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# Assessing the impact of an intervention to withhold value-added tax in Zambia

Kwabena Adu-Ababio,[1] Aliisa Koivisto,[2] Andreya Kumwenda,[3] Gregory Chileshe,[3] John Mulenga,[3] Mutemwa Mebelo,[3] Ian Mufana,[3] and Yenda Shamabobo[3]

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**Abstract:** Improving tax collection is essential if developing economies are to avoid over-reliance on external donor funds and loans. Revenue authorities in the Global South have recently adopted new policy tools to improve domestic revenue mobilization through taxes. One such new policy is a withholding system for value-added tax (VAT). In this study, we investigate the impact of adopting a system for withholding value-added tax on VAT collection in Zambia. While similar systems are in place in many countries, empirical research into their impact is still limited and inconclusive. Using a difference-in differences approach, we estimate the impact of introducing such a system in Zambia on the value added, sales, purchases, and output VAT of affected firms. We observe significant positive impacts after the reform on those indicators that the withholding agent reports and on remits to the tax authority. We find that the reform improves compliance with the introduction of a change in the tax remitting liability in the transaction chain.

**Key words:** withholding VAT, tax compliance, tax administration, Africa

**JEL classification:** H25, H26, H32, H71

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[1] University of Helsinki and UNU-WIDER, Helsinki, Finland; corresponding author: kwabena@wider.unu.edu; [2] VATT Institute for Economic Research, Helsinki; [3] Zambian Revenue Authority, Lusaka, Zambia.

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

# 1 Introduction

Withholding is an approach to improving tax compliance which is based on research findings that tax evasion is low for third-party reported income (Kleven et al. 2011; Smith and Keen 2010). Withholding means that a tax revenue, or a share of it, is remitted to a tax authority directly by a third party. This third party can be, for example, a buyer remitting turnover tax on behalf of a supplier or seller (Garriga and Tortarolo 2019). Several developing countries, including Zambia, Ethiopia, Uganda, and Tanzania, have extended this approach to value-added tax (VAT) to promote revenue mobilization. Assigning the remitting liability to more-established and larger actors in the production chain also addresses the challenge of raising VAT created by the informality and poor bookkeeping of many firms in developing countries. The change in assignment does not negate the deterrence mechanisms within VAT but renders it more effective by reducing certain lapses due to, for example, broad informality and misreporting (Slemrod and Velayudhan 2022). For example, in Uganda about 73 per cent of firms misreport their VAT returns, as pointed out by Almunia et al. (2021).

The Zambian Revenue Authority (ZRA) launched a withholding VAT (WVAT) reform in 2017 to curb the problem of high levels of VAT non-compliance. The ZRA was challenged by the inability to trace back the transactions of claimed input VAT (refund VAT) filed by buyers due to the size or formality of suppliers. Therefore, it assigned relatively compliant buyers to capture output VAT from all of their suppliers to partially address this existing evasion. WVAT is simply a means of collecting VAT via third parties (the buyers). VAT is withheld by appointed agents called WVAT agents. The appointed agent is required to withhold VAT on all supplies made to the agent by registered suppliers for each tax period and remit the tax withheld to the ZRA. The suppliers whose output VAT has been withheld by the appointed agent are required to complete and file their VAT returns in the normal way, declaring supplies both to appointed WVAT agents and to non-WVAT agents. The mechanism is comparable to the reverse charging of VAT in use in countries such as the UK, Sweden, and Finland, where the purchaser pays the VAT charge on particular business-to-business transactions, such as subcontractor work in the construction industry or trading of emission allowances (Newman et al. 2018). The Zambia case differs in that the duty of withholding is assigned to specific firms rather than to any firm purchasing the affected products or services.

In this paper, we analyse the impact of the withholding structure set up to collect monthly VAT in Zambia using the full population of the country's registered taxpayers. After the introduction of the system, dedicated large VAT-registered buyers such as government agencies and large firms in, for example, the mining and manufacturing industries act as appointed agents. These WVAT agents withhold the full VAT on all of their purchases from VAT registered firms and remit it to the state agency responsible for revenue collection. We employ rich administrative tax data for the fiscal years 2014 to 2020 to assess the impact on firm reporting decisions and tax revenue of the reform introducing WVAT agents. We estimate the impact on the reporting of supplier firms on sales, purchases, and value added of being exposed to a WVAT agent.[1] We apply the difference-in-differences method and use the variation in exposure across firms to the reform to categorize them into treatment and control groups. This enables us to analyse firm reporting behaviour when the remitting responsibility changes. By focusing on firms in the tax return data, we capture the intensive margin impact on firm-level reporting as implied by our method. Furthermore, we estimate the impact of the frequency of reporting, as irregular reporting is prevalent in Zambia.

[1] 'Value added' refers to sales minus cost of purchased inputs, i.e. the base for value-added tax.

The use of the difference-in-differences approach enables us to isolate the effects of the WVAT intervention from existing interventions, such as the introduction of electronic fiscal devices (EFDs) and a tax amnesty programme, that affect both groups equally.

The study focuses on firms not operating as withholding agents themselves. Such firms are often smaller and are therefore less commonly audited than the firms chosen to operate as withholding agents, and they may therefore have greater incentives to misreport. Yet under-reporting of VAT can also follow from poor bookkeeping. While in our study we focus on firms not operating as agents themselves, the impact on reporting of the WVAT reform should not be limited only to those firms, as those acting as withholding agents can also have their VAT withheld by other firms. In our sensitivity checks, we inquire as to whether the impact on selected outcomes changes when in addition to the standard treatment sample of firms that supply solely to withholding agents, we include supplier firms that also act as withholding agents. Furthermore, when considering the full impact of the WVAT system, the additional costs borne by the agents should also be taken into account.

We assign the VAT-filing firms into treatment and control groups based on post-reform sales to firms or public agencies that act as WVAT agents. We begin with graphical evidence to test the parallel trend assumption that firms in the different groups developed similarly before the withholding reform. The evidence shows that, ex ante, development in the treatment and control firms was similar in terms of the selected outcome variables of reported value added, sales, purchases, and output VAT. We use a difference-in-differences framework to estimate the impact on value added, sales, purchases, and output VAT. We focus on these variables because they determine the tax liability and revenue impact, but also because they can be directly manipulated by the supplier if unchecked. Impact estimates show noticeable increase in reported sales and value added among firms who had their VAT declarations withheld, compared with firms without withholding agents. We interpret that this increase is attributable to firms with sales withheld increasing truthful reporting. We estimate that the sales, value added, and output VAT of the treated firms increase on average by 10 per cent post reform. In addition, the reform increases the frequency of VAT reporting for irregular tax-filers. Based on the firm-level effect, our estimate of the aggregate revenue impact is at least a 13 per cent increase in total VAT revenue annually, relative to 2016. It is evident from the results obtained that the intervention performed adequately well in increasing VAT revenue.

The literature analysing impacts on tax reforms most often focus on how taxpayers react to changes in specific tax regimes. However, the mediating role of withholding agents acting on behalf of the tax authority has usually been overlooked. Although the introduction of these tax collection intermediaries is gaining ground in most countries, not much is known about the impact of this. Such a withholding setup should not be downplayed, as it plays a significant role in the revenue mobilization process especially in countries with poor synergies between firms and revenue authorities. In less-developed countries where compliance may be very limited, these intermediary setups, such as the VAT withholding system, hold promise for efficient and effective revenue mobilization. In this study context, the frequent contact of the intermediaries (agents) with multiple suppliers will be the ultimate link that promotes information diffusion to tax authorities, as explored by other scholars such as Battaglini et al. (2019), Boning et al. (2018), and Chetty et al. (2013)

Our paper contributes to the literature in several ways. First, and most importantly, we add to the limited literature on the revenue impacts of withholding regimes in developing countries. According to our knowledge, this is one of the first studies to investigate the impacts of a VAT withholding regime where the withholding process is not limited only to state transactions but encompasses all firm-level transactions. Most closely related are Yesegat and Joseph (2017) and

Majoni (2021), who study the withholding of VAT in Ethiopia and Zimbabwe respectively and find a significant relationship between implementing the VAT withholding regime and VAT revenue. As well as focusing on a different country context, these studies also differ significantly from what we do methodologically. We differ from the qualitative study by Yesegat and Joseph (2017) with an analysis of firm transactions unlimited to payment and acquisitions by public entities through employing quantitative methodologies. We differ from Majoni (2021) through examining a longer pre- and post time horizon, and this potentially accounts for the firm and time fixed effects. Garriga and Tortarolo (2019) study the revenue impacts of a withholding regime for a turnover tax in Argentina (Buenos Aires). While the few existing studies on withholding regimes concentrate on local regions, districts, or municipalities, this study takes a nationwide perspective on the revenue impacts of a withholding reform. Second, we also add to the increasing literature which investigates tax compliance using administrative data in developing countries. Studies by Almunia et al. (2021) in Uganda, Mascagni et al. (2019) in Rwanda, and Jouste, Barugahara, et al. (2021) and Jouste et al. (2021) in Uganda all contribute to the knowledge on the internal and external discrepancies in administrative tax data in these respective countries based on an intervention, as this study does. Third, our study broadens the understanding of how VAT compliance can be enforced in less-formalized public systems and ascertains whether VAT withholding systems have the potential to increase tax output and the number of taxpayers. In line with this, we extend the knowledge on formalization interventions in developing countries as by Floridi et al. (2020) do for Latin America and South-East Asia and Lediga et al. (2020) do for Africa. This is important because developing countries are realizing that the assumed deterrence ensured by conflicting incentives involving suppliers (charging VAT inclusive price) and buyers (claiming input VAT refund) might not go far enough in their jurisdictions, and that there is need to enhance compliance by introducing certain additional mechanisms, of which the withholding regime forms an integral part. Lastly, we contribute to the large literature examining tax compliance and enforcement, from the Allingham and Sandmo (1972) concept, where the probability of being detected and punished drives the evasion incentives of taxpayers, to more recent refinements where additional transactional information from third parties boosts tax collection (see, e.g., Kleven et al. 2011; Kleven et al. 2016; Pomeranz 2015). Withholding reforms can generate such third-party information and are gaining ground in this strand of literature on developing countries (see Brockmeyer and Hernandez 2016; Carrillo and Shahe Emran 2018; Waseem 2019).

The rest of the paper is structured as follows. The mechanisms of the withholding intervention and the institution implementing it, the ZRA, are discussed in Section 2. The section also discusses the progression of VAT as this source of revenue is key in terms of the withholding intervention. The main theoretical and empirical concepts used to estimate the impacts of the intervention are discussed in Section 3. The section furthermore discusses the data used in the study as well as our outcome variables. Section 4 first presents summary statistics before showing the results on the impact estimates on the key variables. The section also conducts sensitivity checks on the impact estimates to test their stability in the face of data limitation or complexity. Conclusions and policy recommendations follow in Section 5.

## 2 Institutional context

In this section, we discuss the main attributes of the WVAT mechanism that the ZRA introduced to maximize its revenue generation power. First, we introduce the VAT scheme in Zambia.

VAT was first introduced in Zambia in July 1995 at a rate of 17.5 per cent, before which the country had implemented a sales tax regime (Parliament of Zambia 2016). The rate increased to 20 per cent in 1997, but it reverted to 17.5 per cent in 2007 due to public agitation. Since 2008 the

ZRA has collected VAT at a rate of 16 per cent. The regime has evolved to incorporate the three categories of VAT, standard-rated supplies, zero-rated supplies, and exempt supplies. Tax legislation dictates that a supplier must register for VAT if the value of their taxable supplies in business exceeds or is likely to exceed the statutory threshold of 800,000 kwacha (K; around US$50,000) in any 12 consecutive months or K200,000 (around $13,000) in any consecutive three months. Furthermore, a taxable supplier with annual turnover of less than the statutory registration threshold has the option to register voluntarily.

The VAT system in Zambia is applicable to all businesses in the production chain (i.e., from manufacture through to retail). A registered business charges and collects VAT on its supply of goods and services to customers. The VAT so charged is called output tax. On the other hand, registered businesses reclaim the VAT that they pay on purchases of taxable goods and services for their businesses. The tax so reclaimed is referred to as input tax. The net of output and input tax is paid to ZRA or refunded to the taxpayer. Therefore, a business dealing in taxable supplies can claim back the input tax, while a business dealing in exempt supplies will not be required to register for VAT and therefore cannot claim the input tax because it is attributable to exempt supplies. Firms dealing with exempt supplies may claim refunds only in instances where they produce additional taxable supplies.

