AN ANALYSIS OF DISCREPANCIES IN TAXPAYERS' VAT DECLARATIONS IN RWANDA

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Summary

This report provides a descriptive analysis of discrepancies resulting from matching different value added tax (VAT) data sources in the Rwanda Revenue Authority database. VAT returns are declared by businesses of all sizes and types, from companies to individual traders. Internal discrepancy is the gap between different data sources, namely VAT declaration and VAT annexes, for the same taxpayer. External discrepancy refers to the gap, for the same transaction, between buyer's and seller's reports. We summarize the extent and depth of these discrepancies, as well as any changes that have occurred since a new VAT refund claim validation procedure was introduced in January 2017, which mainly affected buyers' reporting. While internal discrepancy does not seem to be an issue, external discrepancy is much more frequent, with just 18 per cent of our observations reporting the same VAT amount across buyers and sellers. This share rises to 40 per cent when buyers' reports are compared to sellers' electronic billing machine (EBM) records. The great majority of discrepancies are due to transactions not being reported at all by one of the trading partners. This analysis is purely descriptive and is meant to provide more information on these discrepancies, in view of potentially designing a further study to test possible policy measures to increase compliance on VAT using available administrative data.

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Acronyms

CIT	Corporate income tax
EBM	Electronic billing machine
NGO	Non-Governmental Organization
PIT	Personal income tax
RRA	Rwanda Revenue Authority
RWF	Rwandan Franc
TIN	Taxpayer identification number
US$	United States Dollar
VAT	Value added tax

Introduction

One of the most important developments in tax administration in Africa is the widespread adoption of the value added tax (VAT) in several countries across the continent. Today, over 140 countries around the world have a VAT, compared with 47 in 1990, with most of the recent adopters being low-income countries (IMF 2011). This trend was largely supported by the International Monetary Fund, which has long been a proponent of the VAT's benefits. One of the most important of such benefits is its self-enforcement mechanism that provides an incentive for buyers to request a receipt from sellers so that they can claim refunds on the VAT paid on their own purchases. In principle, the VAT system sets opposite incentives for buyers and sellers: while the former would prefer to record all purchases, as they can then claim them as refunds, the latter prefer to under-report sales, so they pay less VAT. These opposed incentives might reduce the opportunities for collusive evasion and thus increase tax compliance. Another important advantage of VAT is the paper trail that it leaves behind for all transactions. Since both the seller and the buyer need to keep records for each transaction, and both need to report the relevant data to the revenue authority, the latter should in principle have more information to use for enforcement.

Despite these advantages, VAT is sometimes perceived to underperform in low and middle income countries (Keen and Simone 2004; Gordon and Li 2009; Besley and Persson 2013; Pomeranz 2015). There are at least two factors that make the VAT particularly challenging to implement in these countries. The first one is administrative complexity. Since each taxpayer's net payments are the result of the VAT due on sales minus any refund claimed on inputs, there is more information that the revenue authority needs to check to prevent evasion and fraud, compared to a simple sales tax. While checking sales is needed to prevent evasion through under-reporting, VAT also requires some kind of check on refund claims to avoid over-claiming of inputs, for example through fake invoices or multiple claims on the same invoice. Widespread anecdotal evidence on this type of fraud was one of the key motivations to conduct this study. The second challenge is evasion and informality, which are particularly prevalent in low-income countries. In a context where some taxpayers are not registered at all and under-reporting is widespread, the VAT chain may break down – thus undermining the good functioning of the self-enforcement mechanism. A typical example is the case of collusive agreements between sellers and buyers, where both parties benefit by not reporting their transaction at all (more details in Section 3).

While the informality problem is harder to fix, the first challenge (related to administrative complexity) could be solved by making better use of available administrative data. Both refund fraud and sales under-reporting could be easily detected by cross-checking the information reported by sellers and buyers, for the same transaction, using the data they report to the revenue authority (more details in sections 2 and 3). One of the key aims of our analysis of discrepancies is to check the extent to which the available data is used for enforcement in Rwanda. By doing this, we also uncover potential threats to the proper functioning of the VAT system and taxpayers' compliance with this tax. In terms of the key research questions, data and methods, our work

directly links with Almunia, Gerard, Hjort, Knebelmann, Nakyambadde and Raisaro (2017), who consider VAT discrepancies in Uganda, and provides a comparable example in a neighboring country. Our results show that discrepancies between sellers' and buyers' reports are widespread in Rwanda, despite the great enforcement efforts that the RRA has made on VAT, including the introduction of electronic billing machines (EBMs) and a new validation procedure for VAT refund claims (see Section 1). As discussed in Section 5, there are multiple explanations for this behavior, including poor recordkeeping and compliance costs, evasion, and, potentially, taxpayers' perception that the RRA does not have the necessary data to uncover cheating or that it does not have the capacity to use such data. Our results show that, even if appropriate systems are in place to collect information and support enforcement in Rwanda, it seems that their full potential remains untapped in practice.

Against this background, this report starts by providing an overview of VAT in Rwanda, including the RRA's recent measures to improve compliance. In Section 1.1.1 we also highlight how this report complements existing RRA initiatives to use available data for enforcement and risk management purposes. Section 2 describes our dataset, while Section 3 provides a basic conceptual framework for our analysis. Section 4 reports our main results on discrepancies, showing their extent and depth, disaggregating results by size, sector, and taxpayer type, as well as any changes that have occurred after the new refund claim validation procedure was introduced in January 2017 (more details in Section 1). This analysis is purely descriptive and is meant to map discrepancies, in view of potentially designing a further study to test potential policy measures to increase compliance on VAT using available administrative data. Section 5 takes stock of the results and provides some possible explanations and reflections on their implications for VAT compliance in Rwanda. Section 6 concludes and offers some recommendations for policymakers.

1   VAT in Rwanda

VAT was introduced in Rwanda in 2001, with the hope that it would largely enhance domestic revenue mobilization. The expectation was not only that it would lead to more revenue collection, but also that it would enhance other tax types by providing a wider range of data that could be referenced or cross-checked. Indeed, VAT became a key tax generator in Rwanda, representing over a third of total domestic tax revenue in 2013/14 (Mascagni, Monkam and Nell, 2016).[1] It is levied at a rate of 18 per cent, except for a number of sectors that are exempted, such as transportation and education, and a number of goods that are zero-rated, such as exports.[2]

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[1] VAT made up 32.4 per cent of total revenues in 2016/17, i.e. including revenue from customs and taxes on trade (Rwanda Revenue Authority 2017).

[2] According to Article 5 of the Code of Value Added Tax (Law 37/2012 of 09/11/2012), the following goods are zero-rated:

exported goods and services, international transportation of goods and services, goods and services to tourists, diplomats, international organizations (IOs) and non-governmental organizations (NGOs). Moreover, according to Article 6 of the same law, the following sectors are exempted: water supply, health, education, agriculture, transportation, lending, lease and sale of property, financial and insurance services, energy supply, mobile telephones

Taxpayers operating in VAT-exempted sectors do not charge any VAT, but also cannot claim any refund on their inputs, even if they pay VAT on their purchases. Note that this is different from zero-rated goods, as in this case VAT on inputs is refundable. VAT declarations are due monthly or quarterly, depending on business size.[3] All declarations are filed electronically.

As far as refunds are concerned, the law provides for a 90-day window within which refunds need to be settled. Refunds below a threshold are processed automatically and deducted from taxpayers' payments in the next VAT period. These thresholds, which are defined in terms of VAT amount, are: Rwandan Franc (RWF) 50,000 (US Dollar (US$) 57)[4] for small taxpayers, RWF 100,000 (US$ 114) for medium taxpayers, and RWF 200,000 (US$ 228) for large taxpayers. Any refund claim larger than these thresholds triggers some form of audit, either a simple desk audit or a full audit depending on the amount of the claim.[5] Our consultations with the RRA's refunds teams revealed that most taxpayers undergo some form of audit before their refunds are processed. This, coupled with limited staff in the refund teams, means that refund settlements are often delayed beyond the 90 days stipulated by law. These delays are widely seen as a major problem both by taxpayers and tax officials and emerged as a critical issue in the last Rwanda TADAT assessment.[6] Once a refund is approved, it will normally be deducted from the VAT liability, although in some special cases a refund can be paid out in cash. This is mostly the case for embassies and international organizations, or businesses that are closing.

Despite its substantial contribution to tax revenue in Rwanda, VAT has faced a number of challenges in its implementation, which have limited the realization of the intended benefits. Taxpayers were slow in implementing the tax, a challenge fueled by already low taxpayer knowledge and compliance in Rwanda. In our initial consultations, we noted a widespread concern amongst tax officials that compliance with VAT is relatively low. In particular, there seems to be a lot of anecdotal evidence of fraud on the refunds side, with taxpayers allegedly abusing the refunds system using fake receipts and multiple claims for the same receipt. This concern is indeed one of the key motivations for this analysis. However, we found that refund fraud may not be the

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and SIM cards, ICT, national defense and security. In addition, Article 7 states that zero-rated goods and services under Article 5 which are exempted under Article 6 are considered as zero-rated. So, for example, international transportation of goods and services is zero rated but other forms of transportation are exempted. Similarly, mobile phones are normally exempted, but if they are sold to a diplomat, they are zero rated.

[3] According to the Code of Value Added Tax (Law 37/2012 of 09/11/2012), taxpayers with turnover below RWF 200 million (US$ 228,050) can file quarterly, while others file monthly.

[4] An exchange rate of 877 Rwandan Francs to 1 US Dollar has been used for this and all other currency conversions in this paper. Source for exchange rate: https://www.oanda.com/currency/converter/ February 2019.

[5] For small taxpayers, a desk audit is done for refund claims between RWF 50,000 (US$ 57) and RWF 500,000 (US$ 570); for medium taxpayers, from RWF 100,000 (US$ 114) to RWF 1,000,000 (US$ 1,140); for large taxpayers, the corresponding figures are RWF 200,000 (US$ 228) and RWF 2,000,000 (US$ 2,280). Full audits are carried out for amounts greater than the respective upper thresholds.

[6] The Tax Administration Diagnostic Assessment Tool (TADAT) has been developed by international development partners, with technical input from a wide range of experts. It is designed to provide an objective, standardized, evidence-based, quality-assured assessment of a country's tax administration system, helping to make these systems fairer and more efficient. http://www.tadat.org/

main challenge, while indeed there are several issues that severely limit VAT compliance and the potential to increase this. A recent study confirms that the VAT gap in Rwanda is still high, though it is declining.[7] Therefore, there seems to be potential for increasing VAT revenue by improving compliance. To this aim, the RRA put in place a number of initiatives to increase enforcement and improve VAT compliance, and these are described in the next section.

