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Tax evasion in Kenya and Tanzania: Evidence from missing imports ☆

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ABSTRACT

In this paper we estimate the amount of tax evasion in customs authorities in both Kenya and Tanzania by calculating measurement errors in reported trade flows between the two countries and correlate those errors with tax rates. We find that the measurement error is correlated with the tax rates in Tanzania. We also introduced a third country into our analysis, the United Kingdom, and tax evasion seems to be more severe in trade flows between Kenya and Tanzania compared to trade flows between the United Kingdom and Kenya/Tanzania. Finally we also find that the tax evasion coefficient is lower in the Kenya–United Kingdom case compared to the Tanzanian–United Kingdom case which suggests that tax evasion is more severe in the Tanzanian customs authority.

1. Introduction

Building the capacity of low-income countries to mobilise more tax revenues is currently at the top of the development policy agenda. Tax-systems have undergone major changes since the mid-1990s, and the reform process is expected to continue. Some of the important changes expected are a simplification of the tax-regime, including broadening of the tax-base; the rationalisation of the exemption-system to avoid further erosion of the tax-base; and a review/change of tariff-rates and the introduction of revenue-raising measures to compensate for possible losses arising from the further liberalisation of the trade-regime (IMF, 2011). Another important change is to improve the efficiency of the tax administration itself. A number of African countries have implemented comprehensive reforms of their tax administrations. Part of the exercise has been to establish autonomous revenue authorities, which would be less vulnerable to political intervention and tax evasion practices.

According to the Transparency International Corruption Perception Index, Tanzania has always ranked higher than Kenya in the overall perception index (Transparency International (TI), various years). In the Kenyan case, a more detailed analysis shows that the overall bribery index has declined over the years (TI-Kenya bribery reports, various issues). The Kenyan tax authority has improved its overall index over time, and it was ranked as one of the most improved organisations within the country in 2004. Corrupt practices have been reported within the tax administration in Tanzania (Ehrhart and Mwaipopo, 2003; Fjeldstad and Rakner, 2003). More recent evidence suggests that this is still the case in Tanzania: a third of those that had been in contact with the customs department had paid a bribe (Transparency International-Kenya, 2013). In the same survey, it was also found that 23% bribed the tax authorities. In the Kenyan case, 25% paid a bribe to the customs department while 14% paid a bribe to the tax authorities. Thus, although Tanzania is performing better on the overall corruption rating compared to Kenya, Tanzania is performing worse in those institutions that are crucial to the mobilisation of tax revenue.

In this paper, we estimate the amount of tax evasion in Kenya and Tanzania based on trade flows and the average tax rate on imported products. Following the methodology outlined by Fisman and Wei (2004), we compare the discrepancy in Tanzania's recorded imports from Kenya with Kenya's recorded exports to Tanzania. The same approach, but opposite, is used to evaluate tax evasion on the Kenyan side. The trade gap is assumed to be a proxy for tax evasion. In principle, the reported trade flows should be the same, assuming no evasion (and measurement errors). In their study on China, Fisman and Wei (2004) matched the measurement error with product-specific tax rates and found that the measurement error is highly correlated with Chinese tax rates. A novel feature of their approach is that they were able to differentiate between three different aspects of tax evasion: underreporting of unit value, underreporting of taxable quantities, and mislabelling a higher-taxed product as a lower-taxed type.

In this paper, we present evidence of tax evasion in both Kenya and Tanzania. By studying the developments over two years, we are also able to report whether tax evasion is improving or worsening over time. Furthermore, introducing a third country, the United Kingdom (UK), enables us to compare tax evasion not only between two developing countries but also between a developed and a developing country. Finally, using the method of Pritchett and Sethi (1994), we examine the responsiveness of tariff revenues to tax rates for Kenya and

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Tanzania and use those results as a robustness check for the other results obtained in this paper.

The paper proceeds as follows. In the next section, we provide a brief overview of the theory of tax evasion and related empirical studies. Section three describes the methodology and the data used in the study. The empirical results are presented and analysed in section four. Finally, conclusions are provided in the closing section.

2. Tax evasion — theory and empirics

A number of theoretical models that aim to incorporate tax evasion have been developed. The seminal work in the area is from Allingham and Sandmo (1972), who created a model based on a risk-averse taxpayer. The outcome of the model shows that a higher penalty rate or a higher probability of detection tends to discourage tax evasion and that a higher tax rate will induce more tax evasion. More recent studies have questioned the expected utility maximisation framework of the Allingham–Sandmo model (A–S model) due to its poor fit to observed behaviour of choice under uncertainty. For example, Eide (2002) replaced the expected utility with rank-dependent expected utility, which resulted in a more restricted model, but the comparative statics of the evading person were still the same as in the A–S model. Another critique of the A–S model is that it isolates the decision to evade from other types of economic decisions, e.g., the decision to work in the informal market. Sandmo (2004) sketches an extension of the A–S model to allow for a labour–leisure choice in the utility function, mirroring the choice between hours spent to earn regular income and hours spent either on leisure or on informal market activities.