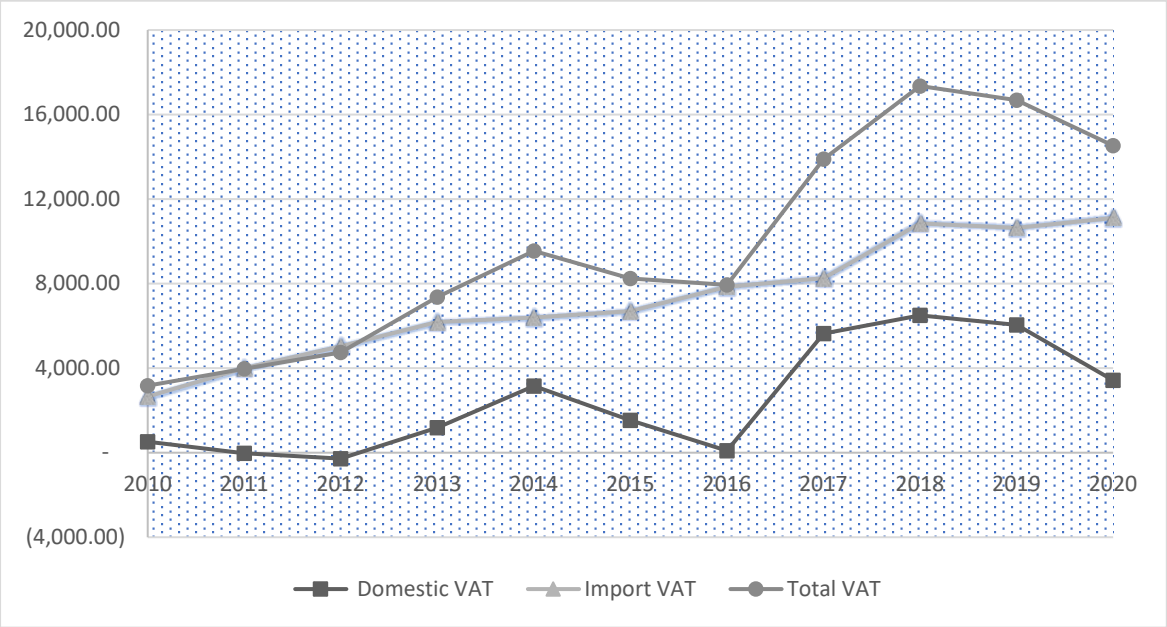
Figure 1 plots the development of VAT revenue in Zambia from 2010 to 2020. The total VAT revenue collected comprises import VAT and domestic VAT. The tax revenue collections from VAT have increased steadily over the years, with a sharp increase in 2017. One potential factor in the sudden increase is clearly the introduction of the WVAT scheme. However, Zambia also implemented other enforcement policies at around the same time. Our study aims to identify the causal impact of the withholding system on revenue using the difference-in-differences method, which controls for other coinciding events in the economy. On average, from 2016 to 2020 VAT revenue contributed about 31 per cent of total tax revenue collected. In 2016 and 2020, VAT recorded deficits against yearly parliamentary targets of 39 per cent and 51 per cent respectively. In Figure 2, we show how the share of VAT has evolved over time. Table 1 displays the share of VAT collections out of tax revenue over 2014 to 2021.

Table 1: Share of VAT collection out of tax revenue, 2014–21

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| Tax revenue (amount in million K) | 27,604.2 | 29,927.8 | 31,191.8 | 38,899.3 | 48,176.7 | 52,681.4 | 57,665.1 | 72,295.6 |
| Total VAT (amount in million K) | 9,553.7 | 8,236.7 | 7,957.0 | 13,887.4 | 17,351.6 | 16,684.4 | 14,531.6 | 18,955.9 |
| VAT % of tax revenue | 34.6% | 27.5% | 25.5% | 35.7% | 36.0% | 31.7% | 25.2% | 26.2% |

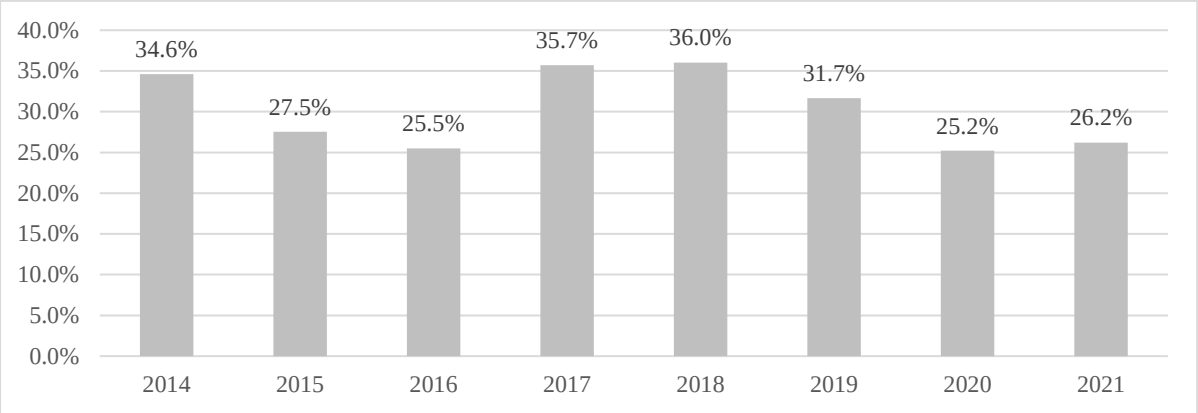
Source: authors' construction based on ZRA tax registry data.

Figure 1: VAT revenue performance in Zambia, 2010–20 (in million K)




Source: authors' illustration based on ZRA tax registry data.

Figure 2: Percentage of VAT to total revenue collection, 2014–21




Source: authors' illustration based on ZRA tax registry data.

The WVAT mechanism was introduced in Zambia on 1 January 2017 to increase the likelihood of timely and correct remittance of VAT by suppliers. The law empowers the ZRA to appoint a government agency or a firm as a tax agent to withhold VAT on payments made to a taxable supplier of goods and services. WVAT agents consist of large firms and public sector entities. The basis of this appointment is the number of transactions that the firms/government entities engage in. WVAT agents are required to withhold 100 per cent of the VAT payable on their purchases and remit it directly to the ZRA. Before introducing the WVAT mechanism, it was observed that a sizeable amount of charged output VAT per year was remitted late, partially remitted, or not remitted at all (ZRA 2022). The initiative was introduced to increase the ease with which VAT is declared and paid, thereby helping to make organizations more compliant.

The key implementer, the WVAT agent, performs the function of remitting VAT on behalf of the supplier by paying the taxes as soon as the businesses invoice for services and goods is received. The agent makes declarations (returns) on the invoices on which VAT was withheld and makes full payment on or by the 16th day of the month following the end of the tax period. In addition,

the agent generates the online WVAT certificate that the supplier refers to in its declaration. The supplier needs to be VAT registered with up-to-date contact details on the relevant online platform. The supplier allocates the generated certificates to the return to enable them to claim successfully. Suppliers need to submit their VAT returns on or by the 18th day following the end of a tax period, referring to the respective tax credit certificates that support the withheld VAT, and declare all sales in the respective VAT schedules even if the agent has not paid the withheld VAT. The withholding of tax is accounted by suppliers using the WVAT Schedule to capture details of withheld VAT certificates issued to them for each invoice where VAT was withheld.

# 3 Methodology

In this section we discuss the methodological concepts employed in our study. First, we explain how the existence of a withholding structure may contribute to tax compliance. We relate this to scenarios applicable to the Zambian tax system and justify the reasons behind such a structure. Next, we discuss how the study is conducted based on the selection criteria into treatment and control cohorts, as well as the estimation techniques that reveal the inferential differences before and after the intervention.

In our study, firms fall into three alternative groups. First are the supplier firms selling to withholding agents, i.e. our treatment group. The second group is supplier firms not selling to withholding agents, i.e. our control group. The third group consists of withholding agents. Although the main group of interest in this study is the supplier firms selling to withholding agents, withholding agents may also sell to other agents and thus have their VAT withheld by them. In our standard methodology and analysis, we exclude withholding agents from the treatment sample of supplier firms. The reason for this is that in addition to withholding of VAT by other agents, the reform may have influenced the VAT reporting of the agents in other ways. For example, the reform removed the incentives of an agent to misreport purchases. Furthermore, the increased liability in remitting VAT may have increased the perceived threat of audit for the agent. However, in our sensitivity analysis in Section 4.4, we analyse the reform's impact on selected outcomes by including supplier firms who double as withholding agents in the treatment group.

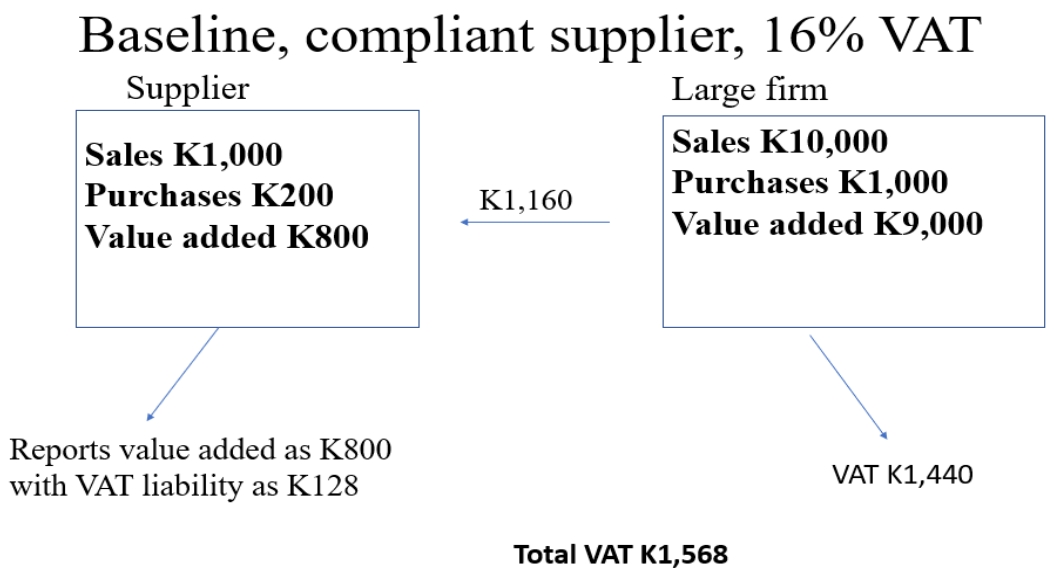
## 3.1 Conceptual framework

Before we analyse the impact of the reform, we explain the rationale behind its ability to induce reporting with the potential for revenue increase. We describe the different scenarios and link them to the relation between declared tax liability and third-party withholdings, whose impact we will be analysing throughout the paper.

Consider the baseline situation where a large firm that sells goods worth $S = K10{,}000\ (+\ VAT\ 1{,}600)$ to final consumers and buys products from a small supplier with $K1{,}000\ (+VAT\ K160)$. Thus the value added of the large firm is $V_l = K9{,}000$. Assume monthly sales for the small firm $C = K1{,}000$ (excluding VAT), obtained only from purchases by the large firm. The supplier also spends on VAT-deductible inputs worth K200, hence its value added $V_s = K800$. Firms pay monthly VAT, $T$, based on value added such that at the beginning of the next month, they submit a tax declaration for the previous period on which they are charged a VAT rate of $\tau = 16\ per\ cent$. Hence, total VAT liability for the large firm will be output VAT minus input VAT, $K1{,}600 - K160 = K1440$, which can also be calculated as $\tau V_l = 0.16 \times 9{,}000 = K1{,}440$, while the tax of the small firm will be $\tau V_s = 0.16 \times 800 = K128$. Assuming that firms

report their value added truthfully, total VAT will be $T = \tau V_l + \tau V_s = K1{,}568$. This is shown in Figure 3 with emphasis on a compliant supplier.

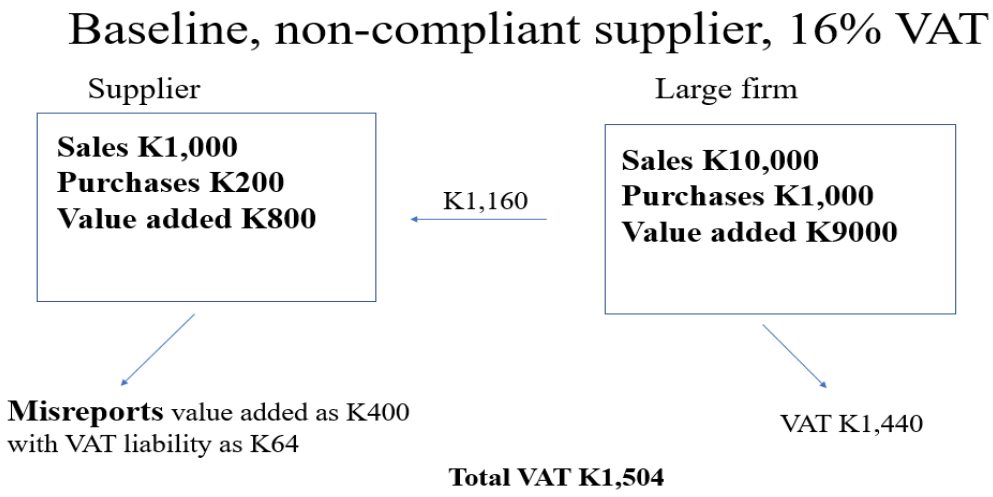
Figure 3: VAT reporting without withholding for an honest supplier




Source: authors' own concept and illustration, 2022.

In an alternative situation, where the smaller firm, due to poor bookkeeping or greater evasion (by either exaggerating purchases or downplaying sales), misreports its value added such that now $V_s = K400$ even though it actually makes the same sales of $K1{,}000$ to the large firm with purchases worth K200. The large firm is assumed to keep proper records and continues to report truthfully due to fear of an audit. Therefore, the total VAT due to misreporting is $T = K1{,}504$.[2] This situation is shown in Figure 4 with emphasis on a non-compliant supplier.

Figure 4: VAT reporting without withholding for a non-compliant supplier




Source: authors' own concept and illustration, 2022.

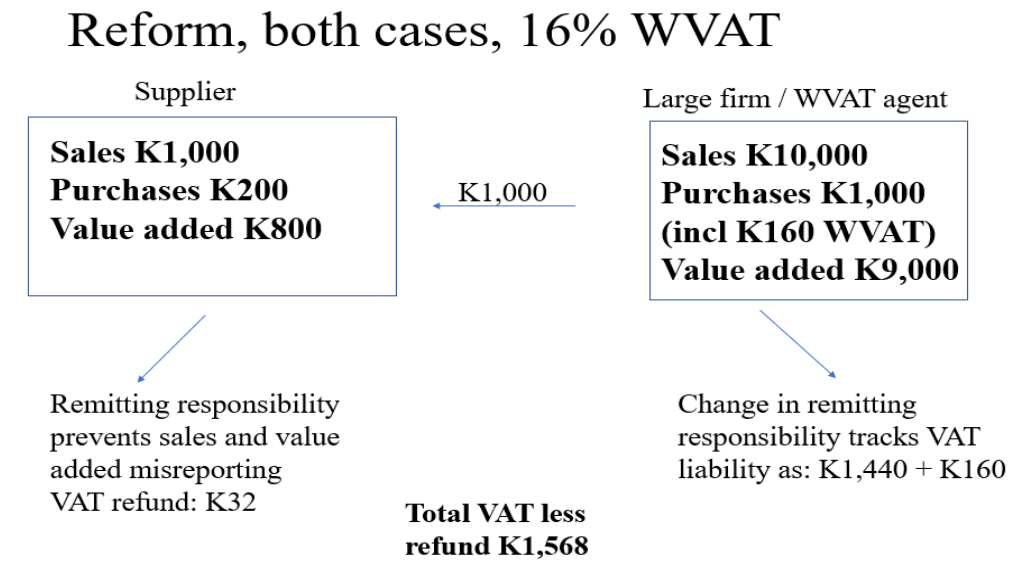
[2] $K1{,}440 + K64 = K1{,}504$.