1.1 The RRA's initiatives to improve VAT compliance

In 2013, the RRA introduced EBMs. Every business registered for VAT should install an EBM at its premises and use it for all VAT transactions. The data from these transactions is stored in the EBM and transmitted directly to the RRA. A recent evaluation has shown that EBMs increase VAT revenue substantially, but that many businesses still fail to use them (Eissa and Zeitlin 2014). The introduction of EBMs also faced a number of practical challenges, in addition to non-compliance (e.g. under-reporting of sales and failure to use the machine). For example, there is extensive anecdotal evidence that businesses fail to recharge the SIM card that allows the sending of data from the EBM to the RRA's server, resulting in a lack of data coming from a specific business, which can last for long periods of time before being fixed. Our consultations also revealed that taxpayers often do not fully understand how EBMs work and make several mistakes in inputting their sales. For example, they might include the Taxpayer Identification Number (TIN) instead of the amount, or include more zeroes – both resulting in sales amounts much larger than the true amount. We will come back to this issue in sections 4 and 5. Importantly, one of the key limitations in tapping the EBM's full potential has been the lack of the RRA's analytical capacity to make the most of the large volumes of data at its disposal.

In January 2017, the RRA introduced *validation controls on refund claims*, to tackle the issue of abuses of the VAT refund system highlighted above (e.g. fake invoices, multiple claims for the same invoice). Under this new procedure, safeguard measures were put in place to ensure that a given VAT input claim checks a number of parameters, such as: the client TIN is valid, the invoice hasn't been claimed before, the invoice was issued within a period not beyond two years (as stipulated in the law), and the invoice was produced by a machine fulfilling all EBM invoicing requirements (e.g. machine ID, date, amount). If the input claim is based on VAT paid at importation, then the validation control will also look at parameters like the importer's TIN, the customs station where the goods were cleared from, and other information such as the Déclaration de Mise en Consommation (DMC) number, date, and VAT amount. If, for instance, the claimant fails to include the receipt number or if the receipt number fails to meet the validity tests (e.g. non-existent or already claimed), the refund is automatically rejected and can only be considered upon

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[7] The compliance gap here means the difference between the potential VAT given the current policy framework and actual VAT revenues. It measures the performance of a tax administration in collecting the tax due from taxpayers. For an analysis of the VAT gap in Rwanda, see Hutton (2015). Estimates of the VAT compliance gap are also available in Mascagni, Monkam and Nell (2016).

written request to the RRA and further investigation by RRA officials. The introduction of this new validation procedure was accompanied by communication campaigns by the RRA, aimed at informing taxpayers of the new rules. While some of them will have understood its implications thanks to these RRA campaigns, others might have learned about it from experience, for example by investigating the reasons for rejected refund claims (Parekh 2017).

1.1.1   The risk team's consistency checks and complementarity with our analysis

Last but not least, the RRA's risk team conducts some consistency checks that are very similar to the ones we present in this report – although our analysis complements their work, rather than duplicating it. The risk team performs two main types of checks. The first involves checking all input refunds claims that buyers attribute to a seller, and cross-checking that total amount with the seller's report for the same period. This check is performed every month, and it is aimed at capturing cases of under-reporting by sellers. However, due to capacity constraints in the risk team, only discrepancies larger than RWF 1 million (US\$ 1,140 – in terms of VAT amount due by sellers) are cross-checked with the invoice level data from the sales annex or the EBM database (see Section 2 for more details on data). These checks yield a number of cases to be investigated, which normally amount to between 15-50 cases for monthly declarations and 100-150 for quarterly declarations. The typical cases fall in three categories: suppliers declare nil even if the buyers have a positive record; they do not declare at all; or they declare a lower amount than the buyer's record. The second check performed by the risk team involves comparing the amount of sales from the VAT declaration to the sum of transactions from the EBM dataset over the same period. Again, this is only done for large discrepancies, above a threshold of RWF 1 billion (US\$ 1.1 million) in terms of sales.

In addition to these checks, the EBM unit does sporadic and non-systematic analyses of sales discrepancies between EBM and declarations for a given period, say a quarter, to get an indication of EBM usage and potentially to contact taxpayers who seem to have large differences within a given period.

Our analysis complements these valuable initiatives in two main ways. First, we take a more systematic approach by cross-checking all possible discrepancies (see Section 3) without using thresholds or other restrictions. We also further disaggregate our results by sector, taxpayer type and firm size, as well as trends in time, to provide a complete map of discrepancies. Second, our analysis is carried out from a research perspective, rather than being motivated by enforcement needs. Therefore, we do not specifically focus on issues that are sensitive from a risk management perspective. Perhaps the most important implication of this is that we discuss at length cases where the buyers report less than the seller. While these cases do not have an immediate revenue implication, we argue that they are symptomatic of deeper issues in the way the VAT functions in Rwanda. By doing this, we provide further insight into VAT compliance that may support policymakers to improve the performance of this tax.

2 Data description

In addition to extensive consultations with RRA officials from various departments (e.g. risk, EBM, refunds teams), this study relies on administrative data from the RRA. Much attention has been paid to extracting the correct data, checking it, and ensuring that the data used is indeed complete and fit for the purpose of this analysis. More specifically, we used the following four main sources of data, which have been subject to our cross-checks and analysis.

1. *VAT declarations*. This data is at the firm level and can be quarterly or monthly.[8]
2. *Local purchases annex*. This data is filed as an attachment to the VAT declaration and follows the same submission deadlines. It is at the transaction level, including the TINs of both the buyer and the seller, and covers inputs purchased locally (i.e. excluding imported inputs).
3. *Sales annex*. This data is filed as an attachment to the VAT declaration and follows the same submission deadlines. It is at the transaction level, including the TINs of both the buyer and the seller.
4. *EBM data*. This data is at the transaction level, including the TIN of the buyer and of the seller.[9] EBM data is not submitted with the VAT declaration, but is transmitted regularly by all EBMs to the RRA's database.

Since all taxpayers who file a declaration are required to file the two annexes along with it, annexes are available for all taxpayers who declare, unless they are nil-filers.[10] In that case, since they report no sales and no inputs, they have no transaction to record (whether that is legitimate or not). On the other hand, EBM data is independent of the declaration process and could be available regardless of whether the taxpayer declared or not (see Section 4).

In addition to the four data sources above, we have tried to obtain data on refunds but have not been able to access it. In particular, we were interested in the timing of refunds (delay between claim and settlement) and in the share of accepted refunds vis-à-vis rejected ones. Instead of using such more detailed data, we are instead using data from the local purchases annex, which includes claims submitted for VAT inputs. Actual settlement of those claims happens after the time of declaration for many such cases.

All data refers to declarations filed in the period July 2016–June 2017 inclusive. This allows us to observe six months before and six months after the policy change of January 2017. All data was extracted in August 2017 and it includes any revision to tax records carried out up to that time,

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[8] The data shows that about 40 per cent of declarations are quarterly and 60 per cent are monthly.

[9] EBM data at the item level is also available, in principle, and an effort to make this dataset available for research is ongoing. We have not accessed it or used it for this study.

[10] There are only a very small minority of cases where taxpayers are missing annexes but declare positive amounts in their declaration. Of those missing the purchases annex, only nine report a positive VAT on inputs in the declaration; of those missing the sales annex, only 35 report a positive value of VAT on sales and 38 report positive purchases.

either by the taxpayer or by the revenue authority. Since VAT data is quarterly for some taxpayers and monthly for others, we have aggregated all data to the quarterly level to ensure comparability across all taxpayers. We therefore have four quarters in total, two before and two after the policy change. Most of our analysis is done using TIN-quarter (Section 4.1) or pair-quarter (Section 4.2), where pairs are seller-buyer trading partners, as the unit of observation.

Three notes are due on the data, before delving into the framework (Section 3) and the analysis (Section 4).

First, we observe a relatively large share of **nil-filers** in the declarations data: 43 per cent of TIN-quarter observations have zero total sales, zero VAT sales and zero VAT purchases in at least one quarter. This number reduces to 35 per cent if we consider the so-called chronic nil-filers, those who nil-file across all quarters in which they file. Although the reasons for filing nil are not entirely clear, this phenomenon is widespread in other African countries too (see Mascagni and Mengistu 2016 for Ethiopia and Almunia *et al.* 2017 for Uganda). In principle, there is no clear reason to exclude nil-filers from our computation of discrepancies. When one trading partner is a nil-filer, the discrepancy would simply be equal to the total value of the transaction as declared by the other partner. Since most nil-filers do not report annexes with their tax declaration, we have no transaction-level data to calculate discrepancies. To allow for the calculation of discrepancies, we consider that their record is simply zero at the transaction and at the declaration level. So, for example, we would consider a taxpayer who nil-files and has no EBM data to have zero internal discrepancy – or fully consistent records.

Second, many of the sellers' reports, both from the sales annex (93 per cent) and from EBM data (86 per cent), do not have a **valid buyer TIN**.[11] That means that either the buyer TIN was not included at all in the seller's record, or that a number was included but it did not correspond to one of the TINs in the list provided to us by the RRA.[12] In most cases the buyer would be a final consumer, although it could also be a business that did not provide its TIN at the time of the transaction. Still, we don't expect buyers to have any incentive not to include their TIN, as that would prevent them from making a refund claim on that purchase. The first explanation (i.e. related to sales to final consumers) is somewhat supported by the data, since transactions without a valid buyer TIN have a much lower value than those with a valid buyer TIN. When looking at the sales annex, the sale amount for transactions with a valid buyer TIN is on average RWF 131,000 (US$ 149), as opposed to RWF 15,000 (US$ 17) for those without a valid buyer TIN.[13] Another

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[11] On the other hand, the great majority of buyer reports (98 per cent) include a valid seller TIN, as this is required for the refund to be accepted.

[12] The RRA provided a list of all active and valid TINs available in Rwanda, which we have cross-checked against our data to exclude invalid TINs. We found some cases where a number was included as a buyer TIN, but it did not correspond to one of the TINs in the list or, in some cases, did not have the correct format for a TIN. We have excluded all such cases as invalid buyer TINs that could not be matched with buyers' records.

[13] These figures change to about RWF 100,000 (US$ 114) and RWF 16,000 (US$ 18), respectively, when looking at EBM data with and without a valid buyer TIN.

explanation for invalid buyer TINs is related to exports, as in this case foreign buyers do not necessarily have a valid TIN to be included in the seller's sales annex. In our calculation of external discrepancies, we exclude transactions where the buyer TIN is missing or not valid, as it is impossible to match these records with the sellers'.[14] If, instead, the buyer TIN is valid in the seller's record but the buyer has no record of that transaction, we consider this to be a 100 per cent external discrepancy (see Section 3). As far as internal discrepancies are concerned, we simply need to have both declaration data and the sales annex, irrespectively of whether the seller inputted a valid buyer TIN or not.