The theoretical literature is often concerned with evasion by individual taxpayers, but firms can also be evaders of indirect taxes. The seminal work in this area is Marrelli (1984), who extended the A–S model to instead fit a risk-averse firm and established results very similar to the A–S model. In a later study, Marrelli and Martina (1988) extended Marrelli's (1984) work to an oligopolistic framework with strategic interaction between firms. More recently, the research regarding the connection between firm behaviour and tax evasion has shifted attention from indirect taxes to corporate income taxes (Chen and Chu, 2002; Crocker and Slemrod, 2003). According to this literature, the theoretical framework of the A–S model is inadequate because the model does not distinguish between ownership and control of a firm, which is crucial because the choice to evade depends on who will be penalised. A recent review of the literature on tax evasion has shown that the theoretical predictions for the effect of tax rates on evasion are dependent on modelling assumptions (Slemrod and Yitzhaki, 2002). Hence, empirical studies would be useful both from a theoretical and a policy perspective.

Pritchett and Sethi (1994) examine the relationship between tariff revenues and tariff rates using data from Jamaica, Kenya, and Pakistan. They find a weak relationship between de facto tariff rates, calculated by dividing tariff revenues with import values for each product, and statutory rates. Fisman and Wei (2004) analyse the effect of tax rates on tax evasion in the trade flow between Hong Kong and China, and they note that the evasion gap is highly correlated with tax rates: much revenue is lost on products with higher tax rates. The point estimates suggest that China's average tax rate on its imports is already on the wrong side of the Laffer curve: any increase in the tax rate is likely to produce a reduction rather than an increase in tax revenue. On average, a one percentage point increase in the tax rate induces a three percent increase in evasion. They also conclude that practices such as underreporting import unit values and mislabelling higher-taxed products as lower-taxed varieties are widespread.

One important area where tax evasion has been reported to be a severe problem is customs duties. There are, to our knowledge, only a few studies in this area focussed on African data. For instance, in Mozambique, there are substantial differences between the policy stance as given in the published tariff rates and de facto trade policy (Arndt and Tarp, 2007). Overall, the actual tariff revenue in 1997 was slightly less than 40% of the level projected by the de jure tariff rates and estimated import volumes. A more recent analysis using the Fisman–Wei approach found a strong and positive effect from tax rates on tax evasion in Mozambique (Dunem and Arndt, 2009). For every percentage point increase in customs tax rates, evasion increases by 1.4%.

Bouët and Roy (2012) in a comparative study of Kenya, Nigeria and Mauritius also found a significant effect from tariff rates on evasion. The point elasticity for Kenya was similar to the above study on Mozambique, at approximately 1.4. However, this evasion elasticity is based on import tariffs only, excluding other taxes.[1] They also found that the ranking of the estimated evasion elasticity matched the ranking of these three countries in terms of institutional quality approximated by the Transparency International Corruption Perception Index. Even if the Kenya bribery index appears to have improved over time, their estimate for the evasion elasticity appears to have risen between 2001 and 2004.

Tsikata (1999) finds large discrepancies for Tanzania between revenues as implied by the published tariff and estimated import volumes versus the actual receipts. The differences are explained by a combination of (legal) exemptions, corruption/smuggling across official entry points (ports and roads) and smuggling across unofficial entry points (unguarded borders). A study by Mpango (1996) focused on measuring the magnitude of deliberate under-invoicing of imports in Tanzania and the related motivating factors. The magnitude of deliberate aggregate under-invoicing of imports was found to be approximately 20%, induced by high scheduled tariff rates, vigorous exchange rate adjustment, low salaries and minimal incentives offered to the customs staff and opportunities for evasion. The issue of tax evasion as a factor that contributes to poor tax performance is also discussed in Mwinyimvua (1996), who cites avenues for the evasion of import duties and sales and excise taxes that include under-invoicing, smuggling, the use of tax exemptions, complex tax schedules, excessive documentation, and corruption.