In principle, the VAT system without the withholding mechanism already has built-in enforcement mechanisms, e.g. enabling the cross-checking of invoices in audits using the paper trail created. Yet, audits are laborious to conduct, and tax authorities may not have the capacity to do this monitoring in practice.

Now assume that the tax authority tries to solve this discrepancy by determining that these large operators in the economy must withhold VAT on their purchases. The withholding agent is legally obliged to participate in the tax collection process by withholding the VAT and remitting it directly to the tax authority.

In the Zambian case, the withholding agent holds the whole VAT amount. So now, assume the withholding $\omega = \tau = 16\ per\ cent$, such that the agent firm now pays only the price without VAT, i.e. K1,000, when it earlier paid the tax-including price of K1,160. Again, the supplier has a VAT refund of $\tau V_s - W = -K32$ to claim. Then the supplier firm needs to file a VAT return to claim the refund. Thus, the tax authority recoups its whole VAT amount of $T = K160$ (see Figure 5).

Figure 5: VAT reporting with withholding for a supplier




Source: authors' own concept and illustration, 2022.

Post reform, tax revenues can increase in the sense that although the supplier can always decide to under-report its value added to tax authorities, the VAT on sales to the agent has been reported and remitted by the agent. WVAT agents are obliged to withhold and pay the VAT on any purchases from other firms. Informal or smaller firms that would usually escape the tax net can now be captured, as their VAT is remitted even if they do not formally file their taxes. Moreover, they have incentives to file their taxes at least when they have VAT refunds to claim. This would then increase the number of compliant taxpayers because of the enforcement mechanism in the transactions with a withholding agent.

### 3.2 Empirical strategy

We conduct a difference-in-differences (DiD) analysis using VAT return data to estimate the impact of the withholding reform on reported value added and total amount of VAT revenue collected. The goal is to measure the extent to which the withholding reform raises the VAT revenue of firms impacted by the reform and induces reporting among firms. The treatment group is suppliers that sell to a firm appointed as a WVAT agent and that thus have part of their VAT revenue withheld after the reform; the control group is constructed from similar firms who do not sell to withholding agents and hence do not have VAT withheld. Based on their parallel pre-trends, the control group here is comparable so that without the reform, these firms should have evolved similarly in terms of the selected outcomes.

We assign treatment status (i.e., with or without a withholding agent) using a simple selection rule: firms selling to withholding agents are considered treated firms while firms without sales to WVAT agents and at the same time not acting as agents themselves form the control group.[3] As firms with and without agents follow similar trends in the key parameters, we do not perform additional matching algorithms, so all filing firms are included in the study. As explained earlier, to ensure clear interpretation of the results, firms acting as both WVAT agents and suppliers are left out of the main analysis as their behaviour might be ambiguous.

We can estimate the impact of the reform in two ways using DiD—either basic:

$$Y_{it} = \beta_0 + \beta_1 T_t + \beta_2 D_i + \beta_3 D_i T_t + \beta_4 X_{it} + \varepsilon_{it} \quad (1)$$

or with firm and year fixed effects:

$$Y_{it} = \beta_0 + \beta_3 D_i T_t + \beta_4 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where $\log Y_{i,t}$ is the outcome variable (reported value added/total output VAT, sales, purchases) for each firm pre- and post reform, $T_t$ is a binary variable that takes the value 0 pre-reform and 1 post reform, and $D_i$ is an indicator variable taking the value 1 if the firm has sales to a withholding agent (treated) and 0 otherwise (control). $D_i T_t$ is the interaction term denoting the withholding intervention for the treated group after the reform. Thus, $\beta_3$ captures the potential effect of the reform. $X_{it}$ is a vector of covariates that may influence our variables of interest, $\alpha_i$ and $\gamma_t$ denote firm and year fixed effects respectively, and $\varepsilon_{it}$ is the error term. The above model is used to account for differences in outcomes between taxpayers with and without withholding agents, the pre- and post-reform situations. This is done by adjusting for pre-reform differences and comparing these differences over time while controlling for time-confounding effects.

The above strategy can be generalized into an event study where we denote $\delta_m$ as the coefficients of the differences in the evolution. These coefficients examine the difference in the evolution of the treatment and control group of Zambian firms and thus capture the potential impact of the withholding regime. We use a regression framework and estimate the following equation using data from three years before and four years after the introduction of the withholding regime.

[3] To avoid a post-reform assignment, a selection assigning firms to the treatment and control groups based on pre-reform sales would be ideal. However, we are unable to do this as firms report transaction-level information with withholding agents only after the adoption of the system.

$$y_{it} = \alpha_0 + \sum_{m=-3}^{m=4} \lambda_m I(t = k + m) + \sum_{m=-3}^{m=4} \delta_m (I(t = k + m) * D_i) + \alpha_i + \varepsilon_{it} \quad (3)$$

where $I(t = k + m)$ is an indicator for the observation year $m$ before or after the intervention year $k$ (with negative numbers denoting years before the introduction of the withholding regime). In the equation, $\lambda_m$ captures the common trend component of firms with and without withholding agents relative to the withholding regime. The coefficients $\delta_m$ denotes the differences in the outcomes of interest $y_{it}$ for firms with and without agents at year $m$ after the introduction of the withholding regime while $D_i$ is an indicator variable for a firm with or without a withholding agent.

In a DiD study, the parallel trend assumption is key for identification. The assumption means that in the absence of the reform, the outcomes of the groups would have evolved similarly. The trends can be investigated by plotting the event study coefficients as a graph over the study period. This enables us to test and investigate the common trend. If the groups follow each other closely for the period before the reform, this gives support for the research setting.

### 3.3 Data and predictions

We combine two sets of data in our analysis: monthly VAT returns on all Zambian firms for 2014 to 2020 and annual firm-level VAT withholding data, including invoiced amounts on goods supplied in the reform period, 2018–20. VAT return data include information on firms' output and characteristics. The source of both datasets is the ZRA. The combined data constitute a unique dataset of the full population of VAT returns, providing a unique opportunity to study firms before and after the introduction of the withholding regime. The data include 53,482 VAT filings and withholdings for 13,692 unique firms; 4,559 firms have had their VAT withheld at least once within the reform period and 9,133 have never had their VAT withheld but filed taxes for the authority. We follow firms' reported sales, purchases, value added, and tax liability over time, concentrating on these parameters because VAT liability is based on their reporting, yet they may be misreported. Most essentially, we can examine how firms adjust their reporting of value added (compared with a clearly defined control group) around the introduction of the reform and in the subsequent years. In our main analysis, we adjust for inflation by using values deflated to the price level of 2020.

If firms already reported correctly (i.e., did not evade taxes or misreport), the withholding regime should not have a systematic effect on reported value added and VAT. However, if firms tended to misreport, we would expect to see changes in reporting behaviour after the reform. The change in VAT filing due to the reform should reveal closer-to-true values for value added and total VAT.

The predictions of the intervention impact on these variables are as follows. We expect the reported sales of exposed or treated supplier firms to increase post reform because the withholding agent reports the cost of the goods procured while remitting the full VAT from the supplying firm, compared with the pre-reform situation, where the supplier reported their sales and was not necessarily reporting truthfully. However, we expect purchases to be ambiguous, as this reporting remains the supplier's prerogative and may be prone to misreporting. One hypothesis assumes that nothing happens to purchases. Another hypothesis assumes that, on one hand, if suppliers try to avoid increasing VAT due to higher sales, they may start to exaggerate their purchases, while on another hand, they may start reporting their purchases accurately to claim back refunds. Hence, ex ante, it is not clear what will happen to purchases. If the reform has a larger positive impact on truthful reporting of output VAT than the size of its negative impact on reporting of input VAT, supplier firms' value added will increase post reform. If value added and sales of treated firms increase, output VAT will increase post reform. This stems from the increases in value added as recorded by the suppliers and captured in sales by the withholding agents.

# 4 Results

In this section, we discuss the main results of the study. We first outline the treatment and control group, discussing the distribution of specific variables across the groups. We discuss the parallel trend assumption, showing how the groups performed before the withholding intervention in terms of specific variables. Then we discuss the visual evidence and the standard results of our DiD estimations, which informs us on the impacts of the withholding regime. We also disaggregate the results into location and industry impacts to see how different groups respond to the tax reform. Finally, we relax some assumptions and test the sensitivity and robustness of our standard results in a series of checks.

## 4.1 Descriptive statistics

Table 2 shows the number of observations in our data divided by treatment status. The number of returns filed increased significantly in 2017 and 2018 following the implementation of the WVAT mechanism in 2017; this increase is also observed in the control group. Other factors that may have contributed to the jump in the number of returns filed include the implementation of a tax amnesty programme[4] in 2017 and 2018 and of electronic fiscal devices (EFDs) in 2018. The DiD method enables us to isolate the impact of the WVAT from that of these other factors, as the other interventions affect our treatment and control firms equally. Hence, we do not consider these other programmes as a threat to our identification.

Table 2: Count of returns by treatment status and year

| Return year | Treatment status | | | | | |
|---|---|---|---|---|---|---|
| | Control | | Treated | | Total | |
| | Count of returns | Annual % change | Count of returns | Annual % change | Count of returns | Annual % change |
| 2014 | 3,669 | | 2,028 | | 5,697 | |
| 2015 | 3,973 | 8.3 | 2,311 | 14.0 | 6,284 | 10.3 |
| 2016 | 4,264 | 7.3 | 2,653 | 14.8 | 6,917 | 10.1 |
| 2017 | 4,776 | 12.0 | 3,161 | 19.1 | 7,937 | 14.7 |
| 2018 | 4,900 | 2.6 | 3,937 | 24.5 | 8,837 | 11.3 |
| 2019 | 4,931 | 0.6 | 3,908 | −0.7 | 8,839 | 0.0 |
| 2020 | 4,854 | −1.6 | 3,910 | 0.1 | 8,764 | −0.8 |
| Total | 31,367 | | 21,908 | | 53,275 | |

Note: return values are based on study data and may deviate from official values.

Source: authors' calculations based on ZRA administrative data, 2022.

Table 3 tabulates our data by region and treatment status. Many of the VAT-registered taxpayers are in the Lusaka and Copperbelt provinces; as a result, the two regions recorded the highest number of returns filed in the study period. The Central and Southern provinces are the other

[4] The tax amnesty intervention ensured that all taxpayers with outstanding tax returns paid all principal tax liabilities for tax periods prior to 1 March 2017, after which all interest and penalties accrued for the said period would be waived in full. Within this amnesty window, all outstanding liabilities had to be settled.

provinces where VAT-registered taxpayers are in relatively high concentration. The other provinces have relatively lower levels of economic activity, hence the number of both taxpayers and VAT returns filed during the period were comparatively lower (see Table 2).

Table 3: Treatment status by province

| Province | Control | % | Treated | % | Total |
|---|---|---|---|---|---|
| Central | 1,367 | 4.36 | 250 | 1.23 | 1,617 |
| Copperbelt | 6,157 | 19.65 | 7,678 | 37.78 | 13,835 |
| Eastern | 616 | 1.97 | 204 | 1.00 | 820 |
| Luapula | 115 | 0.37 | 29 | 0.14 | 144 |
| Lusaka | 20,850 | 66.54 | 10,973 | 54.00 | 31,823 |
| Muchinga | 44 | 0.14 | 30 | 0.15 | 74 |
| Northwestern | 254 | 0.81 | 472 | 2.32 | 726 |
| Northern | 86 | 0.27 | 59 | 0.29 | 145 |
| Southern | 1,628 | 5.20 | 524 | 2.58 | 2,152 |
| Western | 218 | 0.70 | 103 | 0.51 | 321 |
| Total | 31,335 | 100 | 20,322 | 100 | 51,657 |

Source: authors' calculations based on ZRA administrative data, 2022.

Table 4 describes how different industries are represented in VAT data and across treatment status. The wholesale and retail trade sector recorded the highest number of returns filed, followed by the manufacturing and the construction industries. This is consistent with the taxpayer register, which indicates that most registered businesses in Zambia are wholesale and retail trade in nature.