Third, as mentioned in sections 1.1 and 5.1.2, we heard examples of some very large mistakes, particularly with regard to EBM data, although such mistakes might happen in the transaction-level data reported in the annexes too. To tackle this issue, we cap discrepancies at the 99th percentile of the distribution, without deleting any observation. By doing this, we obtain a more realistic picture of the discrepancies' size, taking into account at least the largest mistakes. Still, in the appendix (tables A7 and A8) we also report our main results on the depth of discrepancy also without this cap.

3   A conceptual framework for the analysis of VAT misreporting

Based on the data described in the previous section, our main objective is to perform a systematic analysis of discrepancies amongst taxpayer records. These discrepancies can provide some preliminary indications on the extent to which the RRA is making full use of its data, and on VAT compliance. More specifically, Figure 1 illustrates the relations between the four datasets described in Section 2. The symbol (=) means that the datasets should be consistent. In other words, they should report the same data for the same taxpayer and/or for the same transaction.

Figure 1 Internal and external consistency of VAT reports

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[14] The alternative would be to assume that the buyer is not reporting the purchase, although they could have. However, assuming that the buyer is under-reporting would inflate our calculations and it would be hardly realistic, since we do expect a large share of sellers' transactions to be to final consumers.
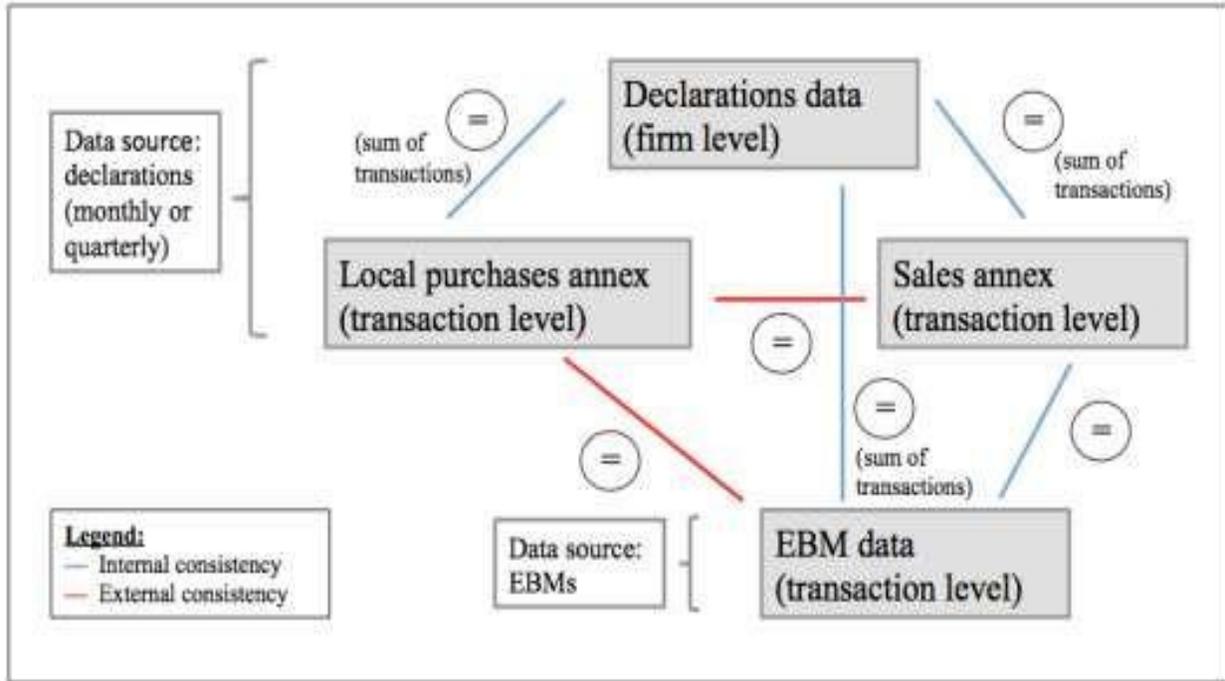
Source: Authors' elaboration.

Within this framework, our analysis looks into two types of consistency: internal and external.

Internal consistency is between the datasets connected by the blue lines in Figure 1. This consistency refers to the information reported in different data sources for the same taxpayer. For example, the sum of transactions in the local purchases annex should be the same (or sufficiently close, considering a margin of error) as the total of VAT inputs declared in the VAT declaration for the same time period (i.e. quarter or month). Similarly, the sum of transactions reported in the sales annex (or, equally, in the EBM data) should correspond to total VAT sales in the declaration. Finally, VAT transactions reported in the sales annex should correspond to EBM receipts.

External consistency occurs across taxpayers, between datasets connected through the red lines. This means consistency between what is reported by the buyer and what is reported by the seller for the same transaction. On the one hand, if there is no evasion and no mistakes, the value declared by the seller should be the same as the one declared by the buyer. This outcome, however, may also occur if they collude and both under-report the same amount. On the other hand, the two values may differ if any evasion takes place, most notably if the seller declares a smaller amount than the buyer. However, as shown in Section 4.2, we find many cases of the opposite situation too, where buyers report less than sellers.

Our data analysis provides a systematic cross-check of the RRA's datasets to uncover both internal and external discrepancies, investigating both their extent and depth. More specifically, we aim to answer the following research questions:

1. How often do discrepancies occur (i.e. extent of discrepancies, or extensive margin)?
2. How large are these discrepancies when they occur (i.e. depth of discrepancy, or intensive margin)?
3. Are discrepancies more prevalent in specific groups of taxpayers – i.e. small vs. large, personal income tax (PIT) vs. corporate income tax (CIT) – or in specific sectors?
4. Did the recent policy change (i.e. the validation procedure: see Section 1) help in decreasing the prevalence of discrepancies in VAT reports?

While investigating these questions, we also unveiled some unexpected results that, we argue in Section 5, are symptomatic of compliance issues that go beyond the specific issue of data discrepancies.

As anticipated in the introduction, in principle, neither internal nor external discrepancies should happen, as they could be easily detected and investigated by the RRA. However, as we highlighted in Section 1, the RRA's limited capacity to analyze large volumes of data prevents it from tapping the full potential of such data for enforcement. Given that these discrepancies do indeed exist, as we document in this report, it is useful to think how they can be related to non-compliance.

Unilateral vs. collusive evasion

Importantly, external discrepancies refer to cases of unilateral, rather than collusive, evasion, as only one of the two parties in a transaction misreports the relevant value.[15] If both were misreporting by the same amount, say both reporting zero instead of the true amount, there would be collusive evasion but no discrepancy would appear in the data. Such collusive agreement would be advantageous for both, since the seller would not pay VAT on the relevant sale, while the buyer would be able to get a discount equal to the VAT amount. This is an important caveat to our analysis. Since we only rely on the data that taxpayers report to the RRA, any case of collusive evasion, including cases where entire transactions are unreported, goes completely undetected in our analysis.

Seller value < buyer value

The most obvious instance of non-compliance is the case in which the value reported by the seller is lower than the value reported by the buyer. In fact, this is the main issue checked by the risk team in their regular checks (see Section 1.1.1) and one that came out in our initial consultations as a crucial source of concern. In this case, the source of non-compliance could be either the buyer or the seller. On the seller's side unilateral tax evasion could happen if the seller produces a VAT receipt for the buyer but does not include this transaction in his or her declaration. By doing this, he or she can keep the VAT amount paid by the buyer and simultaneously reduce his or her declared turnover, thus paying less tax. On the buyer's side, unilateral evasion could occur, for example, if the buyer attributes a receipt to the seller even if the transaction did not take place or if the receipt is entirely fictitious. By doing this, he or she makes a pure gain on the VAT refund.

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[15] The exception to this is mistakes that can be made by just one of the trading partners.

Seller value > buyer value

We would not instead expect many instances of the opposite case, where the amount reported by the seller is larger than the one reported by the buyer. On the one hand, it would not be in the interest of the seller to over-report turnover and thus pay more tax. There may however be a few such cases, which may, for example, refer to fake TINs of companies that then declare bankruptcy. On the other hand, the buyer would not have much of an incentive to under-report the value of his or her inputs,[16] as he or she would not be able to receive the full refund for the sale that took place. Therefore, we would, in principle, not expect to observe many cases where the seller amount is higher than the buyer amount. However, we show in Section 4.2 that cases like these are quite prevalent, and in fact more prevalent than the 'obvious' case of tax evasion where the seller under-reports and the buyer over-reports. We provide some explanations of this issue, and how it related to VAT compliance, in Section 5.

4   An analysis of discrepancies

Two things should be noted at the outset, which are relevant for both internal and external discrepancies (sections 4.1 and 4.2, respectively). First, we always use VAT amounts in our computations of discrepancies. By doing that, instead of using the value of sales or inputs, we take into account the fact that some sales, despite being subject to VAT, may enjoy a zero rate (see Section 1). In such cases, comparing the amount of VAT sales from the seller with VAT inputs from the buyer would be misleading, because the former would report such a sale, while the latter would not – since there is no VAT refund to claim. Note that, however, the same would not be true for exempted taxpayers, as they might still pay VAT without being able to claim it as a refund (see Section 1). All discrepancies in the next two sections are calculated based on VAT tax amounts. Second, we include a small margin of error in computing discrepancies, to avoid picking up rounding issues or minor mistakes. Unless indicated otherwise in the text, we disregard any discrepancy below RWF 5,000 (less than US$ 6). In other words, the data is still considered to be consistent even if a minor discrepancy of less than RWF 5,000 exists.[17]

4.1   Internal consistency

4.1.1   Calculation of internal discrepancies

First, we check the consistency of taxpayers' own reports in three ways (related to Figure 1): 1) between the sum of VAT from the sales annex and total VAT paid on sales from the declaration; 2) between the VAT sum from the local purchases annex and VAT claimed on inputs in the declaration; 3) between the sum of VAT on sales from EBM data and total VAT in the

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[16] Note that, as discussed in Section 2, our calculation of discrepancies does not include transactions for which the buyer TIN is missing or not valid. So these are cases where there is a valid buyer TIN, but the value reported by the buyer for the transaction is lower (up to zero) than the one reported by the seller.

[17] Note that this is complementary to the 99th percentile cap we use on outliers, in terms of discrepancy (see Section 2).

declaration.[18] All findings reported in this section refer to TIN-quarter observations as the unit of analysis (see section 2). As such, they should be understood as the reporting behavior of a given TIN (i.e. taxpayer) in a given quarter, not necessarily across all quarters.

Table 1 reports the extent and depth of internal discrepancies, which represent respectively the extensive and intensive margins. Since we observe discrepancies in both directions (for example, declarations being larger or smaller than the sum from the sales annex), we separate cases of positive (VAT declaration > total from annex/EBM data) and negative discrepancy (VAT declaration < total from annex/EBM data). The depth of discrepancies, or intensive margin, is calculated for cases in which a discrepancy occurs at all. We separately calculate both the average positive discrepancy and the average negative discrepancy, dividing the smaller value by the larger one at the TIN-quarter level. So, for example, a 100 per cent negative discrepancy between EBM data and the declaration means that none of the transactions from the EBM data were included in the declaration. The numbers reported in the table are the average value of these observation-level discrepancies.