Although tax reforms in Tanzania have made the tax regime simpler in terms of rate structure and the number of tariff bands, tax exemptions are still a concern. In 2000, the Tanzania Revenue Authorities reported that tax exemptions were in the range of 2.3% of the tax-GDP ratio, which is equal to approximately 24% of total revenue collected (Sogema, 2013). The level of tax exemptions in Tanzania is still high. In Tanzania, between 2005/6 and 2007/08, tax exemptions averaged 3.9% of GDP. In comparison, in Kenya and Uganda, exemptions amounted to 1% and 0.4% of GDP, respectively (Sogema, 2013).

3. Methodology and data

In this study, we will focus on four issues. The first is whether there is any correlation between the measurement error, as reported by the ratio between exports and imports, and the tax rate in both Tanzania and Kenya.[2] This correlation can be identified in two ways: we first utilise data on imports and exports reported in values and we secondly utilise data on imports and exports reported in quantities. The second issue that we want to analyse is whether the trade gap is due to mislabelling a higher-taxed product as a lower-taxed type or not, using both value and quantity data. Thirdly, we will also analyse whether there is any

[1] As in Fisman and Wei (2004), we will argue that the sum of tariffs, VAT and excise duties is the most appropriate measure. Multiple sources of taxation that increase the average tax rate on imported products are, from a theoretical perspective, likely to lead to higher evasion. As a robustness check, we have also replicated some of the regressions, restricting the tax variable to include only the tariff rate at customs. The results are similar to those reported in the text.

[2] In this study, legal import tax exemptions are accounted for. The ratio between exports and imports includes all registered trade-flows including legal exemptions. As statutory tax rates are used in the regressions, the results are not affected by any difference in legal exemptions between the two countries. However, using de facto tax rates (as in Section 4.1), legal exemptions could affect the results.

difference in the magnitude of the coefficient on tax rate in the two countries. If the answer is yes, it would imply that tax evasion is more severe in that particular country. Finally, we introduce a third country into our analysis, the UK, which enables us to undertake a similar analysis between the UK and Kenya and Tanzania.

Following the approach established by Fisman and Wei (2004) and using a terminology similar to Dunem and Arndt (2009), for every product that country A imports from country B, the value of exports (X_V) is defined as the value reported by country B and the value of imports (M_V) as that reported by country A. Similarly, using quantities instead of values, export quantity (X_Q) is the quantity of exports reported by country B and import quantity (M_Q) is the quantity of imports reported by country A. Furthermore, we define our measure of evasion to be determined by the ratio between export value (export quantity) and import value (import quantity). Ideally, in a case with no evasion and no measurement errors, this ratio should be equal to one.

Starting with our first issue, viz. examining whether the ratio is increasing in the tax rate due to evasion, we specify a linear relationship between the export–import ratio in value and the tax rate:

$$Log\left(\frac{X_V}{M_V}\right)_i = \beta_0 + \beta_1 \times taxrate_i + \varepsilon_i \tag{1}$$

where sub-index *i* denotes products and *taxrate* denotes product specific tax rates (tariffs plus value-added tax and excise duties) in the importing country.[3] If evasion is induced by the tax rate, we expect $\beta_1 > 0$. The interpretation of β_1 (if $\beta_1 = 3$, for example) is that if the tax rate increases by one percentage point, the gap between reported exports and imports increases by three percent. In the case where quantities are used instead of values, the following equation will be used[4]:

$$Log\left(\frac{X_Q}{M_Q}\right)_i = \beta_0 + \beta_1 \times Taxrate_i + \varepsilon_i. \tag{2}$$

The approach in this study supposes that tax rates are implicitly exogenous in the equation explaining tax evasion. It is, however, possible that strong evasion for a product incites the government to reduce tax rates. This result is most likely more likely in regard to local government taxes. For example, in Tanzania, several nuisance taxes were recently abolished (Levin, 2005). Import duties and value added taxes, which are the focus in this study, are less likely to be endogenous, particularly when a country is a member of a regional integration zone.[5]

The import value (or quantity) reported by country B may not be the true direct imports from country A because both direct imports from country A and transhipments through country A from other countries may be misreported as direct imports from country A. Denoting the true direct imports by country B from country A by *M*, the misclassified direct imports can be expressed as (following the terminology by Dunem and Arndt (2009)):

$$M_i^* = (1+\theta_i)M_i; \quad \text{and} \quad 0 \le \theta_i \le 1 \tag{3}$$

where θ_i is an independent and identically distributed (*iid*) random variable. Using Eq. (3) together with Eq. (1) (or 2 for quantities), the transformed baseline equation in values will become,

$$Log\left(\frac{X_V}{M_V^*}\right)_i = \beta_0^* + \beta_1 \times Taxrate_i + u_i \tag{4}$$

where

$$\beta_0^* = \beta_0 + E\left(\varepsilon_i - log\left(1+\theta_j\right)\right)$$

and

$$u_i = \varepsilon_i - log\left(1+\theta_j\right) - E\left(\varepsilon_i - log\left(1+\theta_j\right)\right) \sim N\left(0, \sigma^2\right).$$