Table 4: Treatment status by sector

| Sector | Control | % | Treated | % | Total |
|---|---|---|---|---|---|
| Accommodation and food service activities | 1,060 | 3.38 | 638 | 3.14 | 1,698 |
| Activities of extraterritorial organizations and bodies | 17 | 0.05 | - | 0.00 | 17 |
| Activities of households | 6 | 0.02 | - | 0.00 | 6 |
| Administrative and support service | 1,437 | 4.58 | 1,032 | 5.07 | 2,469 |
| Agriculture, forestry, and fishing | 2,074 | 6.62 | 370 | 1.82 | 2,444 |
| Arts, entertainment, and recreation | 312 | 1.00 | 48 | 0.24 | 360 |
| Construction | 2,678 | 8.54 | 1,449 | 7.12 | 4,127 |
| Education | 53 | 0.17 | 21 | 0.10 | 74 |
| Electricity, gas, steam, and air conditioning | 153 | 0.49 | 79 | 0.39 | 232 |
| Financial and insurance activities | 369 | 1.18 | 93 | 0.46 | 462 |
| Human health and social work activity | 121 | 0.39 | 22 | 0.11 | 143 |
| Information and communication | 330 | 1.05 | 341 | 1.68 | 671 |
| Manufacturing | 3,019 | 9.63 | 1,933 | 9.50 | 4,952 |
| Mining and quarrying | 720 | 2.30 | 524 | 2.58 | 1,244 |
| Other service activities | 2,379 | 7.59 | 1,159 | 5.70 | 3,538 |
| Professional, scientific, and tech activities | 1,499 | 4.78 | 1,700 | 8.36 | 3,199 |
| Public administration and defence; social sector | 13 | 0.04 | 14 | 0.07 | 27 |

| | | | | | |
|---|---|---|---|---|---|
| Real estate activities | 703 | 2.24 | 163 | 0.80 | 866 |
| Transportation and storage | 1,469 | 4.69 | 946 | 4.65 | 2,415 |
| Water supply; sewerage, waste | 98 | 0.31 | 74 | 0.36 | 172 |
| Wholesale and retail trade; repair | 12,833 | 40.94 | 9,738 | 47.87 | 22,571 |
| Total | 31,343 | 100 | 20,344 | 100 | 51,687 |

Source: authors' calculations based on ZRA administrative data, 2022.

Table 5 provides the summary statistics for the key variables in the treatment and control group. Generally, the mean values for the treated sample are observed to be larger than the means for the control group. This is expected, as firms/taxpayers making more transactions and thus having higher output are also more likely to interact with withholding agents. They may also be reporting more sales due to the treatment in contrast to the control group. The DiD method controls for the difference in levels between the groups.

Table 5: Key variables by treatment status

| | Treated | | Control | |
|---|---|---|---|---|
| | Mean | Std dev. | Mean | Std dev. |
| Total sales | 31,827,692.56 | 284,446,094.70 | 11,859,863.71 | 108,477,455.40 |
| Total purchases | 18,094,777.64 | 140,511,174.30 | 7,979,571.63 | 81,646,873.02 |
| Value added | 21,985,457.53 | 131,699,515.10 | 6,882,790.86 | 78,469,848.23 |
| Standard-rated output VAT | 3,517,673.20 | 21,071,922.24 | 1,101,246.54 | 12,555,175.67 |
| Total output VAT | 3,561,750.80 | 21,191,420.08 | 1,125,407.97 | 12,574,949.02 |
| Total VAT | 538,787.22 | 23,758,505.63 | 70,556.79 | 4,904,181.87 |
| Amount withheld | 1,894,441.33 | 23,842,860.92 | . | . |
| Observations | 21,908 | | 31,367 | |

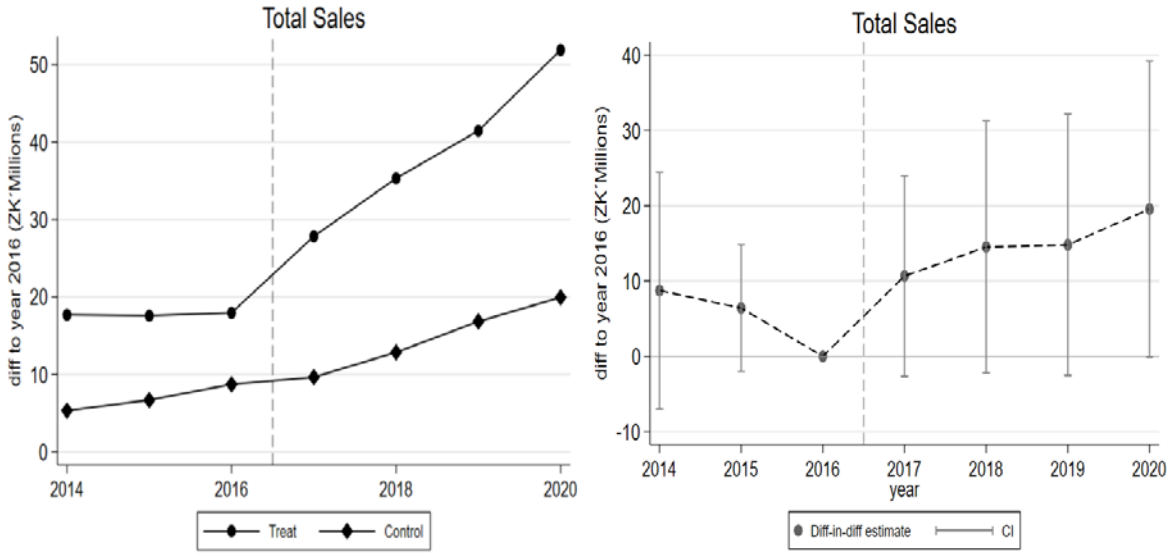
Note: values in nominal terms; total sales included both taxable and exempt sales; total purchases includes spending on bought inputs including taxable and exempt purchases and imports; value added is calculated from VAT liability; standard-rated output VAT is the VAT liability for standard-rated outputs and total output VAT includes reverse VAT for imported services; total VAT refers to net VAT payable after deductions and allowances; amount withheld is the VAT amount withheld.

Source: authors' calculations based on ZRA administrative data, 2022.

### 4.2 Difference-in-differences results

Next, we present figures for the development of the four main variables of interest to demonstrate that our parallel trends assumption holds. The assumption states that if the outcomes for treatment and control cohorts, although different in level prior to the commencement of the intervention, have parallel pre-treatment trends, the post-reform differences in differences can be attributed to the reform. The variables of interest are value added, total sales, total purchases, and total output VAT.

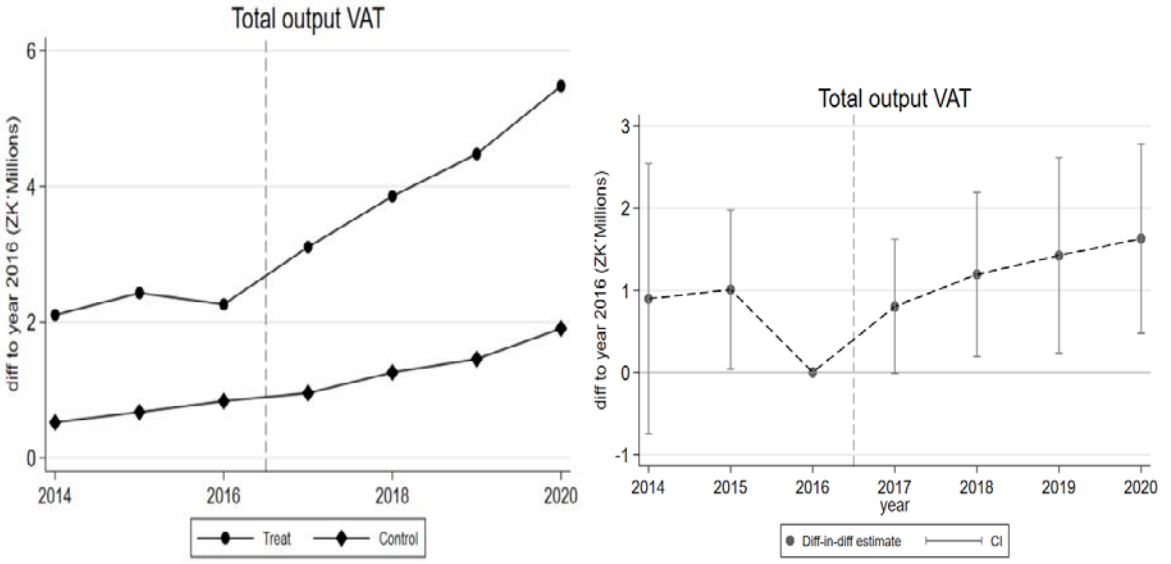
Figure 6: Development of sales of treatment and control groups




Note: left panel shows the evolution of regression coefficients of total sales between treatment and control groups; right panel shows the evolution of the difference between the treated and control groups as estimated with Equation 3; values are inflation adjusted to year 2020.

Source: authors' calculations based on ZRA administrative data, 2022.

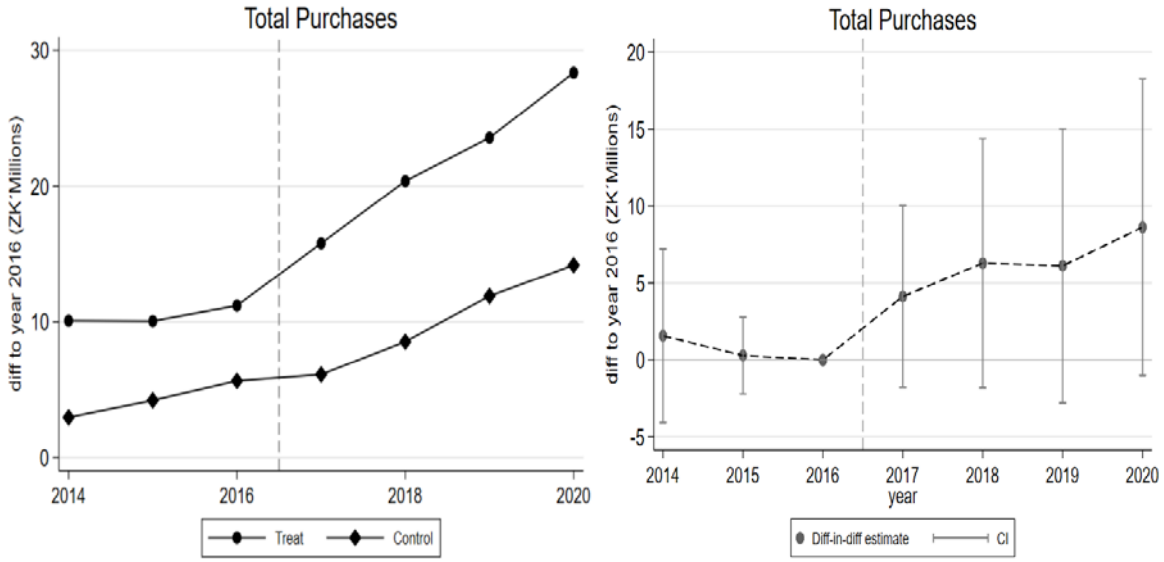
Figure 7: Development of total output VAT of treatment and control groups




Note: left panel plots the evolution of regression coefficients of total output VAT between treatment and control groups; right panel plots the evolution of the difference between the treated and control groups as estimated with Equation 3; values are inflation-adjusted to 2020.

Source: authors' calculations based on ZRA administrative data, 2022.

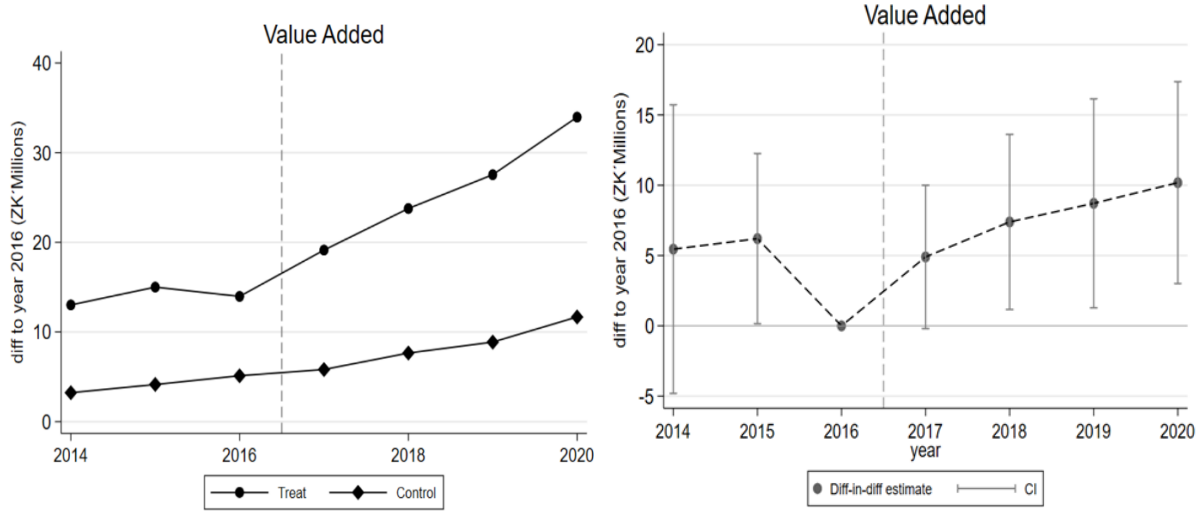
Figure 8: Development of purchases of treatment and control groups




Note: left panel plots the evolution of regression coefficients of total purchases between treatment and control groups; right panel plots the evolution of the difference between the treated and control groups as estimated with Equation 3; values are inflation-adjusted to 2020.

Source: authors' calculations based on ZRA administrative data, 2022.

Figure 9: Development of value added of treatment and control groups




Note: left panel plots the evolution of regression coefficients of total value added between treatment and control groups; right panel plots the evolution of the difference between the treated and control groups as estimated with Equation 3; values are inflation-adjusted to 2020.

Source: authors' calculations based on ZRA administrative data, 2022.

In the left panels of Figures 6–9, we plot the variables of interest for the treatment and control firms to observe their progression before and after the reform. These graphs suggest that the parallel trends hold, as the firm outcomes of both groups developed similarly pre-reform. After the introduction of WVAT, the trends diverge. In the right panels of Figures 6–9, we visualize the development of the difference between groups using event study graphs. We observe strong positive impacts in the variables of interest, especially for total output VAT and value added, right after the introduction of the intervention. For total sales and purchases, the effect of the reform appears clear and shows a clear increase in outcomes immediately after the WVAT reform.

Although both trends increase over the years after the reform, estimates for reported sales seem stronger in later years, especially after 2019, while reported purchases show larger estimates immediately after the reform. For all four outcomes, the effect of the reform seems to get stronger over time, albeit for purchases where the estimates for the first four years are not statistically significant at conventional confidence intervals, pointing towards a trend for bigger point estimates.