Table 1 Extent and depth of internal discrepancies

Discrepancy		Extensive margin			Intensive margin		
		Extent of discrepancy	% positive – VAT decl. > annex/EBM	% negative – VAT decl. < annex/EBM	Average discrepancy	Average positive discrepancy	Average negative discrepancy
Declaration – sales annex		1.8%	0.4%	1.4%	42%	13%	50%
Declaration – purchases annex		0.05%	0.03%	0.02%	58%	28%	86%
Declaration – EBM		43%	18%	25%	34%	26%	39%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many observations out of the total have a discrepancy. The average shows the discrepancy size as a share of the larger of the two values being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

4.1.2 High level of consistency between declarations and annexes

Comparing declarations and annexes, Table 1 shows that such discrepancies are not a big issue in Rwanda: taxpayers broadly report consistent information to the RRA in their declarations and the related annexes. On the extensive margin, the local purchases and sales annexes are generally consistent with the values reported in the tax declarations. The great majority of our TIN-quarter observations show no discrepancy between the declaration and the local purchases annex (99.9 per cent) or the sales annex (98.2 per cent). In absolute numbers, internal discrepancies occur for 24 TINs from the local purchases annex and 1,007 TINs from the sales annex. Although these internal

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[18] Although we could also, in principle, check the consistency between the sales annex and the EBM data, this would be redundant given the very high consistency between the declaration and sales annex.

discrepancies are low for all four quarters covered in our data, the extent of discrepancies seems to increase in the later quarters. For sales, discrepancies increase from 1.3 per cent in the first quarter to 2 per cent in the last. For purchases, discrepancies slightly increase from 0.09 per cent in the first quarter to 0.1 per cent in the last one.[19] On the intensive margin (i.e. the depth of the discrepancy), Table 1 shows that discrepancies are a lot larger when they are negative, namely when the amount in the annex/EBM data is greater than the one reported in the declaration.

4.1.3   EBM usage and internal discrepancies between declarations and EBM data

When comparing declarations with EBM data, the first thing to note is that EBM usage seems to be relatively low in Rwanda. Amongst all TIN-quarter observations in the declarations data, only about 53 per cent also have any EBM data in the same quarter. There are three reasons that may explain this rather limited coverage of EBM data. The first one is nil-filing, as 84 per cent of those who do not have EBM data in a given quarter (but who file a declaration) declare zero turnover in the same quarter. This leaves us with 16 per cent of observations where the taxpayer declares a positive amount in their tax declaration but does not seem to have any EBM data.[20] When we cross-check EBM data with sales annexes, we find that only 15 per cent of those who submitted a sales annex (therefore excluding nil-filers) do not have any EBM data in the same quarter. Second, some firms benefit from exemptions from EBM use. These are, for example, telecommunication companies, petrol stations, financial institutions or companies that issue fewer than three invoices per year. Indeed, when considering the sector and excluding nil-filers, it can be seen that limited usage is more prevalent in financial and insurance services, where 37 per cent do not have EBM data, electricity and gas supply (31 per cent), education (28 per cent), and mining and quarrying (25 per cent). Third, there is a lot of anecdotal evidence of limited usage of EBMs. In some cases, taxpayers may simply fail to use the EBM, although they still declare the sale; in other cases there may be technical issues with the EBM that prevent them from communicating the data to the RRA (see Section 1). Interestingly, and perhaps unsurprisingly, limited coverage is a problem mostly for small firms. While EBM data is available for most large businesses (93 per cent of those in the top decile), a lower share of the smallest taxpayers seem to use EBMs or, at least, their EBM does not seem to send any data to the RRA (the figures of those with EBM data are 76 per cent and 75 per cent respectively for the first and second deciles).[21] Limited coverage of EBM data for small taxpayers is consistent with the fact, which emerged during our consultations, that taxpayers which are particularly small scale often cannot manage to use the machine properly – resulting in lack of data in some cases.

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[19] One possible explanation for the slight increase in discrepancies over quarters is that the most recent data has not yet been corrected for any revision that the taxpayer or the tax authority may want to make, which may make the data more consistent.

[20] Sixteen per cent of observations correspond to 2,705 unique TINs that appear to have this issue.

[21] Deciles are computed using the declared business income from CIT/PIT declarations in 2016. Nil-filers are removed from the calculation of deciles.

While limited coverage is a key challenge for EBM, there are also some taxpayers that seem to issue EBM receipts without declaring for VAT (4 per cent of all TIN-quarter observations in the EBM data).[22] There are at least two possible explanations for this, which emerged during our consultations. The most likely is that this issue stems from the RRA's campaigns to encourage more taxpayers to use EBMs for sales monitoring purposes, even if they are not VAT registered. One such campaign was conducted in 2016. The second explanation is that some taxpayers may voluntarily adopt the EBM even if they are not obliged to do so. They might do that, for example, if they are planning to apply for a tender – although having an EBM is not a formal requirement in many cases. There is also anecdotal evidence of some cases where an EBM was acquired to generate fictitious VAT invoices, but we would not expect such cases to be an important part of the explanation here.

On the extensive margin, discrepancies between EBM sales data and declarations are much more frequent than those between declarations and the sales annex.[23] Table 1 shows that 43 per cent of TIN-quarter observations have a discrepancy larger than our margin of error (RWF 5,000 or US$ 5.7). The cases of negative discrepancy (declaration < EBM) are more frequent than those of positive discrepancy (declaration > EBM), representing respectively 25 per cent and 18 per cent of observations reporting any discrepancy at all.[24] It is not clear why taxpayers declare less than the total amount of EBM invoices. One possible explanation is that sellers provide an EBM invoice, but then fail to include it in their tax declaration to avoid paying tax – since the tax due is calculated based on the latter. This would only be a reasonable non-compliance strategy if taxpayers thought that data from EBMs is not available to the RRA or that the RRA does not make use of it for enforcement purposes (see Section 5.1.1). Likewise, the hypothesis of human mistakes in inputting VAT in the EBM cannot be disregarded. We discuss these possible explanations in more detail in Section 5. In addition, there is a smaller but still sizeable proportion of discrepancies where the EBM amount is lower than the declaration amount. These cases might be due to delays in communication of data from EBMs, firms that are exempted from EBM use, or failure to use the EBM even for transactions that are reported in the VAT declaration.

On the intensive margin, discrepancies between EBM data and declarations can be quite large. The depth of negative discrepancies, reported in Table 1, suggests that declarations only cover about

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[22] Similarly, we have EBM data for taxpayers who have not filed a sales annex in a given quarter. This is the case for 9 per cent of taxpayers without a sales annex.

[23] It is worth noting that this is *not* due to the mismatch between EBM and declarations datasets. In fact, we keep only those taxpayers with both EBM and VAT declaration data and disregard those with either of the two sets of data missing. However, in order to consider VAT nil-filers with missing EBM data, we impute zero to VAT from EBM so to include them in the computation of discrepancy. As stated above, 86 per cent of taxpayers with missing EBM are nil-filers in VAT declaration, so they are not inconsistent. Note that including nil-filers without EBM data implies an increase of taxpayers with nil discrepancy (zero VAT declared and zero VAT EBM).

[24] In absolute terms, they correspond to 9,449 taxpayers who have at least one discrepancy in any quarter, out of a total of 17,672 that have both EBM data and a VAT declaration.

39 per cent of the total value of EBM sales as they appear in EBM data. On the other hand, positive discrepancies are larger, when they occur. In these cases, EBM data covers about 26 per cent of the declaration amount.

4.1.4 Internal discrepancies by sub-groups

We also calculate the extent and depth of discrepancy by sub-groups based on sector, taxpayer size, taxpayer type (PIT/CIT) and location. The results on sectors are presented in Table 2, while other results on sub-groups are reported in tables A1 and A2 in the appendix.

Looking at the extent and depth of discrepancies by broad sectors, Table 2 confirms that the extent and depth of discrepancies are small when comparing declarations with sales and purchases annexes (almost non-existent for the latter), but large when cross-checking them with EBM data. When considering the sales annex, manufacturing emerges as the single sector where discrepancies are both more frequent (4 per cent) and largest (about 48 per cent of the largest amount, on average), as compared to agriculture and services. A somewhat different picture emerges from the comparison with EBM data, where discrepancies are more frequent for the service sector, compared to others.

Table 2 Extent and depth of discrepancies, by sector

	Extensive margin			Intensive margin		
Discrepancy	Extent: agriculture	Extent: manufacturing	Extent: services	Depth: agriculture	Depth: manufacturing	Depth: services
Declaration – sales annex	1.6%	4%	2%	34%	48%	39%
Declaration – purchases annex	0%	0%	0.04%	-	-	42%
Declaration – EBM	29%	42%	44%	44%	30%	29%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many transactions out of the total have a discrepancy. The average shows the discrepancy size as a share of the largest amount of the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

When looking at firm size, discrepancies (both positive and negative) between EBM data and declaration values are more frequent for top decile firms – 61 per cent – compared to 45 per cent for other deciles (or smaller firms) (see Table A1). However, their nature seems to differ. The average depth is larger for smaller firms with respect to the top deciles: 35 per cent of the largest amount for smaller firms, versus about 17 per cent for the top decile (see Table A2).[25] Moreover, negative discrepancies (EBM value > declaration value) are a bit more frequent for large firms (33

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[25] In addition, in relative terms, discrepancies in large firms are more likely to be small. Discrepancies of up to 10 per cent of the declaration amount are much more common amongst large taxpayers (61 per cent of the cases) than smaller ones (29 per cent). This is consistent with generally greater compliance amongst top decile firms (Mascagni, Monkam and Nell 2016).

per cent) than for smaller ones (26 per cent).[26] This fact is somehow counterintuitive, as we would normally expect large firms to have more accurate tax records and generally to be more compliant. However, our consultations suggested that large firms may have more EBMs (for example, think of a chain of supermarkets) and therefore be more affected by (potentially large) mistakes in EBM data.

Moreover, Table A2 shows the patterns of discrepancies for CIT/PIT and in/out Kigali subgroups, who look similar for sales annex and EBM data. It seems that discrepancies are more frequent and larger for CIT; with respect to PIT; and for taxpayers in Kigali.

4.2 External consistency

4.2.1 Calculation of external discrepancies

To compute external discrepancies, we start by aggregating all transactions reported by a given actor, i.e. buyers in the local purchases annex and sellers in the sales annex, and EBM data, with a given trading partner, at the quarter level. We thus obtain the sum of VAT declared/claimed in each quarter for each pair. By aggregating at the quarter level, we avoid identifying timing issues as discrepancies, as long as the same transaction is reported in the same quarter by both trading partners, and also avoid making mistakes in the invoice numbers. Both of these things would otherwise appear as discrepancies in the transaction level data.

