evading taxes, as traditional economic theory predicts.

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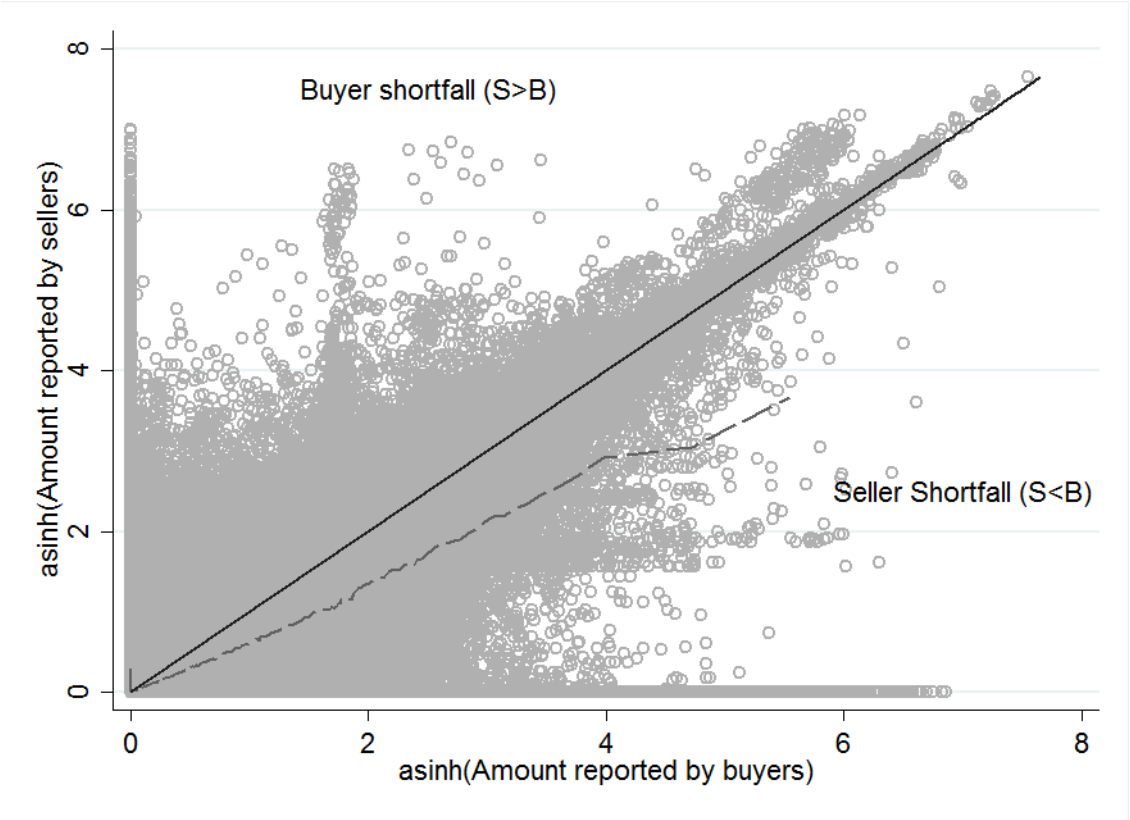
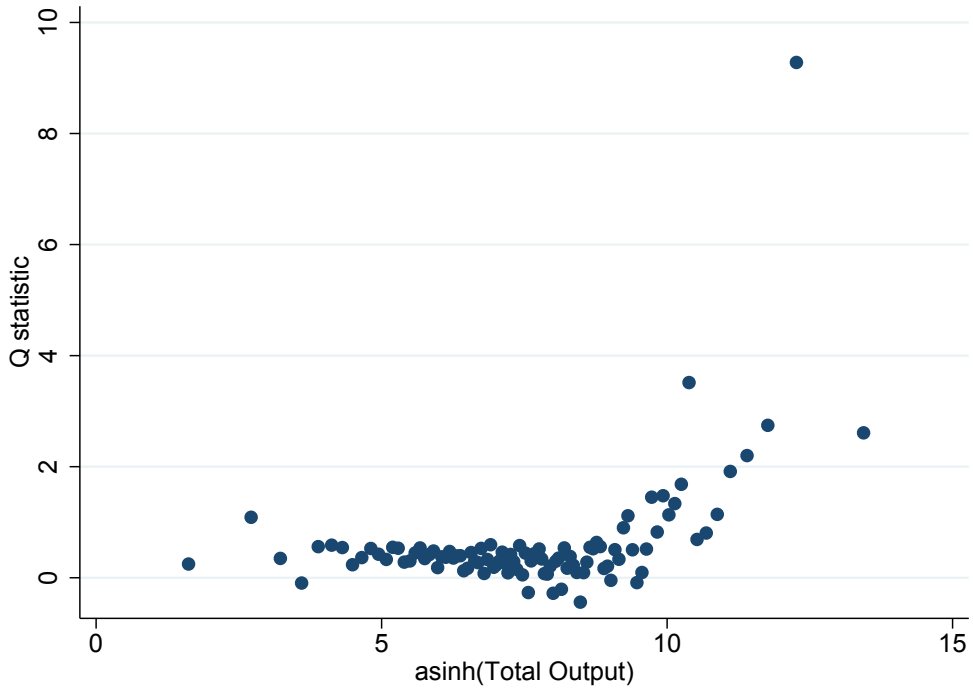
Figures