The above conclusions suggest a positive impact of the withholding reform. Although the trend graphs reveal the direction after the reform, we use a DID approach with the appropriate controls to calculate the impact estimates. In summary, such estimates inform us on the extent of success of the withholding reform given changes in total sales, total purchases, total value added, and total output VAT at a firm level assuming all other factors remain unchanged. These impact estimates are shown in Tables 6–9.

Table 6: DiD estimation results for WVAT—value added (in million K)

| Variables | (1)<br>valadd | (2)<br>valadd | (3)<br>valadd | (4)<br>valadd |
|---|---|---|---|---|
| treat*after | 4.320**<br>(2.059) | 2.201*<br>(1.280) | 2.112*<br>(1.281) | 2.119*<br>(1.283) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.476***<br>(0.617) | 9.497***<br>(1.336) | 9.445***<br>(1.558) | 9.436***<br>(1.741) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| Overall R-squared | 0.002 | 0.469 | 0.469 | 0.468 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |
| Effect in % relative to mean of valadd before reform | 14.99 | 7.64 | 7.33 | 7.35 |

Note: estimations follow Equations 1 and 2; Columns 1–4 show impact estimates of WVAT in Zambia on value added; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE (fixed effects); in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 7: DiD estimation results for WVAT—sales (in million K)

| Variables | (1)<br>totalsales | (2)<br>totalsales | (3)<br>totalsales | (4)<br>totalsales |
|---|---|---|---|---|
| treat*after | 1.057*<br>(5.994) | 4.538**<br>(1.822) | 4.486**<br>(1.844) | 4.501**<br>(1.848) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 2.090***<br>(1.607) | 4.159<br>(3.877) | 5.201<br>(3.261) | 4.670<br>(3.812) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| Overall R-squared | 0.003 | 0.579 | 0.579 | 0.579 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |
| Effect in % relative to mean of sales before reform | 2.76 | 11.85 | 11.71 | 11.75 |

Note: estimations follow Equations 1 and 2; Columns 1–4 show impact estimates of WVAT in Zambia on sales; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 8: DiD estimation results for WVAT—purchases (in million K)

| Variables | (1)<br>totalpurch | (2)<br>totalpurch | (3)<br>totalpurch | (4)<br>totalpurch |
|---|---|---|---|---|
| treat*after | 4.519<br>(3.599) | −0.056<br>(1.133) | −0.183<br>(1.133) | −0.189<br>(1.135) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.254***<br>(0.983) | 3.271<br>(2.608) | 2.972<br>(2.152) | 2.489<br>(2.134) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| Overall R-squared | 0.002 | 0.579 | 0.579 | 0.579 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |
| Effect in % relative to mean of purchases before reform | 21.54 | −0.27 | −0.87 | −0.90 |

Note: estimations follow Equations 1 and 2; Columns 1–4 show impact estimates of WVAT in Zambia on purchases; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 9: DiD estimation results for WVAT—output VAT (in million K)

| Variables | (1)<br>outvat | (2)<br>outvat | (3)<br>outvat | (4)<br>outvat |
|---|---|---|---|---|
| treat*after | 0.694**<br>(0.330) | 0.356*<br>(0.206) | 0.341*<br>(0.206) | 0.342*<br>(0.206) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 2.393***<br>(0.099) | 1.548***<br>(0.214) | 1.540***<br>(0.254) | 1.538***<br>(0.276) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| Overall R-squared | 0.002 | 0.469 | 0.469 | 0.469 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |
| Effect in % relative to mean of output VAT before reform | 43.94 | 22.54 | 21.59 | 21.66 |

Note: estimations follow Equations 1 and 2; Columns 1–4 show impact estimates of WVAT in Zambia on output VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Tables 6–9 show the estimation results based on Equation 2, with values adjusted for inflation to 2020 prices and clustered at the firm level. We start with the most parsimonious specification in Column 1, adding on return year and firm fixed effects for the total population of taxpaying firms in Columns 2–4. Our preferred estimates control for year and firm effects and are reported in the fourth column. The sample includes filing years 2014–20 and we cluster standard errors at the firm level. As expected, the regression results are reconcilable to the visual evidence: the WVAT reform does indeed have a positive effect on our indicators of interest, as shown by the significant positive impacts on reported value added, sales, and output VAT. The last row in each table reports the impact estimate in percentages in relation to the mean level before the reform.

In our specifications for the total value added indicator (Table 6), we observe a significant DiD estimate, showing that reported value added in the treated group has increased as a response to the intervention. In our basic specification (1) we observe an average 15 per cent increase in value added relative to pre-reform levels. We observe some variation in impact estimates as we supplement the DiD specification; the magnitude of our estimate is K2 million based on the full model (4), implying a 7 per cent increase post reform. We note similar impact estimates for total sales (Table 7) and output VAT (Table 9). In the former there is a 12 per cent significant increase after the reform when including all controls. In the latter, output VAT increases by 22 per cent due to supplier firms remitting VAT to tax authorities indirectly through an agent in the basic setup (Table 6, Column 4).

The impact estimates on total purchases as reported in filings for suppliers are ambiguous. Coefficients show different signs across specifications after the intervention but are never significant. As explained in Section 3.3, positive estimates can point to the exaggeration of purchases, or the system may indirectly induce better bookkeeping to help with claiming input VAT to cover for the withheld VAT, while negative estimates may signal a correction to such ex-

ante exaggeration. Subsequently, as the WVAT reform did not change the process for claiming input VAT, it might induce no response or indirect responses in reporting of purchases.

Estimated firm-level impact of the reform on value added can be derived to a coarse revenue impact estimate with some presumptions. Approximately 3,900 firms in the data are impacted annually; the estimated impact on annual value added is K2.119 million at 2020 price levels. With the VAT rate of 16 per cent, for this group of firms the estimated annual revenue impact is $0.16 \times K2.119\,million \times 3{,}900 = K1{,}322.256\,million$ at 2020 price levels, assuming that all of the reported VAT of treated firms was also remitted to the tax authority. This increase in VAT revenue due to WVAT is 6.9 per cent of total VAT revenue raised in 2018 (K17,351.6 million) and a 13 per cent increase in real VAT revenue annually relative to 2016.[5] These coarse estimates indicate that the withholding system significantly contributed to the strong increase in VAT revenue raised after the introduction of the WVAT system, as seen in Figure 1. Furthermore, as this estimate leaves out withheld VAT from firms that neglected to file VAT entirely as well as increased VAT revenue from withholding agents, these estimates are likely to be lower bounds.

The DiD framework studies firm-level impact of the WVAT regime as shown in Equation 2. The reform may also have an impact on how many VAT-registered taxpayers file VAT. The concept of the intervention, as discussed in Section 2.1, is that there is a greater possibility that a supplier firm which has VAT withheld will seek a refund from the revenue authority. To do this, the firm first needs to file taxes, and irregular VAT filing is very common in Zambia. Table 10 reports the estimated impact on a binary variable of VAT return filing among firms that filed at least once after the reform. The estimate of 0.13 implies that the reform increased the probability of filing VAT for such firms by approximately 13 percentage points. This is likely to be a lower bound, as it leaves out those firms that have never filed, which are likely more prevalent in the control group.

Table 10: DiD estimation results for WVAT—filing VAT return 0/1

| Variables | (1)<br>Filing VAT | (2)<br>Filing VAT | (3)<br>Filing VAT | (4)<br>Filing VAT |
|---|---|---|---|---|
| treat*after | 0.130***<br>(0.007) | 0.130***<br>(0.009) | 0.130***<br>(0.007) | 0.130***<br>(0.009) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 0.599***<br>(0.004) | 0.560***<br>(0.003) | 0.506***<br>(0.006) | 0.467***<br>(0.004) |
| Observations | 64,848 | 64,848 | 64,848 | 64,848 |
| Overall R-squared | 0.075 | 0.068 | 0.094 | 0.087 |
| Number of taxpayers | 9,264 | 9,264 | 9,264 | 9,264 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on the probability of filing VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

[5] Correcting to 2020 values with Consumer Price Index (CPI): $K1322.256\,million/(7{,}957.0 \times 1.0658 \times 1.075 \times 1.01573 \times 1.0915) = 0.1308$.

### 4.3 Heterogeneity analysis

In this section, we explore heterogeneity in treatment effects along location and industry dimensions, which are likely to influence the impact of the reform. We notice from Tables 2 and 3 above that the distribution of firms across the provinces and industries in the country is not uniform. As a result, it is likely that the impact of the treatment may by limited to those populous provinces or key sectors in which supplier firms likely trade with withholding agents. In our setup, this implies that the positive impacts seen in the standard results might be different in those provinces and industries with fewer firms. Furthermore, different sectors and regions may struggle with different levels of baseline evasion, creating heterogeneity in the impact of the WVAT reform. We study this conundrum by analysing our impact estimated by delineating province and industry cohorts, then progressively observe the reform impacts for each province and sector in the usual specification including all fixed effects. Moreover, we can tell the regions and industries driving the significant results above. For heterogeneity across locations, we concentrate on the provinces with the most supplier firms—Copperbelt and Lusaka—as well as those with the fewest—Muchinga and Northern. We analyse the rest of the provinces—Central, Eastern, Luapula, Northwestern, Southern, and Western—as a single cohort. For heterogeneity across sectors, we concentrate on those industries that usually act as intermediary producers for other sectors. These are administrative and support services, construction, real estate, transport and storage, and wholesale and retail, with remaining sectors grouped as a single cohort. Tables 11–14 show the impact results for our outcome variables of interest in levels for each province cohort while Tables 15–18 show the results for similar outcomes in levels for selected industry cohorts. Appendix E and F show results for outcome variables in logs for location and industry respectively.

From Table 11, we see that impact on reported value added is slightly higher in the Copperbelt than the Lusaka province. There is more variation in the impact estimates for the smaller regions, but given the larger confidence intervals, they may as well be in the same ballpark. In particular, supplier firms in the Copperbelt region continue to explain the increase in reported sales post reform as shown in Table 12. There is on average an increase of 8.4 per cent value added among supplier firms in that province remitting through withholding agents. The disaggregated result for reported purchases is similar to the aggregate result. In Table 13, all provinces see insignificant impacts on this outcome.

Output VAT increases in all province groups. The positive and significant impact among firms in the Copperbelt can potentially be attributed to the large number of the withholding firms that are within this mining-dominant province. With many suppliers engaged in business-to-business transactions with such large firms which act as withholding agents, we observe at the province level positive post-reform impacts which complement the results seen at the aggregate country level. Disaggregated results based on log changes of the outcome variables show similar results.

Table 11: DiD estimation results for WVAT—value added by province (in million K)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 2.535**<br>(1.483) | 1.758<br>(1.632) | 4.201***<br>(1.561) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 1.174***<br>(4.127) | 7.894***<br>(3.012) | 5.208***<br>(0.473) |
| Observations | 13,835 | 31,823 | 2,069 |
| Overall R-squared | 0.081 | 0.396 | 0.899 |
| Number of taxpayers | 3,658 | 8,369 | 1,576 |
| Effect in % relative to mean of value added before reform | 8.37 | 6.29 | 5.06 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on value added disaggregated by provinces; provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 12: DiD estimation results for WVAT—sales by province (in million K)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 1.903<br>(1.670) | 2.790<br>(7.315) | 3.390<br>(4.265) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 4.854***<br>(1.632) | 1.110<br>(2.803) | -1.324<br>(2.663) |
| Observations | 2,469 | 4,127 | 3,538 |
| Overall R-squared | 0.074 | 0.516 | 0.759 |
| Number of taxpayers | 580 | 1,298 | 1,014 |
| Effect in % relative to mean of sales before reform | 4.74 | 7.41 | 3.25 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on sales disaggregated by provinces; provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 13: DiD estimation results for WVAT—purchases by province (in million K)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 1.502<br>(1.660) | -0.628<br>(1.742) | 0.025<br>(2.117) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 9.399***<br>(1.823) | 4.905*<br>(2.863) | 2.013**<br>(0.816) |
| Observations | 13,835 | 31,823 | 6,057 |
| Overall R-squared | 0.072 | 0.621 | 0.977 |
| Number of taxpayers | 3,658 | 8,369 | 1,576 |
| Effect in % relative to mean of purchases before reform | 8.41 | −2.69 | 0.03 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on purchases disaggregated by provinces; provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 14: DiD estimation results for WVAT—output VAT by province (in million K)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 0.420*<br>(0.237) | 0.285<br>(0.263) | 0.680***<br>(0.250) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 1.915***<br>(0.660) | 1.294***<br>(0.482) | 0.834***<br>(0.075) |
| Observations | 13,835 | 31,823 | 6,057 |
| Overall R-squared | 0.086 | 0.825 | 0.927 |
| Number of taxpayers | 3,658 | 8,369 | 565 |
| Effect in % relative to mean of output VAT before reform | 18.46 | 20.71 | - |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on output VAT disaggregated by provinces; provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

There is an increase in reported value added in all sectors. For heterogeneity within sectors, we observe that results based on level outcomes are particularly clear in the administration and support services sector. The sector records positive and significant impact estimates for reported value added (9 per cent), purchases (37 per cent), and output VAT (10 per cent). The largest sectors in this analysis are wholesale and retail and others including the manufacturing and mining sectors. In this 'others' sector, including in manufacturing and mining, the reported value added appeared to increase particularly clearly. The smallest impact in percentages was on the wholesale and retail sector; it is likely that a lion share of the business in this sector is directed to consumers, and thus the withholding applies to a very limited value of the business.

Results based on log outcomes (see Appendix F) continually show positive impact estimates in most sectors. For the outcome variables of interest, the administration and support sector sees higher magnitudes while industries such as construction, real estate, and wholesale and retail which record insignificant results for level outcomes register positive and significant impact estimates for log outcomes. For instance, sectors such as construction (24 per cent), transport and storage (32 per cent), and wholesale and retail (21 per cent) record positive log impacts for output VAT (see Appendix F).