At this point, we match the quarter-level local purchases annexes with the sales annex or EBM data, based on seller TIN, buyer TIN and quarter. By matching we are able to see if transactions reported by a buyer or a seller in his or her annex in a given quarter are present in his or her partner's annex in the same quarter. Where there is corresponding reporting, we can compute quarter-level discrepancy as the difference between the VATs in the pair. We do not consider transactions with an invalid TIN number, to avoid including exports and sales to final consumer as discrepancies (see Section 2). However, if there is a valid TIN but no corresponding data reported by the trading partner, we consider the latter as reporting zero. So, for example, if a seller reports transactions with a valid buyer TIN in a given quarter, but that buyer never reports any purchase from that seller (e.g. he or she is a nil-filer), we consider the discrepancy for that pair-quarter observation to be equal to the full value of the transactions reported by the seller for the pair-quarter.

Our main results (in this section) refer to the aggregate values of VAT payments/refunds from sellers' and buyers' reports at the quarter level. So, the unit of observation is always the pair-

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[26] Table with this data omitted for simplicity, and available on request.

quarter. We also calculate discrepancies at the transaction level, but our results do not change much (see Table A3 in the appendix).[27]

Table 3 reports the extent and depth of the external discrepancy or, respectively, the extensive and intensive margin. It is slightly different from Table 1, as here we want to highlight four interesting cases that correspond to the columns of Table 3. These are:

1. The first trading partner (for example, in row one: the seller as appears in the EBM data) reports a transaction with a valid buyer TIN but there is no corresponding record from the other trading partner (for example, in row one: the buyer).
2. Both trading partners' records are consistent with each other, within our 5,000 RWF (US$ 5.7) margin of error.
3. The amount reported by one trading partner (for example, in row one: the buyer) is lower than the one reported by the other (also in the example of row one: the value reported by the seller in the EBM data).
4. The amount reported by one trading partner (for example, in row one: the buyer) is higher than the one reported by the other (also in the example of row one: the value reported by the seller in the EBM data).

In cases where the information is reported by both trading partners but is not consistent (cases 3 and 4 above) we also include, in the same cell, the size of the discrepancy (i.e. depth) as a share of the larger of the two values.

Table 3 Extent and depth of external discrepancies

		No corresponding record	Consistent corresponding record	Lower corresponding record	Higher corresponding record	Total
1	**EBM data (compared to purchases annex)**	66%	18.2%	10.9% (Depth: 50%)	4.6% (Depth: 47%)	100%
2	**Sales annex (compared to purchases annex)**	64%	18.5%	11.2% (Depth: 50%)	6.2% (Depth: 52%)	100%
3	**Purchases annex (compared to EBM data)**	25%	40.3%	10.2% (Depth: 47%)	24.1% (Depth: 50%)	100%
4	**Purchases annex (compared to sales annex)**	65%	18.1%	6.1% (Depth: 52%)	10.9% (Depth: 50%)	100%

Note: The average depth shows the discrepancy size as a share of the largest amount of the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

4.2.2 Extensive margin: extent of external discrepancies

Comparing sellers' reports from their sales annexes to buyers' reports from their local purchases annexes (row 2), only 18 per cent of our pair-quarter observations report consistent data. This figure is very similar when we compare EBM data to buyers' purchases annexes (row 1). This

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[27] We always compute discrepancies using two separate datasets: i) the pairs of buyers and sellers from sales and local purchases annexes, and ii) the pairs of buyers and sellers from EBM data and local purchases annexes.

leaves us with a vast majority of observations where buyers and sellers report discordant information for the same transaction. Many of these inconsistencies are due to the complete failure of buyers or sellers to report transactions that have occurred in the seller-buyer pair in the given quarter. For example, the majority of those 81.8 per cent of observations reporting any discrepancy in row 1 are due to buyers not reporting a corresponding record at all. These cases represent 66 per cent of the total, while in 10.9 per cent of the cases the buyer report is lower, but greater than zero, and in 4.6 per cent of the cases the buyer actually over-reports. Note that, as discussed in Section 2, these are all cases where the seller reported a valid buyer TIN, so the transaction could, in principle, be refunded to the buyer, as none of them is a final consumer. These percentages are qualitatively the same when comparing sales annexes with purchases annexes, as shown in row 2 of Table 1. What these figures tell us is that the vast majority of discrepancies occur because the buyer under-reports the value of the transaction, either completely failing to report it (column 1) or reporting a lower amount at the quarter level (column 3). This finding is the opposite of what we would expect (see Section 3): while the seller loses out in terms of tax payments by reporting more, the buyer also loses in terms of missed refund claims. We discuss possible reasons for this behavior in Section 5.

On the other hand, comparing the buyers' reports to the sellers', as in rows 3 and 4, reveals a somewhat larger degree of consistency with EBM data (40 per cent of pair-quarter observations are consistent), while the figure for consistency with the sales annex is comparable with those in rows 1 and 2. The fact that buyers' claims are backed up more in the EBM data than in the sales annexes is consistent with the fact that EBM data generally reports more sales than declarations or sales annexes, as highlighted in Section 4.1. When compared with EBM data (row 3), two thirds of the buyers' reports are fully backed by sellers' reports, either being fully consistent (40.3 per cent of observations) or being lower than the sellers' reports (24.1% of observations). However, when compared with the sales annexes (row 4), buyer over-reporting seems to be a much larger issue, occurring in over 70 per cent (65 per cent plus 6.1 per cent) of the cases – of which the majority are explained by no record at all on the seller side (65 per cent of all cases).

In sum, looking at all our observations, cases of buyer under-reporting (either by not reporting at all or reporting a partial amount of the total reported by the seller) are much more frequent than cases of buyer over-reporting. From the sales annex data, buyer underreporting or over-reporting occur in 75 per cent and 6 per cent of the observations, respectively. Likewise, from EBM data, buyer under-reporting and over-reporting occur in 77 per cent and 5 per cent of the observations, respectively.

4.2.3   Intensive margin: depth of external discrepancies

On the intensive margin, discrepancies are quite large. In most cases, they are equal to the entire value of the transaction, as the trading partner reports no corresponding record at all. In cases where there is a value, the depth of discrepancies is about half the highest value reported for the

same transaction. The relative size of the discrepancy is computed as a share of the discrepancy over the largest VAT value, i.e. over the buyer's VAT claims for discrepancies where VAT buyer > VAT seller, and over the seller's VAT payment for the opposite case (VAT buyer < VAT seller). The average discrepancy is always between 47 per cent and 52 per cent in all rows, and slightly larger when we compare the sales annex with the purchases annex, as opposed to the EBM data and the purchases annex (see Table 3). In absolute value, the average discrepancy for the case of sales annex > purchases annex (for the pair-quarter observation) is about RWF 340,000 (US$ 388), while the same figure for cases where EBM data > purchases annex is about RWF 492,000 (US$ 561). To give a sense of the magnitude of these discrepancies, the average discrepancy in the largest decile of the discrepancy amount is RWF 2.5 million (US$ 2,851) for the case of sales annex > purchases annex. Dispersion is also large, as the average discrepancy in the smallest decile is just about RWF 7,000 (US$ 7.9). We observe the same pattern when looking at cases where EBM data > purchases annex: the average amount is RWF 2.2 million (US$ 2,508) in the largest decile, falling to RWF 7,000 (US$ 7.9) in the smallest one.

4.2.4 External discrepancies by size, location, taxpayer type and sector

Next, we match the VAT discrepancies dataset with CIT/PIT declarations for fiscal year 2016, to get additional variables that define sub-groups. As in Section 4.1.4, we do this because income tax declarations contain detailed information on important variables such as location, tax type and sector, which are not available in the VAT dataset. An implication of this is that we can only observe these variables if a VAT taxpayer filed an income tax return. This poses a problem, as buyers and sellers can be of different types (i.e. one a corporation and the other an unincorporated PIT taxpayer) or work in different sectors (or at least they might be classified differently). The shares reported in Table 4 refer to characteristics of the buyer in each of our pair-quarter observations. Clearly, we could only do this for those TINs that matched with TINs in the CIT/PIT data. These are respectively 80 per cent and 77 per cent of the total buyer TINs that appear in the 'sales annex–purchases annex' discrepancy dataset and the 'EBM data–purchases annex' discrepancy dataset. In Table A4 in the appendix, we report the same discrepancy details using the characteristics of sellers from each pair quarter observation. In this case, we find that most of those appearing as sellers in our observations also declared income tax.[28] Looking at different sub-groups of taxpayers, it seems that discrepancies where the buyer reports more than the seller (unilateral evasion, as discussed in Section 3) are more prevalent in Kigali and for taxpayers filing for CIT rather than PIT. As far as sectors are concerned, there seem to be more buyers over-reporting in manufacturing. These trends are consistent when using either the sales annex or EBM data. Table 4 summarizes the results, showing the share of cases in which the buyer reports more than the seller, with the opposite case omitted for brevity and the two summing up to 100 per cent.

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[28] Ninety-three per cent of seller TINs in the 'sales annex–purchases annex' discrepancy dataset match with TINs from CIT/PIT declarations. Likewise, 92.5 per cent of seller TINs in the 'EBM data –purchases annex' discrepancy dataset do the same.

Tests for significance in differences within categories have been carried, too. P-values are all equal to zero, meaning that the differences within location, tax types and sectors are all highly statistically significant.[29] We discuss sectors in further detail in Section 5, where we try to identify whether VAT-exempted sectors can be an important explanation of the external discrepancies we document here.

Table 4 Extent of external discrepancies, by location, taxpayer type and sector of buyers

Discrepancy	Location		Taxpayer type		Sector		
	In Kigali	Out of Kigali	CIT	PIT	Agriculture	Manufacturing	Services
Sales annex < purchases annex	37%	32%	37%	31%	30%	38.5%	36%
EBM sales data < purchases annex	31%	24.5%	31%	26%	22.6%	30%	30%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many pair-quarter observations out of the total have a discrepancy. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

4.2.5   Trends of discrepancies by quarter: before and after the policy change

As discussed in Section 1, the policy change of January 2017 introduced a new validation procedure for input refund claims that was intended to reduce fraud. We therefore explore the frequency of external discrepancies by quarter, to check if these decreased after the policy change. Table 5 shows promising evidence of the effectiveness of the new procedure. It includes the frequency of any discrepancy (as a share of total observations), including cases where the buyer's report is larger than the seller's, and cases where there is a buyer report but no corresponding record for the seller TIN indicated by the buyer (see Section 4.2.1). The cases where the buyer report is larger than the seller's (i.e. what the procedure aims to prevent) decreased drastically in the first quarter of the policy change (quarter 3): from 37 per cent to 28 per cent when using the sales annex (row 2) and from 15 per cent to 7 per cent when using EBM data (row 4). This percentage remains similarly low in quarter 4 in both cases, although it increased slightly in the EBM case, potentially because buyers may be learning what information is required in the new procedure (Parekh 2017). When comparing both sales annexes and EBM data with buyers' reports, we find that the decrease in buyer over-reporting was accompanied by a higher frequency of buyer under-reporting (or seller over-reporting), which may be the result of a higher percentage of rejected claims (see rows 1 and 3). We also run a chi-square test for the significance in the change in shares between quarters 2 and 3, when the policy change kicks in. Asterisks in column 3 indicate that the p-value of the test is lower than 1 per cent. This means that the differences across quarter

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[29] Asterisks omitted for clarity.