FIGURE 1
DOMESTIC VAT AMOUNTS DECLARED BY SELLERS VS BUYERS



Notes: In this figure, we plot, in gray circles, the inverse hyperbolic sine transformation of amounts reported by sellers over that by buyers for all transactions in fiscal years 2013-2016. The solid black line is the identity line, on which all observations would be if there were no reporting discrepancies. Points above the solid black line are cases of buyer shortfall; points below are cases of seller shortfall. The gray dashed line is a binned scatter plot of the inverse hyperbolic sine transformation of the amounts reported by sellers over that reported by buyers. Data source: VAT Schedules data for fiscal years 2013-2016.

FIGURE 2
Q STATISTIC OVER SIZE.



Notes: In this Figure, we plot a firms estimated Q statistic (Q^f in Equation (2)) over the inverse hyperbolic sine transformation of a firms total output in the estimation period. Data source: VAT Schedules and Monthly Summary data for fiscal years 2013-2016.

Tables

TABLE 1
DISTRIBUTION OF VALUE-ADDED AND VAT LIABILITY BY FIRM SIZE

		(1) Value added	(2) Output-Input VAT	(3) VAT liability
All VAT firms (N = 22,388)	Share > 0	84.33%	77.36%	48.26%
	Share $= 0$	5.12%	7.43%	6.47%
	Share < 0	10.55%	15.21%	45.27%
LTO firms (N = 738)	Share > 0	93.08%	77.75%	48.64%
	Share $= 0$	0.81%	0.77%	1.28%
	Share < 0	6.11%	21.49%	50.07%
MTO firms (N = 1,635)	Share > 0	91.85%	79.94%	50.69%
	Share $= 0$	0.71%	1.39%	1.41%
	Share < 0	7.43%	18.66%	47.91%
Other VAT firms (N = 20,015)	Share > 0	82.82%	77.00%	47.92%
	Share $= 0$	5.95%	8.62%	7.44%
	Share < 0	11.22%	14.39%	44.63%

Notes: Data source: VAT Monthly Summary data for fiscal years 2013-2016. Column (1) shows total value added over the fiscal year, including goods that are VAT-exempt. Column (2) shows the difference between total output VAT and total input VAT. Column (3) shows total tax liability over the fiscal year, taking into account VAT credits carried over from previous fiscal year (2012). Firms can display a positive Output-Input VAT, but a nil or negative VAT liability once offsets are subtracted. LTOs are firms with an annual turnover above 15 billion Ugandan Shillings (USD 4.1 million) and/or belonging to specific sectors such as oil and mining, banking, insurance, and government departments. MTOs are firms with a turnover above 2 billion Ugandan Shillings (USD 550,260, threshold increased to 5 billion Ugandan Shillings/USD 1.3 million in 2015). Other VAT firms refer to VAT-paying firms with an annual turnover lower than the MTO threshold.