Table 15: DiD estimation results for WVAT—value added by sector (in million K)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 7.055** | 1.895 | 1.675 | 3.474 | 0.626 | 3.799** |
| | (2.648) | (2.892) | (1.319) | (2.506) | (1.341) | (1.883) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 3.887*** | 5.871*** | 3.050** | 9.737*** | 7.640*** | 8.635*** |
| | (1.481) | (2.078) | (1.425) | (1.110) | (3.653) | (1.063) |
| Observations | 2,469 | 4,127 | 866 | 2,415 | 22,571 | 19,239 |
| Overall R-squared | 0.008 | 0.065 | 0.434 | 0.257 | 0.437 | 0.642 |
| Number of taxpayers | 580 | 1,298 | 214 | 642 | 5,767 | 4,910 |
| Effect in % relative to mean of value added before reform | 9.16 | 11.53 | 20.46 | 14.69 | 2.95 | 10.31 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on value added disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 16: DiD estimation results for WVAT—sales by sector (in million K)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 19.030 | 2.790 | 0.598 | 3.316 | 0.488 | 2.955 |
| | (1.670) | (7.315) | (2.572) | (4.628) | (1.310) | (3.216) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 48.540*** | 1.110 | 3.009 | 5.874** | 8.316** | 2.331 |
| | (1.632) | (2.803) | (1.957) | (2.567) | (3.521) | (1.782) |
| Observations | 2,469 | 4,127 | 866 | 2,415 | 22,571 | 19,239 |
| Overall R-squared | 0.020 | 0.256 | 0.459 | 0.576 | 0.516 | 0.778 |
| Number of taxpayers | 580 | 1,298 | 214 | 642 | 5,767 | 4,910 |
| Effect in % relative to mean of sales before reform | 16.89 | 13.01 | 4.47 | 7.33 | 1.90 | 5.90 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on sales disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 17: DiD estimation results for WVAT—purchases by sector (in million K)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 4.996** | 2.876 | 0.265 | 0.183 | −2.032 | 1.516 |
| | (2.281) | (3.874) | (1.926) | (3.311) | (1.146) | (1.637) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 7.307 | 4.241** | 0.714 | 1.443 | 0.448 | 2.154 |
| | (0.814) | (1.770) | (0.601) | (4.158) | (1.780) | (1.896) |
| Observations | 2,469 | 4,127 | 866 | 2,415 | 22,571 | 19,239 |
| Overall R-squared | 0.027 | 0.255 | 0.459 | 0.567 | 0.516 | 0.778 |
| Number of taxpayers | 580 | 1,298 | 214 | 642 | 5,767 | 4,910 |
| Effect in % relative to mean of purchases before reform | 37.42 | 23.22 | 3.20 | 0.75 | −10.60 | 5.37 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on purchases disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table 18: DiD estimation results for WVAT—output VAT by sector (in million K)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 1.016* | 0.290 | 0.196 | 0.569 | 0.091 | 0.645** |
| | (0.425) | (0.460) | (0.219) | (0.401) | (0.215) | (0.306) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 6.240 | 0.950*** | 0.476** | 1.554*** | 1.234** | 1.446*** |
| | (2.373) | (0.328) | (0.230) | (0.178) | (0.584) | (0.171) |
| Observations | 2,469 | 4,127 | 866 | 2,415 | 22,571 | 19,239 |
| Overall R-squared | 0.008 | 0.065 | 0.270 | 0.433 | 0.260 | 0.635 |
| Number of taxpayers | 580 | 1,298 | 214 | 642 | 5,767 | 4,910 |
| Effect in % relative to mean of output VAT before reform | 9.51 | 30.18 | 36.80 | 79.12 | 11.92 | 47.06 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on output VAT disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## 4.4 Robustness checks

In this section we discuss the stability of our estimates when prior assumptions change or the underlying dataset is changed. We show with a battery of checks and variations that the results continue to hold. We do this seeking to confirm that the results showing that the WVAT reform resulted in positive impacts is a plausible one. We first rule out the possibility that our main result is caused by the choice of deflators. We do this by ignoring price indices applied to return values in the standard results for the nominal return amounts as reported by suppliers in the tax return. Next, we discuss the intensity of the reform. Also, we test different specifications of our variables of interest to gauge the sensitivity of our results when exploiting a different form of the dependent variable. Additionally, we relax our definition of the 'treated' sample by including firms that act both as suppliers to WVAT agents and as WVAT agents themselves. This allows cases where withholding agents double as suppliers, which we defined above as group three firms. Finally, we check for extensive margin responses of the withholding regime by exploring the entry status of suppliers before and after the intervention.

Tables A1–A4 in Appendix A show the results for our outcome variables in nominal terms. In specifications using the full model (Column 4), we observe similar study results which are not sensitive to price deflators. Although our standard results are based on 2020 prices, similar analysis without an index but accounting for price level differences only using year fixed effects produces similar results, with unsurprisingly higher magnitudes as well as significance levels. For instance, reported sales and value added increase by K8.6 and K6.3 million respectively post report. In Zambia, where inflation has been between 6 and 18 per cent annually, such magnitudes are misleading, as they do not account for price changes. By controlling for inflation, we obtain real-impact estimates adjusted to reflect economic indicators for the reference period. We show in Appendix A all impact results using unadjusted variables.

Our treated group now consists of firms differently impacted by the reform. While for some firms, sales with agents make up a small share of all sales, for some they may be a lion's share. Thus, the treatment group is heterogeneous in terms of the intensity of the treatment. Treatment intensity could be considered by applying, for example, a continuous-treatment DiD. However, we are unable to fully explore this intensity due to the nature of our datasets. This is because we do not know the intensity relative to all sales, including those not reported as we presume there is significant evasion in terms of the volumes that firms report. Assigning treatment pre-reform would be helpful but is impossible, as we know only transaction-level information on the sales with future agents before the reform.

In the next check, we vary the nature of the outcomes of interest, which permits the verification of the stability of our reported impact estimates. In our standard results shown in Tables 6–9, for the outcome variables of reported value added, sales, purchases, and output VAT we estimate the impact of the WVAT reform using these outcome variables in levels (2020 CPI-adjusted Kwacha). This indicates by how much on average per firm the revenue authority gained in terms of the real local currency due to the reform. Although such interpretation may be understandable in the Zambian context, a full picture of plausible impacts may elude an international or external reader. As a check on the main results and to improve the interpretability of the results, we vary the specification of our outcome variables to logarithms and first differences, enabling the easy interpretation our impact estimates. A notable weakness of these transformations is that using logarithmic transformation excludes zero and negative values, potentially distorting the results, while first differences require continuous reporting—also not evident in our country context. We proxy the outcome variables by first difference as reported in Appendix D and then by logs as in Appendix C. The former does not yield any precise estimates. However, the latter yields significant impacts for all outcome variables. As seen in Column 4 in Tables C1 and C4, value added and output VAT increase by 27 per cent, confirming the initial results when using level variables. Our study reveals results on firms' reported purchases which show the least impact of 14 per cent. Given this ambiguous result, we maintain our explanation of the unobservable nature of this variable in the transaction chain with the withholding agent as the cause of this minimal impact estimate.

In the standard impact results, we assume strict treatment and control groups; the former comprises uniquely supplier firms while the latter includes firms not trading with withholding agents, and withholding agents themselves are left out of the analysis. This is done with the main purpose of avoiding ambiguity, as the behaviour of supplier firms may differ from that of agents. Moreover, as the target of the reform is to improve the compliance of supplier firms, it is important to delineate their implied impacts before including the effects of the reform on other players in the transaction chain. To understand the full impact of the reform, it may be useful to also extend the analysis to firms that act as both suppliers and withholding agents. As our next sensitivity check, we relax this prior by analysing impacts of the reform using the full data, which include as the treatment group some 213 firms that act as both suppliers and withholding agents. For further

robustness in the DiD regression, we include or omit a dummy for firms acting as agents and suppliers, to control for the behavioural trend and see if this affects the results. We observe that increasing the treatment sample to include firms acting as both suppliers and withholding agents does not change the direction of our impact estimates. We observe higher magnitudes and significance levels for all variables of interest excluding purchases, which was also not precisely estimated in our standard results. Higher magnitudes may denote higher volumes of transactions among the withholding agents, which are largely formalized in their dealings with other firms. The higher impact may reflect the additional ways in which the reform may have enforced the VAT reporting of agents. For example, in addition to withholding of VAT by other agents, the reform removed the incentives for an agent to misreport VAT-deductible purchases. Also, the increased liability in remitting VAT may have increased the perceived threat of audit for agents. From Appendix B, we observe that the impact on value added is about 17.4 per cent post reform, as compared with 10.5 per cent in the standard case.

We explore more options for extensive margin responses by investigating the extent to which new supplier firms filed their VAT returns due to the introduction of withholding intervention. The intervention may have pushed more firms into filing their returns especially in instances where firms are in refund positions that prompt claims. Such claims can only be received after the firm has met filing regulations with tax authorities. The chain of events potentially increases new entrant firms engaging with withholding agents post reform. Table 19 shows the number of new entrant firms from 2015 to 2020, providing us with descriptive evidence on the entry of firms (in VAT filing) on the part of both the treatment and the control cohorts.

Table 19: New supplier firms pre- and post WVAT regime by treatment status

| | Treat | | | Control | | |
|---|---|---|---|---|---|---|
| | Number of VAT filers | Share of new VAT filers | | Number of VAT filers | Share of new VAT filers | |
| Year | | No. | % | | No. | % |
| 2014 | 2,028 | - | | 3,669 | - | |
| 2015 | 1,843 | 468 | 20.3 | 2,878 | 1,095 | 27.6 |
| 2016 | 2,240 | 413 | 15.6 | 3,317 | 947 | 22.2 |
| 2017 | 2,651 | 510 | 16.1 | 3,705 | 1,071 | 22.4 |
| 2018 | 3,323 | 614 | 15.6 | 4,004 | 896 | 18.3 |
| 2019 | 3,692 | 216 | 5.5 | 4,220 | 711 | 14.4 |
| 2020 | 3,671 | 239 | 6.1 | 4,075 | 779 | 16.1 |

Note: the table shows the number and relative share of existing supplier firms, the number and share of entrant supplier firms, and the total number of firms, in 2014–2020; figures are based on study data for supplier firms' filing returns each year and do not represent firms on the tax register.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

From Table 19, we observe that in 2017 at the time of the adoption of WVAT, the treatment and control suppliers see an increase in the number of filers of about 16 per cent and 22 per cent respectively. The highest increases are observed in 2015–20. The number of new suppliers among treated firms (Column 2) filing each year is relatively high in 2015–18. The relative number of new filers around the time of the reform in 2017 does not stand out when compared with the control sample, suggesting that WVAT reform may have contributed to the number of filers also through a lower exit from VAT filing. However, a new filer is defined as a filer that did not previously file VAT in period 2014–20, which is likely to misclassify some firms that had been filing occasionally before the study period as a new filer. The table gives indicative evidence that the reform may have had a positive impact in the extensive margin, i.e. in the number of VAT filers, yet there is a positive trend also in the control group. However, this is merely descriptive, as we cannot rule out other factors influencing the increase. The high number of new entrants to the data around 2015–

18 may indicate a positive trend in the economy or that the various tax registration enforcement policies that ZRA had been implementing at the time were paying off. The number of VAT filers among treated suppliers has since been stagnant in the last years of the study period, while for control firm it was increasing.

## 5 Conclusion

In this study, we use administrative data on withholding agents and tax returns in Zambia to analyse how withholding of VAT affects a supplier's reported valued added, sales, purchases, and output VAT. We extensively describe the key indicators for suppliers engaging with withholding agents in comparison with those without any withholding obligation, in order to understand the withholding reform, how these players interact in the transaction chain, and how the system affects final reporting to the tax authority. In the analysis, we employ a difference-in-differences methods with firms trading with withholding agents as the treated group and firms not trading with agents as a control group. In the development of key outcomes pre- and post reform, we observe the similarity in trends between the groups before the reform, which is crucial for the choice of our estimation strategy.

We find that suppliers who remit part of their returns through an agent increase their reported value added by 7.3 per cent, which accounts for a firm average of K2 million annually post reform, indicating that the reform improved tax compliance among treated firms. The results hold when disaggregated by location and industry. For these results, we observe a particularly clear impact for supplier firms in Copperbelt province and the administration and support industry.

Based on the firm-level impact on value added, we estimate an effect on aggregate VAT revenue. The withholding reform increased VAT by approximately 13 per cent annually relative to VAT revenue in 2016. As a share of VAT revenue in 2018, the impact was 7 per cent.

We observe higher output VAT among treatment firms post reform. Output VAT in 2020 prices increased by K342,000 after the reform. This represents a 22 per cent increase post reform for those suppliers who filed returns. This increase is mainly driven by sales, which equally sees a 12 per cent increase on average post reform. The reform compels the supplier firm to corroborate its sales volume to the withholding agent, who in turn reports this as purchases. As such, the supplier can only misreport up to a point, as their records must match those of the buyer who doubles as a withholding agent.

Contrary to the results for sales and output VAT, where impact estimates are positive and precise, the estimated impact on total purchases as reported by supplier firms is ambiguous. The standard impact results in all specifications for this outcome are not significant. This confirms the fact that treatment firms continue to (mis)report similar purchase volumes on average post reform, depending on the implied assumption. Total purchases in the reform scenario continue to be reported only by the suppliers, not by the withholding agent, leaving room for erroneous reporting on the part of all supplier firms.

We finally perform sensitivity checks on the results gathered. While adjusting for inflation in the standard results, we analyse data without this adjustment to show that the results are still significant when not accounting for inflation or when using logarithmic values. Moreover, we confirm that unrestricting our treatment to include firms who double as withholding agents does not change the sign of our impact estimate. We observe higher magnitudes in both specifications when we control for the treatment firm doubling as a withholding agent. Interestingly, the sign for total

purchases in this case switches, indicating higher volumes post reform. We conclude that this is driven mainly by the inclusion of these withholding agents, who must now truthfully report their purchases to claim input VAT.