2 and 3 are highly statistically significant and we can reject the null hypothesis that the shares in these two quarters are statistically equal.

Table 5 Extent of external discrepancies by quarter

Discrepancy	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Sales annex > purchases annex	26.8%	29.4%	37.6% ***	37.3%	33.1%
Sales annex < purchases annex	40.2%	37.1%	28.3% ***	28.4%	33.8%
EBM sales data > purchases annex	44.7%	45.9%	53.2% ***	51.8%	49.3%
EBM sales data < purchases annex	16.6%	14.9%	6.7% ***	7.9%	11.1%

Note: All figures include the 'no corresponding record' cases. All figures are frequency of any discrepancy over the total of pair quarter observations. Quarter 1 = July–September 2016; quarter 2 = October–December 2016; quarter 3 = January–March 2017; quarter 4 = April–June 2017. *** indicates a p-value lower than 1% – in this case, p-values are always zero. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

5 Discussion of results

In Section 4 we presented several results, both on internal and external discrepancies (sections 4.1 and 4.2), disaggregated by sub-groups (sections 4.1.4 and 4.2.4) and looking at trends over quarters to evaluate the new registration procedure (Section 4.2.5). These results, as much as they are informative, also raised a number of questions that we aim to address in this section.

5.1 Why would a taxpayer report inconsistent information to the RRA?

Our analysis of internal discrepancies revealed that taxpayers often report inconsistent information to the RRA, especially when comparing EBM data with their declaration. Just over half of all our TIN-quarter observations have consistent information in that comparison (see Table 1). In Section 4.1 we document both cases of positive (declaration > EBM) and negative (declaration < EBM) discrepancies. While the former may be the result of limited EBM usage (see sections 1.1 and 4.1.3), the latter is not only more puzzling, but also more frequent. It is therefore the case we focus on in this section. Why would taxpayers report inconsistent information to the RRA, and thus expose themselves to the risk of being caught misreporting and, potentially, prosecuted? This problem seems to occur particularly in the comparisons with EBM data, when looking at cases of internal consistency where the sum of recorded EBM transactions is greater than the declaration for the same TIN-quarter observation. Rational taxpayers would make sure that, at least, the information *they* report to the revenue administration is consistent, to leave as few clues as possible for the RRA to detect any misreporting. Our consultations with relevant RRA departments (e.g. EBM team, risk team, business analysts) revealed two possible explanations for this apparently puzzling behavior, which probably occur at the same time rather than being alternatives.

5.1.1 Evasion and taxpayer beliefs about the RRA's capacity

First, taxpayers may not know that the RRA has all the necessary data to uncover discrepancies in their reports, or they might know the data is available but believe that the RRA does not have the capacity to do this. In this scenario, they would be issuing EBM receipts, but would then fail to include those sales in their declaration. Since taxes are calculated on the amount declared (declaration and annexes), rather than based on EBM data, the taxpayer would be able to gain from this type of evasion. Still, why would a seller issue an EBM invoice if he or she is intending to evade? One possibility is that buyers require invoices, for example if they want to claim VAT refunds or claim a purchase as a business expense in their income tax declaration, or if they want to have proof of purchase in case of any checks.

Having fully consistent information takes taxpayers some time and effort, and that may not seem to be worth it unless there is a high enough (perceived) probability that the RRA would actually uncover and follow up such misreporting. In other words, taxpayers believe they can get away with such inconsistencies. This belief, in fact, would not be entirely wrong. Before the new validation procedure (see Section 1.1), the RRA did not have any system in place to systematically cross-check data. Even after its introduction, the validation procedure only covers refund claims, not sales data, and it seems that a small but sizeable proportion of TIN-quarter observations still do not add up (see Table 5). Moreover, the checks performed by the risk team are only done for some cases, and not systematically for all taxpayers (see Section 1.1.1). As far as we are aware, there is no comprehensive check for all consistency relations shown in Figure 1. However, the available data is still used on a more ad-hoc basis during the audit process, so that specific consistency checks are regularly carried out for specific taxpayers.

5.1.2 Mistakes and quality of taxpayers' recordkeeping

The second explanation for the frequent and large differences between declarations and EBM data is simply that EBM data may contain a lot of mistakes. Our consultations with the EBM team revealed a lot of anecdotal evidence of taxpayers' mistakes in inputting data into the EBM. For example, some taxpayers mistakenly include a TIN number instead of the amount or they input more zeroes than they should. In both cases, the amount on the EBM records would be much larger than the true value. If a taxpayer knew he or she had made such a mistake, he or she could in principle refund the sale through the machine, keeping the original invoice, and issue a new, correct invoice. However, many taxpayers might not even be aware of the mistake, or they might not refund the mistaken invoice and issue the correct one, as we heard the process is rather laborious. In fact, from our data we can see that just 1 per cent of the transactions recorded through the EBM refer to this type of refund.[30] This issue is related to the general low quality of recordkeeping amongst taxpayers in Rwanda, as well as compliance costs. In this context, taxpayers may declare what they know is correct, rather than the total from the EBM, because they know there are mistakes. Part of the problem, therefore, lies in taxpayers' use and general lack of understanding of the machine. This is consistent with the fact that many taxpayers have been forced to adopt an

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[30] In such cases, we can see the refund in the dataset. All our EBM data is net of such refunds.

EBM at the time they were rolled out, but might not have sufficient knowledge about its functioning and its connection to the tax declaration – despite the RRA's efforts on taxpayer education.[31]

Once a mistake is in the EBM database, the only way taxpayers can correct it is by presenting the original invoice and requesting that the EBM team amend the records.[32] Otherwise the EBM team does not normally attempt to identify and correct mistakes, unless they are very large and obvious. For example, if a taxpayer normally has sales of RWF 10,000 (US$ 11.4) but reports one sale of RWF five billion (US$ 5.7 million), the EBM team might spot the mistake and get in touch with the taxpayer to clarify and amend the relevant record in the EBM database. However, this can only happen for very clear cases, while the norm is that mistakes remain in the database.

The widespread presence of mistakes in the EBM data, with most of them resulting in larger values, could explain cases of negative discrepancies (declaration < EBM). While one would expect small taxpayers to be more prone to making such mistakes, our consultations suggested that they might be frequent amongst large businesses too. This is because large businesses have more EBMs, more transactions and, thus, greater potential to make mistakes. Indeed, from our calculations, it can be noticed that negative discrepancies represent a third of all observations in the top decile and 26 per cent on average in all the others. The extent of negative discrepancies falls to just 8 per cent of observations in the bottom decile.

5.2 Why do buyers report less VAT than sellers?

The results of Section 4.2 show that many cases of external discrepancy are due to buyers reporting less than sellers, either because they do not report the sale at all, or because they report a lower quarterly amount than the one reported by the seller for the same pair quarter.[33] The most frequent case is the former, where there is a valid buyer TIN in the seller record, but no corresponding record on the buyer's side. This result is quite unexpected, as we were anticipating more cases of

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[31] Upon acquisition of an EBM machine, the taxpayer is taught by the supplier about the technical specifications for its usage, e.g. how to load airtime, how to cancel an entry, etc. In addition, the RRA has a range of taxpayer education programmes encouraging EBM usage. These include field visits where taxpayers are informed of their obligations regarding EBM, their rights, and the punitive measures for non-compliance; and leaflets with all necessary information, etc.

[32] This, in principle, could also be done through the machine by going transaction by transaction, but it is not straightforward unless the mistake is detected immediately. In other cases, when it is clear that there is a mistake, but the taxpayer does not have the original receipt, they write to the Domestic Tax Department commissioner informing them of this error and asking for that entry to be discarded. In response, the commissioner refers them to the relevant section of the law that guides taxpayers on cancellation of errors. Taxpayers are encouraged to take stock of these records as they could be referenced during an audit. However, there are few such cases.

[33] From the transaction level EBM-local purchases dataset, we can see that in most cases of buyer under-reporting when there is however some report from the buyer, they selectively report some invoices and not others (only 18 per cent of EBM receipts with valid buyer TINs are claimed back), rather than making partial claims on individual invoices (among the transactions reported by buyers and sellers, consistency occurs for 51 per cent of them). Similarly, only 4 per cent of reported sales with a valid buyer TIN are claimed by purchasers. However, when the same invoices are reported by both partners, consistency occurs for almost all of them: 95 per cent.

buyers over-claiming than under-claiming (as discussed in Section 3). There are at least two possible explanations for this behavior, which we discuss in the next sub-sections.

5.2.1   Buyers who cannot claim VAT refunds

The most obvious reason why buyers may not be claiming VAT refunds is that they cannot do so, either because they are VAT exempted or because they are not VAT registered. As far as exempted taxpayers are concerned, they do not charge VAT but might still pay it on their purchases. If they do, they would not be able to claim it as a refund, as discussed in Section 1. To check this possibility, we tried to match goods which are VAT exempted under the law with sectors in our data. The law provides for VAT exemptions in the following sectors: water supply, health, education, agriculture, transportation, lending, lease and sale of property, financial and insurance services, energy supply, mobile telephones and SIM cards, ICT, national defense and security.[34] Unfortunately it is not possible to match all of them with the sector variable in our dataset, or at least not with sufficient precision. However, using the ones that do match, we have computed discrepancies separately for those that we can classify as exempted, compared to others.[35] In Table A5, exempted sectors are: water supply, education, transportation (although in our data this category also includes 'storage'), agriculture, financial and insurance services. Table A5 is fully comparable with Table 3 in terms of the computation of values, but only reports the relevant comparisons. Generally, exempted sectors have a greater incidence of cases where there is no buyer record (see column 1), thus confirming this explanation.

The second possibility is that buyers who fail to claim are not VAT registered. They might, for example, be below the VAT threshold[36] and be liable for turnover tax instead, or be NGOs and embassies that have a TIN but are not VAT taxpayers. In that case, they have no incentive to ask for an invoice for the purpose of claiming a VAT refund. However, they might still need it to claim the purchase as a business expense in their income tax declaration, if they file one, or because they might be asked in other types of checks, for example during the transport of goods. To explore this, we check discrepancies specifically for the sub-group of taxpayers that are registered for VAT.[37] Relatedly, it is worth noting that about 12,000 unique seller TINs report sales to some 32,000-40,000 unique valid buyer TINs. However, buyer TINs actually claiming are about 9,000.[38]

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[34] Article 6 of Law 37/2012 of 09/11/2012.