TABLE 2
SUMMARY STATISTICS AND REVENUE CONSEQUENCES BY FIRM TYPE

	All	(1) Consist	(2) Disadv.	(3) Adv.	(3a) Conspic.	(3b) Looking Small	(3c) Looking Big
No. of distinct firms	19,161	85	5,548	13,528	10,371	345	2,812
Percentage of all firms	(100%)	(0%)	(29%)	(71%)	(54%)	(2%)	(15%)
Total net VAT due	1,554,101	531	864,525	689,045	439,360	49,896	199,789
Seller shortfall							
Number of distinct firms with seller shortfall	17,255	29	4,902	12,324	9,185	343	2,796
Total net VAT due from firms with seller shortfall	1,275,946	11	760,049	515,886	345,909	36,425	133,552
Total VAT subject to seller shortfall	900,099	57	101,680	798,362	455,863	175,719	166,779
Buyer shortfall							
Number of distinct firms with buyer shortfall	18,000	67	5,287	12,646	9,507	341	2,798
Total net VAT due from firms with buyer shortfall	1,316,829	236	798,553	518,039	345,640	38,634	133,765
Total VAT subject to buyer shortfall	727,373	649	528,417	198,307	65,996	48,720	83,591
Correcting seller shortfall and buyer shortfall							
Impact on total net VAT due	446,224	26	−130,753	576,950	359,323	131,119	86,508
Percentage of total VAT collected	32.8%	0.0%	−9.6%	42.4%	26.4%	9.6%	6.4%

Notes: Data Source: VAT Schedules and Monthly Summary data for fiscal years 2013-2016. We include firms with at least one non-missing fixed effect estimates. Revenue consequences are calculated by correcting the VAT liability in the last month of the year for the total VAT under seller shortfall and under buyer shortfall. *Definitions:* (1) Consistent: $Q(f) = 0$; (2) Disadvantageous: $Q(f) < 0$; and (3) Advantageous: $Q(f) > 0$. Under Advantages, firms are further categorized into: (3a) Conspicuous Advantageous: $\hat{\delta}_s(f) \geq 0$ and $\hat{\delta}_b(f) \geq 0$; (3b) Looking small Advantageous: $\hat{\delta}_s(f) \geq 0$ and $\hat{\delta}_b(f) < 0$; and (3c) Looking big Advantageous: $\hat{\delta}_s(f) < 0$ and $\hat{\delta}_b(f) \geq 0$. $Q(f)$ is calculated as a weighted average of the estimated firm-as-buyer fixed effect and firm-as-seller fixed effect, i.e., : $Q(f) = \hat{\delta}_b \times \frac{p}{p+s} + \hat{\delta}_s \times \frac{s}{p+s}$ where s denotes total sales and p stands for total purchases. All values are in thousands of USD.

TABLE 3
EFFECT OF ENHANCED TAX AUTHORITY OVERSIGHT ON VAT COMPLIANCE BY SOPHISTICATED AND CONFUSED FIRMS

	2SLS		
Dependent variable	$asinh(Seller\ shortfall\ amounts)$		
	(1)	(2)	(3)
Sample	Full	Advantageous	Disadvantageous
ImportShare	-0.558***	-0.772***	-0.081
	(0.150)	(0.175)	(0.272)
Sales decile	Yes	Yes	Yes
Inputs decile	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
N	442519	314669	127850
Mean of dep.	0.90	1.03	0.57
Kleibergen-Paap LM stat.	344.261	286.455	74.104
Kleibergen-Paap Wald F stat.	53.101	46.381	11.443

Notes: Data Source: Customs, VAT Schedules and Monthly Summary data for fiscal year 2013-2016. This regression analyzes whether having a larger share of imported inputs has an effect on seller shortfall amounts. Observations are at the firm-month level. The dependent variable is the inverse hyperbolic sine transformation of the amount of seller shortfall a given firm has for all its transactions in a given month. Seller shortfall amounts are assigned using the estimated firm fixed effects. Firms are classified into Advantageous and Disadvantageous based on the value of $Q(f)$, as explained in Section 4.4. We instrument *ImportShare*—the share of a firm's inputs which are imported—using a set of interactions between firm-level baseline import shares and real exchange rate at the country of origin-month level, for Uganda's top 10 trading partners, as described in Appendix Section A.4. First stage results are reported in Table A.10 in the Appendix. In all columns, we include dummies that control for the deciles of firm sales and inputs. Standard errors, clustered at the firm level, are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.