Our results are informative about the general effects of withholding of VAT with the imposition of an intermediary in the form of a withholding agent. The positive tax compliance effect as observed in the indicators of interest implies that such reforms can increase VAT reporting and government revenue. While we observe notable increases in VAT revenue in the treatment group, for a comprehensive cost–benefit analysis the costs of the reform would need to be considered. In addition to administrative costs for the tax authority, the WVAT system generates compliance costs for firms. The agent has an additional administrative burden of remitting taxes on behalf of other firms, and the supplier firm might need to put additional effort into keeping track of its VAT withheld. Also, it is prudent to note that tax compliance as observed in our results might have spillover effects on other tax bases. In our results, we are assuming that treatment firms do not shift misreporting or cheating behaviour to other tax bases. This may not entirely hold in all cases, as firms are likely to find other avenues through which to game the tax system. As a result, when stating the full impact of the reform, a full assessment of the cost and benefits of a withholding reform and their subsequent spillover effects on corporate and personal income tax revenue should be considered (Coolidge 2012).

## References


Allingham, M.G., and A. Sandmo (1972). 'Income Tax Evasion: A Theoretical Analysis'. *Journal of Public Economics*, 1(3–4): 323–38. https://doi.org/10.1016/0047-2727(72)90010-2

Almunia, M., J. Hjort, J. Knebelmann, and L. Tian (2021). 'Strategic or Confused Firms? Evidence from "Missing" Transactions in Uganda'. CEPR Discussion Paper DP16379. London: Centre for Economic Policy Research (CEPR). Available at: https://miguelalmunia.files.wordpress.com/2020/09/almuniaetalvat_090120.pdf (accessed 29 January 2023).

Battaglini, M., L. Guiso, C. Lacava, and E. Patacchini (2019). 'Tax Professionals: Tax-evasion Facilitators or Information Hubs? NBER Working Paper 25745. Cambridge, MA: National Bureau of Economic Research (NBER). https://doi.org/10.3386/w25745

Boning, W.C., J. Guyton, R. Hodge, and J. Slemrod (2020). 'Heard It through the Grapevine: The Direct and Network Effects of a Tax Enforcement Field Experiment on Firms'. *Journal of Public Economics*, 190: 204–61. https://doi.org/10.1016/j.jpubeco.2020.104261

Brockmeyer, A., and M. Hernandez (2016). 'Taxation, Information, and Withholding: Evidence from Costa Rica'. Policy Research Working Paper 7600. Washington, DC: World Bank. https://doi.org/10.1596/1813-9450-7600

Carrillo, P.E., and M. Shahe Emran (2018). 'Loss Aversion, Transaction Costs, or Audit Trigger? Learning about Corporate Tax Compliance from a Policy Experiment with Withholding Regime'. Munich: Personal RePEc Archive. https://doi.org/10.2139/ssrn.3197694

Chetty, R., J.N. Friedman, and E. Saez (2013). 'Differences in Knowledge across Neighborhoods to Uncover the Impacts of the EITC on Earnings'. *American Economic Review*, 103(7): 2683–721. https://doi.org/10.1257/aer.103.7.2683

Coolidge, J. (2012). 'Findings of Tax Compliance Cost Surveys in Developing Countries'. *Electronic Journal of Tax Research (eJTR)*, 10(2): 250–87.

Floridi, A., B.A. Demena, and N. Wagner (2020). 'Shedding Light on the Shadows of Informality: A Meta-Analysis of Formalization Interventions targeted at Informal Firms'. *Labour Economics*, 67: 101–25. https://doi.org/10.1016/j.labeco.2020.101925

Garriga, P., and D. Tortarolo (2019). 'Do Accountants Influence Their Client's Behaviour? Evidence from an Imperfect Tax Withholding Regime'. Available at: https://pablogarriga.github.io/files/tax-preparers.pdf (accessed 23 December 2021).

Jouste, M., M.I. Nalukwago, and R. Waiswa (2021). 'Do Tax Administrative Interventions targeted at Small Businesses Improve Tax Compliance and Revenue Collection? Evidence from Ugandan Administrative Tax Data. WIDER Working Paper 2021/17. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2021/951-8

Jouste, M., T.K. Barugahara, J.O. Ayo, J. Pirttilä, and P. Rattenhuber (2021). 'The Effects of Personal Income Tax Reform on Employees' Taxable Income in Uganda'. WIDER Working Paper 2021/11. Helsinki: UNU-WIDER. https://doi.org/10.35188/UNU-WIDER/2021/945-7

Kleven, H.J., M.B. Knudsen, C.T. Kreiner, S. Pedersen, and E. Saez (2011). 'Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark'. *Econometrica*, 79(3): 651–92. https://doi.org/10.3982/ECTA9113

Kleven, H.J., C.T. Kreiner, and E. Saez (2016). 'Why Can Modern Governments Tax So Much? An Agency Model of Firms as Fiscal Intermediaries'. *Economica*, 83(330): 219–46. https://doi.org/10.1111/ecca.12182

Lediga, C., N. Riedel, and K. Strohmaier (2020). 'What You Do (and What You Don't) Get When Expanding the Net: Evidence from Forced Taxpayer Registrations in South Africa'. Rochester, NY: SSRN. http://dx.doi.org/10.2139/ssrn.3616808

Majoni, B. (2021). 'VAT Withholding Tax and Its Impact on VAT Compliance: Evidence from the Zimbabwe Revenue Authority'. *African Multidisciplinary Tax Journal*, 1: 228–43. https://doi.org/10.47348/AMTJ/2021/i1a13

Mascagni, G., D. Mukama, and F. Santoro (2019). 'An Analysis of Discrepancies in Taxpayers' VAT Declarations in Rwanda'. ICTD Working Paper 92. Brighton: International Centre for Tax and Development (ICTD).

Newman, W., N. Mwandambira, M. Charity, and W. Ongayi (2018). 'Literature Review on the Impact of Tax Knowledge on Tax Compliance among Small Medium Enterprises in a Developing Country'. *International Journal of Entrepreneurship*, 22(4): 1–15.

Parliament of Zambia (2016, December 27). 'Value Added Tax (Amendment)'. National Assembly of Zambia, 27 December). Available at: www.parliament.gov.zm/sites/default/files/documents/acts/The%20Value%20Added%20Tax%20Act%2C%202016.pdf (accessed 29 January 2023).

Pomeranz, D. (2015). 'No Taxation without Information: Deterrence and Self-Enforcement in the Value Added Tax'. *American Economic Review*, 105(8): 2539–69. https://doi.org/10.1257/aer.20130393

Slemrod, J., and T. Velayudhan (2022). 'The VAT at 100: A Retrospective Survey and Agenda for Future Research'. *Public Finance Review*, 50(1): 4–32. https://doi.org/10.1177/10911421221094595

Smith, S.C., and M. Keen (2010). 'VAT Fraud and Evasion: What Do We Know, and What Can be Done?' Working Paper 2007/031. Washington, DC: International Monetary Fund (IMF). https://doi.org/10.2139/ssrn.964339

Waseem, M. (2019). 'Information, Asymmetric Incentives, or Withholding? Understanding the Self-Enforcement of Value-Added Tax'. CESifo Working Paper 7736. Munich: Center for Economic Studies and ifo Institute (CESifo). https://doi.org/10.2139/ssrn.3422631

Yesegat, W.A., and S.-A. Joseph (2017). 'VAT Withholding in Ethiopia: Implications for Revenue Collection and Refunds'. *Australian Tax Forum*, 32(2): 399–428.

ZRA. (2022). *ZRA Annual Report 2021*. Lusaka: ZRA.

## Appendix A: Additional results without inflation adjustment

Table A1: DiD estimation results for WVAT—value added (in million K)

| Variables | (1)<br>valadd | (2)<br>valadd | (3)<br>valadd | (4)<br>valadd |
|---|---|---|---|---|
| treat*after | 8.011***<br>(2.063) | 4.757***<br>(1.447) | 4.507***<br>(1.438) | 4.516***<br>(1.441) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 8.378***<br>(0.625) | 5.409***<br>(1.102) | 4.005***<br>(0.898) | 3.584***<br>(1.120) |
| Observations | 51,703 | 51,645 | 51,703 | 51,645 |
| R-squared | 0.003 | 0.523 | 0.5234 | 0.523 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on value added; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table A2: DiD estimation results for WVAT—sales (in million K)

| Variables | (1)<br>totalsales | (2)<br>totalsales | (3)<br>totalsales | (4)<br>totalsales |
|---|---|---|---|---|
| treat*after | 1.407**<br>(5.470) | 5.473**<br>(2.276) | 5.354**<br>(2.245) | 5.369**<br>(2.249) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.176***<br>(1.476) | 1.958<br>(2.874) | 2.145<br>(1.619) | 1.546<br>(2.405) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| R-squared | 0.004 | 0.608 | 0.609 | 0.609 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on sales; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table A3: DiD estimation results for WVAT—purchases (in million K)

| Variables | (1)<br>totalpurch | (2)<br>totalpurch | (3)<br>totalpurch | (4)<br>totalpurch |
|---|---|---|---|---|
| treat*after | 6.213**<br>(3.169) | 0.048<br>(1.091) | −0.146<br>(1.085) | −0.153<br>(1.087) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 7.154***<br>(0.884) | 1.966<br>(1.639) | 1.320<br>(1.025) | 0.615<br>(1.300) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| R-squared | 0.004 | 0.608 | 0.609 | 0.609 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on purchases; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table A4: DiD estimation results for WVAT—output VAT (in million K)

| Variables | (1)<br>outvat | (2)<br>outvat | (3)<br>outvat | (4)<br>outvat |
|---|---|---|---|---|
| treat*after | 1.290***<br>(0.331) | 0.768***<br>(0.232) | 0.726***<br>(0.230) | 0.728***<br>(0.231) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.358***<br>(0.0100) | 0.878***<br>(0.176) | 0.651<br>(0.144) | 0.580***<br>(0.) |
| Observations | 51,715 | 51,657 | 51,715 | 51,657 |
| R-squared | 0.003 | 0.523 | 0.5234 | 0.523 |
| Number of taxpayers | 13,274 | 13,265 | 13,274 | 13,265 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on output VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## Appendix B: Additional results without restriction on treatment firms

Table B1: DiD estimation results for WVAT—value added (in million K)

| Variables | (1)<br>valadd | (2)<br>valadd | (3)<br>valadd | (4)<br>valadd |
|---|---|---|---|---|
| treat*after | 13.120***<br>(2.728) | 7.079***<br>(1.579) | 13.090***<br>(2.721) | 7.158***<br>(1.586) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 17.700***<br>(0.208) | 12.460***<br>(0.747) | 20.460***<br>(1.574) | 13.900***<br>(1.157) |
| Observations | 51,918 | 51,860 | 51,918 | 51,860 |
| Overall R-squared | 0.004 | 0.444 | 0.004 | 0.444 |
| Number of taxpayers | 13,309 | 13,300 | 13,309 | 13,300 |
| Effect in % relative to mean of valadd before reform | 31.93 | 17.23 | 31.85 | 17.42 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on value added; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table B2: DiD estimation results for WVAT—sales (in million K)

| Variables | (1)<br>totalsales | (2)<br>totalsales | (3)<br>totalsales | (4)<br>totalsales |
|---|---|---|---|---|
| treat*after | 27.710***<br>(6.536) | 12.520***<br>(4.927) | 27.280***<br>(6.448) | 12.360***<br>(4.860) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 28.770***<br>(1.326) | 13.450**<br>(4.349) | 30.063***<br>(2.055) | 11.720***<br>(3.766) |
| Observations | 51,918 | 51,860 | 51,918 | 51,860 |
| Overall R-squared | 0.003 | 0.550 | 0.003 | 0.550 |
| Number of taxpayers | 13,309 | 13,300 | 13,309 | 13,300 |
| Effect in % relative to mean of sales before reform | 43.98 | 19.87 | 44.12 | 19.61 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on sales; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table B3: DiD estimation results for WVAT—purchases (in million K)

| Variables | (1)<br>totalpurch | (2)<br>totalpurch | (3)<br>totalpurch | (4)<br>totalpurch |
|---|---|---|---|---|
| treat*after | 15.280***<br>(4.217) | 1.998<br>(1.610) | 15.000***<br>(4.167) | 1.924<br>(1.575) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 15.350***<br>(0.856) | 1.043<br>(2.409) | 17.660***<br>(1.795) | 2.072<br>(2.559) |
| Observations | 51,918 | 51,860 | 51,918 | 51,860 |
| Overall R-squared | 0.004 | 0.550 | 0.004 | 0.550 |
| Number of taxpayers | 13,309 | 13,300 | 13,309 | 13,300 |
| Effect in % relative to mean of purchases before reform | 47.44 | 6.20 | 46.57 | 5.97 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on purchases; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table B4: DiD estimation results for WVAT—output VAT (in million K)

| Variables | (1)<br>outvat | (2)<br>outvat | (3)<br>outvat | (4)<br>outvat |
|---|---|---|---|---|
| treat*after | 2.105***<br>(0.438) | 1.130***<br>(0.255) | 2.100***<br>(0.436) | 1.143***<br>(0.255) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 2.869***<br>(0.088) | 2.018***<br>(0.283) | 3.309***<br>(0.277) | 2.249***<br>(0.336) |
| Observations | 51,918 | 51,860 | 51,918 | 51,860 |
| Overall R-squared | 0.004 | 0.446 | 0.004 | 0.446 |
| Number of taxpayers | 13,309 | 13,300 | 13,309 | 13,300 |
| Effect in % relative to mean of output VAT before reform | 356.62 | 191.44 | 355.77 | 193.64 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on output VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## Appendix C: Additional results with log transformation on outcome variables