[35] The sectors that do not perfectly match, and that we therefore exclude from the exempt category in this section, are: security (as it is described in the tax code) with public admin and defense, compulsory social security (our data); telecommunications (as per the tax code) with information and communication (our data); lending, lease and sale (as per the tax code) with real estate activities (our data); energy supply (as per the tax code) with electricity, gas, steam and air conditioning (our data); public institutions (as per the tax code), which can be found in different sectors in our data.

[36] A taxpayer must register for VAT if their turnover is above RWF 20 million (US$ 22,805) per year or above RWF 5 million (US$ 5,701) for three consecutive quarters.

[37] We use the list of VAT-registered taxpayers from June 2017, as received by the RRA. Relatedly, 88 per cent of these taxpayers have declared in at least one quarter in the period under study (July 2016–June 2017).

[38] Relatedly, also note that: 1) just 1 per cent of TIN-quarter observations with positive VAT input have no sales; 2) 23 per cent of observations with positive sales have zero VAT on purchases; and 3) consistently, 98.5 per cent of those

Table A6 restricts the analysis to VAT registered taxpayers only. It is worth noting that only 43 per cent of valid buyer TINs reported in the sales annex are actually VAT-registered taxpayers. Similarly, 34 per cent of valid buyer TINs from EBM data are VAT registered. The results in Table A6 show that external discrepancies are still very frequent, even once we exclude taxpayers who are not VAT registered. Even in this sub-sample, only about 25 per cent of observations report fully consistent records, and there are still many buyers who do not claim refunds they could claim, even if they are indeed VAT registered.

A last, more marginal, explanation is that buyers who fail to claim are government institutions, which are not required to claim their purchases but follow a different claiming mechanism.[39] To check for that, we matched our sample with a list of 3,633 government TINs provided by the RRA. First, it can be observed that only 38 per cent (1,370) of these taxpayers appear as buyers in the period under study, representing 1.4 per cent of the total buyer TIN-quarter observations. Second, in the vast majority of the cases – 98 per cent – the discrepancy is due to the buyer totally failing to claim, consistent with the fact that government institutions are not required to claim refunds on inputs. However, they represent a negligible share of the total buyers: when we remove them from our analysis, the share of buyers failing to claim falls from 64 per cent (row 2, column 1 in Table 4) to 63.2 per cent. That means that the vast majority of non-government buyers are still failing to claim refunds for some other reason. In the following subsection we explore a second possible group of explanations.

5.2.2 Appearing small and avoidance of checks

A completely different explanation for buyers' under-reporting points to a deeper issue with VAT non-compliance. If taxpayers are evading VAT by under-reporting their sales, they might not want to claim all the inputs they could claim. By 'appearing small' on both the input and the sales side, they can avoid raising suspicions and, importantly, avoid finding themselves in a refund position. As discussed in Section 1, most taxpayers who claim refunds undergo some kind of check before their refund is approved. Our consultations with officials in the refunds team revealed a widespread perception that taxpayers know this, although they might not be aware of the precise thresholds triggering audits (see Section 1). Therefore, taxpayers may prefer to reduce their refund claims to avoid such checks, which may unveil deeper issues relating to their compliance.[40] Our consultations with tax officials revealed that this explanation is indeed plausible. This explanation is somewhat supported by two facts from our data. First, most taxpayers avoid being in a refund position, i.e. reporting more VAT inputs than VAT outputs. Indeed, just 5 per cent of taxpayers

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who are a buyer in a quarter are also a seller in the same quarter, while 77 per cent of sellers in a quarter are also buyers in the same quarter.

[39] We thank the RRA for suggesting this possible reason for the failure to claim.

[40] Note that up to July 2017, taxpayers could decide to delay their refund claims up to two years, while since then the claim has to be done in the same period as the invoice.

failing to claim in a quarter are in a refund position in the same quarter.[41] Second, we look more closely at those buyers who have a record, but for a lower amount than the one reported by the seller. In these cases, the buyers report VAT inputs that are relatively close, in terms of the amount, to the VAT on output. On average, these taxpayers' VAT input is 63 per cent of the output, while the same figure for the broader population of TIN-quarters is 46 per cent. This is suggestive that, by claiming more, they might be pushed in a refund position. It must be noted that these results, while suggestive, are largely speculative.

However, we cannot rule out that part of the reason also lies with poor recordkeeping (i.e. taxpayers may not have the relevant purchase record anymore) and with distrust in the refunds system, especially due to severe delays in processing refunds (see Section 1). In this context, taxpayers may prefer to under-report both sales and inputs instead of waiting for a long time to obtain refunds, while in the meantime struggling to manage their cash flow.

As a final consideration, another plausible explanation for buyers' under-reporting lies in the strategic use of cumulated VAT on inputs. As emerged in many internal discussions with different RRA departments,[42] buyers in Rwanda usually do not claim all the VAT on inputs at once, in the quarter in which the purchase happens, but prefer to wait and postpone the claim until a future date. Given the two-year time window in which they can claim a refund,[43] buyers would strategically choose in which quarter to claim in order to offset a position in which they have VAT due (for example, a period with more sales), to reduce the VAT they owe. In order to corroborate this argument, Table A9 reports the extent of buyers under claiming when we aggregate transactions at the year level, from July 2016 to June 2017. When considering transactions at the year level, we would expect to see a reduction of buyer under-reporting if the strategic use of claims takes place. For example, a purchase made in the first quarter could have been claimed in the last one and, at the year level, the VAT on the purchase should then match the VAT on the sale as reported by the seller. Indeed, Table A9 shows a slight reduction in the share of buyers failing to claim, from 64 per cent at the quarter level to 59 per cent at the year level. This reduction is almost negligible and is made even less significant by being accompanied by only a small increase in the share of consistent recording and, more importantly, by a parallel increase of the share of buyers still claiming a smaller VAT amount. In conclusion, under-claiming seems to remain widespread and it is still not exactly clear what motivates it.[44]

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[41] Most tellingly, 23 per cent have VAT inputs exactly equal to VAT outputs while 71 per cent report VAT output larger than VAT input. Moreover, it must be noted that just 45 per cent of taxpayers failing to claim in a quarter actually declared VAT in a quarter, so that these figures refer only to a sub-group of buyers not claiming.

[42] Such as the large taxpayer office, small and medium taxpayer office, refund team, EBM team, risk department.

[43] The two-year time window has been removed since June 2017, but it was still valid during the period under study.

[44] It could well be that the postponing of VAT on inputs goes beyond the year, given the two-year time window allowed to make a refund. In order to check for that, we extracted the local purchases annex in February 2019. If late claiming takes place, we would see that in the newly extracted data. However, when we run the same matching with the sales annex, the share of missing claims remains exactly the same as the one summarized in Table 3.

5.3 What is the potential revenue gain from closing discrepancies?

Based on the discrepancies identified in Section 4, a relevant question would be whether closing such gaps would bring about any revenue gains. As far as internal discrepancies are concerned, revenue gains could be likely but there are a number of important caveats to keep in mind. Revenue gains would only be realized in cases of discrepancies in which the sales annex or EBM data report larger values than the tax declaration.[45] In such cases, the RRA could plausibly seek explanations from taxpayers about the discrepancy, since their own reports seem to suggest greater sales than reported in their tax declarations. The first important caveat, however, is that the existence of a revenue gain would lie in the fact that the sales annex or EBM data always report the correct value. However, as discussed in Section 5.1.2, this is far from being true. If it were, closing discrepancies with the sales annex would yield a revenue gain of RWF 13 billion (US$ 14.8 million), while the same figure would be RWF 38.2 billion (US$ 43.5 million) from closing the gap with EBM data.[46] While these figures seem to suggest the presence of substantial benefits from making better use of existing data, three important caveats are in order. First, the potential revenue gain would certainly be lower once one allows for possible refunds that may be associated with these under-reported sales. Second, as already mentioned, at least part of the discrepancies may be due to errors and may therefore not result in a revenue gain upon further investigation. Third, taxpayers may respond to increased scrutiny by finding other ways to evade and even increasing their informal activity. For these reasons, these figures should be taken with a lot of caution and it is far from guaranteed that these revenue gains would materialize in practice.

As far as external discrepancies are concerned, we can expect different potential implications for revenue generation depending on the direction of the discrepancy. On the one hand, the cases of seller report < buyer report might result in a revenue gain, as they are likely to refer to unilateral evasion (by the seller) or refund fraud (by the buyer), as discussed in Section 3. Although this type of discrepancy is less frequent than the other case (seller report > buyer report), closing this gap would produce additional revenue between RWF 103 billion (US$ 117.4 million) and RWF 39 billion (US$ 44.5 million), depending on whether we consider the gap between buyer's reports and, respectively, sales annexes or EBM data.[47] These estimates suffer from the same caveats highlighted in the previous paragraph, related to offsetting refunds, mistakes, and potential

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[45] We could plausibly assume that if the annex/EBM amount is lower than that in the declaration this is because it is incomplete (rather than being incorrect), since taxpayers have no incentive to over-report in their declaration. The resulting revenue gain figure is the sum of all discrepancies between VAT declared and VAT from sales annex/EBM data, in the cases in which the VAT from the sales annex/EBM is larger than the VAT declared, with a RWF 5,000 (US$ 5.7) error margin and with outliers capped at the 99th percentile.

[46] If instead all discrepancies were to be closed, including both cases in which VAT from sales annex/EBM data < VAT declared and cases in which the reverse is true, the revenue gains would be lower as the latter would result in a revenue loss – always assuming the sales annex/EBM data is always right. In that case the revenue gains would be RWF 12.2 billion (US$ 13.9 million) and RWF 17.4 billion (US$ 19.8 million) respectively for the sales annex and the EBM data.

[47] This figure is the sum of all seller report < buyer discrepancies, across all quarters, with a RWF 5,000 (US$ 5.7) error margin and outliers capped at the 99th percentile.

increases in evasion. On the other hand, the case of seller report > buyer report might result in a revenue loss, for cases where the buyer can indeed claim a refund (see Section 5.2.1) and assuming the buyer is under-reporting, since the seller has no incentive to over-report. Although the first order revenue implication of increasing buyer claims would be negative, if the 'appearing small' explanation is correct (see Section 5.2.2), encouraging buyers to claim more could also result in an increase in their declared sales.

To answer the question on whether revenue gains can be realized, it seems that for both external and internal discrepancies the actual potential for revenue generation is quite small – at least until some of the issues with the data and technology are addressed, as discussed in the next section.