Table C1: DiD estimation results for WVAT—value added (log changes)

| Variables | (1)<br>lnvaladd | (2)<br>lnvaladd | (3)<br>lnvaladd | (4)<br>lnvaladd |
|---|---|---|---|---|
| treat*after | 0.342***<br>(0.034) | 0.336***<br>(0.033) | 0.338***<br>(0.033) | 0.338***<br>(0.033) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 14.44***<br>(0.011) | 14.66***<br>(0.317) | 14.47***<br>(0.020) | 14.72***<br>(0.318) |
| Observations | 46,140 | 46,084 | 46,140 | 46,084 |
| Overall R-squared | 0.048 | 0.077 | 0.084 | 0.076 |
| Number of taxpayers | 11,871 | 11,863 | 11,871 | 11,863 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on value added; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table C2: DiD estimation results for WVAT—sales (log changes)

| Variables | (1)<br>lntotalsales | (2)<br>lntotalsales | (3)<br>lntotalsales | (4)<br>lntotalsales |
|---|---|---|---|---|
| treat*after | 0.303***<br>(0.034) | 0.295***<br>(0.034) | 0.294***<br>(0.034) | 0.293***<br>(0.034) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 14.66***<br>(0.011) | 14.86***<br>(0.325) | 14.67***<br>(0.021) | 14.88***<br>(0.325) |
| Observations | 47,986 | 47,930 | 47,986 | 47,930 |
| Overall R-squared | 0.031 | 0.071 | 0.075 | 0.069 |
| Number of taxpayers | 12,210 | 12,202 | 12,210 | 12,202 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on sales; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table C3: DiD estimation results for WVAT—purchases (log changes)

| Variables | (1)<br>lntotalpurch | (2)<br>lntotalpurch | (3)<br>lntotalpurch | (4)<br>lntotalpurch |
|---|---|---|---|---|
| treat*after | 0.228***<br>(0.036) | 0.213***<br>(0.036) | 0.216***<br>(0.036) | 0.213***<br>(0.036) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 14.22***<br>(0.012) | 14.12***<br>(0.172) | 14.27***<br>(0.021) | 14.17***<br>(0.172) |
| Observations | 46,343 | 46,298 | 46,343 | 46,298 |
| Overall R-squared | 0.015 | 0.048 | 0.049 | 0.048 |
| Number of taxpayers | 11,885 | 11,877 | 11,885 | 11,877 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on purchases; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table C4: DiD estimation results for WVAT—output VAT (log changes)

| Variables | (1)<br>lnoutvat | (2)<br>lnoutvat | (3)<br>lnoutvat | (4)<br>lnoutvat |
|---|---|---|---|---|
| treat*after | 0.345***<br>(0.033) | 0.339***<br>(0.033) | 0.341***<br>(0.033) | 0.341***<br>(0.033) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 12.62***<br>(0.011) | 12.83***<br>(0.317) | 12.64***<br>(0.020) | 12.90***<br>(0.318) |
| Observations | 46,229 | 46,173 | 46,229 | 46,173 |
| Overall R-squared | 0.047 | 0.076 | 0.083 | 0.075 |
| Number of taxpayers | 11,889 | 11,881 | 11,889 | 11,881 |

Note: Columns 1–4 show impact estimates of WVAT in Zambia on output VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add firm fixed effects; Column 3 presents estimates with return year effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## Appendix D: Additional results with first difference on outcome variables

Table D1: DiD estimation results for WVAT—value added (first difference in million K)

| Variables | (1)<br>dvaladd | (2)<br>dvaladd | (3)<br>dvaladd | (4)<br>dvaladd |
|---|---|---|---|---|
| treat*after | 0.201 | −0.065 | 0.329 | 0.072 |
| | (1.240) | (1.339) | (1.206) | (1.308) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.114*** | −0.676 | 3.289*** | 2.158 |
| | (0.321) | (0.954) | (1.121) | (1.350) |
| Observations | 37,079 | 37,041 | 37,079 | 37,041 |
| Overall R-squared | 0.00 | 0.02 | 0.01 | 0.02 |
| Number of taxpayers | 10,424 | 10,419 | 10,424 | 10,419 |

Note: this table reports the first difference of annual value added as the dependent variable; Columns 1–4 show impact estimates of WVAT in Zambia on value added; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add return year fixed effects; Column 3 presents estimates with firm fixed effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; in the last row, we report the increase related to the mean value added for the treated group before the reform; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table D2: DiD estimation results for WVAT—sales (first difference in million K)

| Variables | (1)<br>dtotalsales | (2)<br>dtotalsales | (3)<br>dtotalsales | (4)<br>dtotalsales |
|---|---|---|---|---|
| treat*after | 0.182 | −0.300 | 0.400 | −0.065 |
| | (3.098) | (3.371) | (3.096) | (3.375) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 2.804*** | −0.810 | 6.293*** | 4.096 |
| | (0.803) | (2.630) | (2.036) | (3.146) |
| Observations | 37,079 | 37,041 | 37,079 | 37,041 |
| Overall R-squared | 0.00 | 0.02 | 0.01 | 0.02 |
| Number of taxpayers | 10,424 | 10,419 | 10,424 | 10,419 |

Note: this table reports the first difference of annual total sales added as the dependent variable; Columns 1–4 show impact estimates of WVAT in Zambia on sales; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add return year fixed effects; Column 3 presents estimates with firm fixed effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table D3: DiD estimation results for WVAT—purchases (first difference in million K)

| Variables | (1)<br>dtotalpurch | (2)<br>dtotalpurch | (3)<br>dtotalpurch | (4)<br>dtotalpurch |
|---|---|---|---|---|
| treat*after | −2.221<br>(1.787) | −2.710<br>(1.904) | −1.997<br>(1.800) | −2.473<br>(1.916) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 1.667***<br>(0.467) | −0.513<br>(1.706) | 3.499***<br>(0.540) | 2.786<br>(1.748) |
| Observations | 37,079 | 37,041 | 37,079 | 37,041 |
| Overall R-squared | 0.00 | 0.02 | 0.01 | 0.02 |
| Number of taxpayers | 10,424 | 10,419 | 10,424 | 10,419 |

Note: this table reports the first difference of annual total purchases added as the dependent variable; Columns 1–4 show impact estimates of WVAT in Zambia on purchases; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add return year fixed effects; Column 3 presents estimates with firm fixed effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table D4: DiD estimation results for WVAT—output VAT (first difference in million K)

| Variables | (1)<br>doutvat | (2)<br>doutvat | (3)<br>doutvat | (4)<br>doutvat |
|---|---|---|---|---|
| treat*after | 0.040<br>(0.199) | −0.002<br>(0.215) | 0.061<br>(0.194) | 0.020<br>(0.210) |
| Return year FE | No | No | Yes | Yes |
| Firm FE | No | Yes | No | Yes |
| Constant | 0.187***<br>(0.051) | −0.096<br>(0.153) | 0.542***<br>(0.182) | 0.370*<br>(0.219) |
| Observations | 37,079 | 37,041 | 37,079 | 37,041 |
| Overall R-squared | 0.00 | 0.02 | 0.01 | 0.02 |
| Number of taxpayers | 10,424 | 10,419 | 10,424 | 10,419 |

Note: this table reports the first difference of annual output VAT as the dependent variable; Columns 1–4 show impact estimates of WVAT in Zambia on output VAT; Column 1 shows estimates using the reform variable, which includes all after-treatment years; in Column 2, we add return year fixed effects; Column 3 presents estimates with firm fixed effects; Column 4 presents estimates with all fixed effects; robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## Appendix E: Additional results on heterogeneity analysis by location

Table E1: DiD estimation results for WVAT—value added by province (log changes)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 0.309***<br>(0.043) | 0.084***<br>(0.026) | 0.250***<br>(0.073) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 6.040***<br>(0.261) | 4.908***<br>(0.145) | 4.937***<br>(0.391) |
| Observations | 11,360 | 26,707 | 4,845 |
| Overall R-squared | 0.493 | 0.506 | 0.461 |
| Number of taxpayers | 3,011 | 7,084 | 1,295 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on value added disaggregated by provinces; the provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table E2: DiD estimation results for WVA—sales by province (log changes)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 0.143<br>(0.102) | 0.305***<br>(0.115) | 0.072<br>(0.100) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 7.087***<br>(0.517) | 4.715***<br>(0.524) | 4.970***<br>(0.513) |
| Observations | 2,102 | 29,461 | 1,938 |
| Overall R-squared | 0.406 | 0.415 | 0.374 |
| Number of taxpayers | 497 | 1,038 | 861 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on sales disaggregated by provinces; the provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table E3: DiD estimation results for WVAT—purchases by province (log changes)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | −0.083*<br>(0.047) | 0.080***<br>(0.030) | 0.133*<br>(0.074) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 2.797***<br>(0.474) | 4.393***<br>(0.394) | 7.146***<br>(0.793) |
| Observations | 11,660 | 27,515 | 5,257 |
| Overall R-squared | 0.487 | 0.465 | 0.352 |
| Number of taxpayers | 3,087 | 7,244 | 1,368 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on purchases disaggregated by provinces; the provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table E4: DiD estimation results for WVAT—output VAT by province (log changes)

| Variables | (1)<br>Copperbelt | (2)<br>Lusaka | (3)<br>Other provinces |
|---|---|---|---|
| treat*after | 0.313***<br>(0.043) | 0.085***<br>(0.026) | 0.252***<br>(0.073) |
| Return year FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| Constant | 4.245***<br>(0.261) | 3.065***<br>(0.146) | 3.095***<br>(0.390) |
| Observations | 11,370 | 26,735 | 4,847 |
| Overall R-squared | 0.492 | 0.503 | 0.459 |
| Number of taxpayers | 3,014 | 7,090 | 1,296 |

Note: Columns 1–3 show impact estimates with all fixed effects of WVAT in Zambia on output VAT disaggregated by provinces; the provinces are Copperbelt (Column 1), Lusaka (Column 2), and the rest, including Central, Eastern, Muchinga, Northern, Southern, Luapula, Northwestern, and Western (Column 3); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

## Appendix F: Additional results on heterogeneity analysis by industry

Table F1: DiD estimation results for WVAT—value added by sector (log changes)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 0.205* | 0.214** | 0.196 | 0.302*** | 0.209*** | 0.093** |
| | (0.118) | (0.105) | (0.156) | (0.115) | (0.027) | (0.038) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 7.449*** | 4.522*** | 8.134*** | 4.676*** | 4.711*** | 5.571*** |
| | (0.517) | (0.401) | (1.083) | (0.534) | (0.157) | (0.239) |
| Observations | 2,260 | 3,489 | 763 | 2,169 | 20,782 | 15,611 |
| Overall R-squared | 0.357 | 0.426 | 0.285 | 0.475 | 0.579 | 0.455 |
| Number of taxpayers | 491 | 1,014 | 166 | 539 | 4,942 | 4,088 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on value added disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table F2: DiD estimation results for WVAT—sales by sector (log changes)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 0.143 | 0.305*** | 0.180 | 0.115 | 0.192*** | 0.026 |
| | (0.102) | (0.113) | (0.158) | (0.089) | (0.028) | (0.041) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 7.087*** | 4.715*** | 8.073*** | 4.371*** | 4.575*** | 5.898*** |
| | (0.517) | (0.524) | (1.113) | (0.486) | (0.159) | (0.241) |
| Observations | 2,102 | 3,262 | 648 | 2,179 | 19,760 | 16,458 |
| Overall R-squared | 0.406 | 0.415 | 0.280 | 0.541 | 0.557 | 0.362 |
| Number of taxpayers | 497 | 1,038 | 167 | 574 | 5,020 | 4,239 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on sales disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table F3: DiD estimation results for WVAT—purchases by sector (log changes)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 0.218 | −0.174 | 0.004 | 0.067 | −0.080*** | 0.115** |
| | (0.318) | (0.114) | (0.214) | (0.096) | (0.031) | (0.045) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 3.355** | 5.516*** | 5.745*** | 3.871*** | 2.867*** | 5.876*** |
| | (1.440) | (0.717) | (2.312) | (0.977) | (0.453) | (0.489) |
| Observations | 2,102 | 3,262 | 648 | 2,179 | 19,760 | 16,458 |
| Overall R-squared | 0.409 | 0.417 | 0.286 | 0.534 | 0.556 | 0.365 |
| Number of taxpayers | 497 | 1,038 | 167 | 574 | 5,020 | 4,239 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on purchases disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.

Table F4: DiD estimation results for WVAT—output VAT by sector (log changes)

| Variables | (1) Admin and support | (2) Construction | (3) Real estate | (4) Transport and storage | (5) Wholesale and retail | (6) Others |
|---|---|---|---|---|---|---|
| treat*after | 0.182 | 0.239** | 0.118 | 0.320** | 0.213*** | 0.096** |
| | (0.119) | (0.107) | (0.170) | (0.114) | (0.028) | (0.038) |
| Return year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 5.791*** | 2.689*** | 5.705*** | 2.830*** | 2.887*** | 3.739*** |
| | (0.536) | (0.399) | (1.174) | (0.533) | (0.158) | (0.240) |
| Observations | 2,059 | 3,176 | 638 | 2,080 | 19,349 | 15,627 |
| Overall R-squared | 0.339 | 0.421 | 0.300 | 0.477 | 0.577 | 0.456 |
| Number of taxpayers | 491 | 1,014 | 166 | 540 | 4,945 | 4,094 |

Note: Columns 1–6 show impact estimates with all fixed effects of WVAT in Zambia on output VAT disaggregated by selected industries; sectors are administration and support services (Column 1), construction (Column 2), real estate (Column 3), transport and storage (Column 4), wholesale and retail activities (Column 5), and the rest, including mining, manufacturing, education, etc. (Column 6); robust standard errors in parentheses clustered at firm level with firm FE; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' calculations based on ZRA administrative tax returns data, 2022.