6   Concluding discussion and reflections for policymakers

In this study we analyze the information on VAT declaration from different data sources and measure the discrepancies between them. Two types of discrepancies result. On the one hand, an internal discrepancy arises when a taxpayer declares inconsistent VAT in his or her declaration and VAT annex. On the other hand, external discrepancy refers to the gap, for the same transaction, between the buyer's and seller's records. We provide a first attempt to map the extent and depth of these discrepancies in Rwanda and, at the same time, detect any changes that occurred as a result of the new refund claim validation procedure introduced in January 2017, mostly affecting buyers' reporting.

In terms of results, internal discrepancy does not seem to be a big issue, with the exception of sizeable gaps between VAT declaration and EBM data. Instead, external discrepancy is much more widespread. Indeed, just 18 per cent of VAT declared by sellers in the sales annex is accurately reported by corresponding buyers in the purchases annex. This share rises to 40 per cent when buyers and EBM sellers are matched. While this study is purely descriptive, more efforts are needed to explain what determines discrepancies and, consequently, what policy measures should be taken to tackle these inconsistencies. Nevertheless, we still provide some reflections for policymakers and some recommendations.

First, we consider the internal discrepancy between VAT declared and EBM data, which involves 43 per cent of all transactions. Nil-filing and VAT exemptions may partly justify this pattern. However, there is a lot of anecdotal evidence of limited or inaccurate usage of EBM, which could be a key explanatory factor. It could be argued that usage is not optimal on the taxpayers' side, and that they may frequently make mistakes in inputting VAT due to lack of knowledge or the machine's technical glitches. At the same time, it is difficult to imagine the RRA using EBM data for enforcement, given the possibility of widespread mistakes. A number of recommendations could be framed. First, going forward, it would be ideal to clean the EBM dataset to minimize the incidence of mistakes. This could be done in various ways, such as through taxpayer education campaigns teaching users how to use the EBM and make refunds, and online tools to explain how

the EBM works;[48] or through the adoption of a system that can detect large mistakes, for example transactions that seem to be disproportionately large with respect to the business – in this case, specific criteria should be formulated to flag such cases and avoid creating too much of a backlog to be checked. Second, similarly to the purchase automatic verification procedure, the same could be done for the sales annex, so that taxpayers could not file a sales annex for a larger amount than the declaration.[49] From recent discussions with the EBM team, we found out that they launched a sales validation control system in January 2019. Third, the RRA could also run systematic (or even random, to allow for capacity constraints) cross-checks with EBM data. However, this is not advisable until the issues with mistakes in the EBM data are addressed. Fourth, in terms of future research, a key question would look into the reasons why EBM usage is scarce. In particular, a random survey of taxpayers with a low EBM usage would gather their views and inform the RRA as well. A field experiment could be implemented where taxpayers are targeted with different types of messages and change in EBM usage is measured. However, it must be noted that this research would be more related to the specific case of limited EBM usage, rather than to the broader issue of low VAT compliance as a whole, thus producing results that eventually would not be easily generalizable.

Second, we now focus on external discrepancies between different trading partners. Although we find many cases of the typical example of seller under-reporting (or buyer over claiming), somewhat unexpectedly, the majority of discrepancies are due to a buyer under claiming or not claiming at all. This second finding is puzzling and may be symptomatic of deeper issues with compliance and the functioning of VAT, such as buyers willing to appear small or trying to avoid checks, or issues with the refund process. More importantly, under claiming is something that is usually not detected by the risk team, as 'buyer < seller' is not seen as a risk issue. Again, a number of possible recommendations could be produced. First, the implementation of systematic cross-checks of cases of buyer over-reporting/seller under-reporting can yield some improvements in compliance and potentially some revenue gains (with the necessary caveats). However, systematic cross-checks need to be accompanied by adequate capacity and staff to follow up on these potential cases. The risk team and the refunds team currently seem understaffed. A better option might be to add some random cases of discrepancy, on top of the (sensible) criterion of investigating only

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[48] A user guide has been developed but not yet implemented. This guide should be promptly uploaded to the RRA's website and be made available both in terms of written and visual-audio demonstrations online.

[49] The RRA risk team already runs these kinds of checks looking at the total output reported in the EBM data and the VAT declaration. However, they are not automated and cover only large discrepancies. Indeed, we measured that, by using only the RWF 1 billion (US$ 1.1 million) threshold on total amounts from EBM data, the risk team can only detect 1.6 per cent of the cases where output declaration < output EBM (85 per cent of all observations), and 1.3 per cent of the cases where output declaration > output EBM (13 per cent of all observations), while the rest remain undetected. Please note that the 85 per cent and 13 per cent shares here refer to discrepancies in output amounts, not VAT declared, as in the report. We created this discrepancy by taking the difference between the total value of supplies as in the VAT declaration (output declaration) and the total amounts of EBM sales (output EBM) as in the EBM data.

large ones.[50] This would address some of the taxpayer perception issues mentioned in Section 5.1.1. Second, we encourage the RRA to develop a system (similar to the input validation control) that provides a report of taxpayers who are not claiming in a given period, measures the extent of 'missing' claims and triggers a quick follow up by the RRA. It could be possible to include a pop-up message targeting buyers under-claiming which informs them of how much is still missing next time they file and claim. Third, related to future research, the overarching research question would look at what determines the large extent of misreporting of both sellers and buyers. A field experiment could be set up where we randomly target a large number of pairs of trading partners with specific nudges related to some given testable hypothesis. An example of a nudge would consist in informing the 'missing' partner in a pair that his seller/buyer reported a valid transaction with him for a given amount of VAT. Different types of messages could be adopted: enforcement-like input where the extent of penalties and fines for evading VAT is stressed; information about how the RRA uses VAT data in a smart way; or a more service-oriented approach where the taxpayer is invited to contact the call centre to rectify his or her position.[51] The RRA's SMS platform could be used to send messages on a large scale. The main outcome would be the extent of discrepancies after the treatment, which we expect to be lower. A short phone survey could be included in order to gain more information about the sample.

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[50] By using the RWF 1 million (US 1,140) threshold on monthly VAT amounts, the risk team can only detect 33 per cent of the cases where the sum of VAT claimed by all buyers from a specific seller is larger than the VAT declared by that seller. The rest still remains undetected.

[51] Focusing on buyers under-reporting only, for example, one possibility could be to provide detailed information about the refund process.

Appendix

Table A1 Extent of internal discrepancies, by taxpayer type, size and location

Discrepancy	CIT	PIT	Small	Large	In Kigali	Out of Kigali
Declaration – sales annex	2%	1.6%	2.1%	7.5%	2.1%	1.6%
Declaration – purchases annex	0.05%	0.04%	0.07%	0.06%	0.05%	0.04%
Declaration – EBM	44.3%	44%	45%	61%	47.5%	44.3%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many transactions out of the total have a discrepancy. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A2 Average internal discrepancies, by CIT/PIT, size and location

Discrepancy	CIT	PIT	Small	Large	In Kigali	Out of Kigali
Declaration – sales annex	42%	38%	46%	33%	41%	43%
Declaration – purchases annex	52%	20%	55%	53%	64%	16%
Declaration – EBM	34%	29%	35%	17%	33%	32%

Notes: the figures show the discrepancy size as a share of the largest amount between the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A3 Extent and depth of external discrepancies – transaction level

		No corresponding record	Consistent corresponding record	Lower corresponding record	Higher corresponding record	Total
1	EBM data (compared to purchases annex)	81.9%	17.8%	0.27% (Depth: 70%)	0.03% (Depth: 66%)	100%
2	Sales annex (compared to purchases annex)	96.2%	3.63%	0.13% (Depth: 71%)	0.04% (Depth: 66%)	100%
3	Purchases annex (compared to EBM data)	63.2%	36.1%	0.1% (Depth: 66%)	0.6% (Depth: 70%)	100%
4	Purchases annex (compared to sales annex)	96.6%	3.24%	0.04% (Depth: 66%)	0.12% (Depth: 71%)	100%

Note: The average depth shows the discrepancy size as a share of the largest amount of the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A4 Extent of external discrepancies, by location, taxpayer type and sector of sellers

Discrepancy	Location		Tax type		Sector		
	In Kigali	Out of Kigali	CIT	PIT	Agriculture	Manufacturing	Services
Sales annex < purchases Annex	36%	35.8%	36%	35%	40%	33.5%	36.4%
EBM sales data < purchases annex	30%	26.7%	30%	29%	29%	31%	30%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many transactions out of the total have a discrepancy. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A5 External discrepancies for exempted and non-exempted sectors

	No corresponding record	Consistent corresponding record	Lower corresponding record	Higher corresponding record	Total
Exempted sectors					
EBM data (compared to purchases annex)	81%	9%	2% (Depth: 48%)	8% (Depth: 67%)	100%
Sales annex (compared to purchases annex)	78%	9.5%	3% (Depth: 48.2%)	9.5% (Depth: 68%)	100%
Other sectors (non-exempted)					
EBM data (compared to purchases annex)	65%	19%	5% (Depth: 47%)	11% (Depth: 50%)	100%
Sales annex (compared to purchases annex)	63%	19%	6.5% (Depth: 48%)	11.5% (Depth: 49%)	100%

Note: The average depth shows the discrepancy size as a share of the largest amount of the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A6 External discrepancies for sub-sample of VAT-registered taxpayers

	No corresponding record	Consistent corresponding record	Lower corresponding record	Higher corresponding record	Total
EBM data (compared to purchases annex)	54%	25%	15% (Depth: 50%)	6% (Depth: 47%)	100%
Sales annex (compared to purchases annex)	52%	25%	15% (Depth: 50%)	8% (Depth: 48%)	100%

Note: The average depth shows the discrepancy size as a share of the largest amount of the two being compared. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A7 Depth of internal discrepancies without capping

	Average	Positive	Negative
Declaration – sales annex	42%	14%	51%
Declaration – purchases annex	56%	28%	82%
Declaration – EBM	34%	27%	39%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The average discrepancy shows the discrepancy size as a share of the largest amount of the two being compared. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A8 Depth of external discrepancies without capping

	Lower corresponding record	Higher corresponding record
EBM data (compared to purchases annex)	51%	173%
Sales annex (compared to purchases annex)	50%	53%
Purchases annex (compared to EBM data)	173%	51%
Purchases annex (compared to sales annex)	53%	50%

Notes: discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The average discrepancy shows the discrepancy size as a share of the largest amount of the two being compared. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

Table A9 External discrepancies at the year level – buyers under-claiming

	No corresponding record	Consistent corresponding record	Lower corresponding record	Higher corresponding record	Total
Sales annex (compared to purchases annex)	59.2% (64.1%)	20% (18.5%)	13.4% (11.2%)	7.4% (6.2%)	100%

Note: figures at the quarter level in brackets. A discrepancy occurs if the gap is larger than the error margin of RWF 5,000 (US$ 5.7). The extent of discrepancy refers to how many transactions out of the total have a discrepancy. To control for outliers, all discrepancy amounts are capped at the 99th percentile. This table is based on the authors' calculations based on administrative data from the RRA for June 2016–July 2017.

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