In the modified model (Eq. (4)), both the constant term, β_0^*, and the error term, u_i, are assumed to be *iid*. In the empirical section, Eq. (4) will be used to evaluate the relationship between the export–import ratio in value and the tax rate.[6]

There remains the problem that tax evasion not only takes the form of underreporting but also of mislabelling imports (our second issue); Fisman and Wei (2004) assume that this type of mislabelling is easier between similar products. Therefore, the average tax variable (*Avg_sim_tax*) is defined as being the average level of the tax rate of *all other products* in a goods 4-digit class, weighted by the export value. Adding the average tax variable to the right hand side of the regression function gives the following:

$$Log\left(\frac{X_V}{M_V^*}\right)_i = \beta_0^* + \beta_1 \times Taxrate_i + \beta_2 \times Avg_{sim}tax_i + u_i. \tag{5}$$

If evasion by mislabelling is a problem, one would expect β_2 to be negative, i.e., the lower the tax rate on product *i*'s similar varieties, the greater the incentive for mislabelling the import of product *i*. Similarly, in the case of using quantities instead of values, the following equation is used:

$$Log\left(\frac{X_Q}{M_Q^*}\right)_i = \beta_0^* + \beta_1 \times Taxrate_i + \beta_2 \times Avg_{sim}tax_i + u_i. \tag{6}$$

Following Dunem and Arndt (2009), we also extend Eq. (5) to include a squared tax rate variable, to discover whether there is a non-linear relationship between the tax rate and the trade gap. This process gives us the following equation:

$$Log\left(\frac{X_V}{M_V^*}\right)_i = \beta_0^* + \beta_1 \times Taxrate_i + \beta_1 \times (Taxrate_i)^2 + \beta_2 \times Avg_{sim}tax_i + u_i. \tag{7}$$

Finally, in this study we do not control for exemptions because of lack of data. Legal import tax exemptions are accounted for in our gap analysis because the gap between exports and imports includes all registered trade-flows including legal exemptions. As statutory tax rates are used in the regressions, the results are not directly affected by any difference in legal exemptions between the two countries. Indirectly, the results could, however, be affected because evasion may be less sensitive to tax rates for products where exemptions are common compared to products for which exemptions are rare (Fisman and Wei, 2004). This implies that in the Kenyan and Tanzanian context, we would expect evasion elasticity to be lower in Tanzania compared to Kenya. A generous exemptions scheme would lead to fewer tax-evading efforts. Another effect of excessive use of exemptions is that

[3] This specification follows both Fisman and Wei (2004) and Dunem and Arndt (2009) because $log(X/M) = log\,X - logM$; it is also referred to as the *trade gap* in the text.

[4] The ideal way to measure the trade gap is to use import values and export values exclusive of CIF/FOB. However, by regressing the trade gap in quantities on the tax rate, this problem is circumvented, which results in similar β-values. In the cases where values are used instead of quantities, the CIF–FOB problem creates a gap value, but there is no reason why it should be positively correlated with the tax rate. The same discussion also holds, according to us, in the case of *errors*.

[5] Kenya and Tanzania are both members of the East African Community (EAC). Kenya is a member of COMESA (Common Market for Eastern and Southern Africa), which Tanzania left in 1999. Tanzania is still a member of SADC (Southern African Development Community). Tanzania decided to leave COMESA primarily because it felt that membership in SADC better served its regional integration interests.

[6] A similar transformation of Eq. (2) is performed to evaluate the relationship between the export–import ratio in quantities and the tax rate.

Table 1
Summary statistics of the trade flows between Kenya and Tanzania and vice versa in 2000.

Tax evasion Tanzania	Mean	Median	Min	Max	SD	N
$Log(X_V)$	9.399	9.077	6.244	15.238	1.963	767
$Log(M_V)$	9.359	9.199	6.248	15.433	1.715	767
$Log(X_V/M_V)$	0.040	−0.079	−5.955	7.063	1.553	767
$Log(X_Q)$	9.020	9.101	1.099	16.017	2.533	546
$Log(M_Q)$	8.734	8.880	2.079	15.989	2.329	767
$Log(X_Q/M_Q)$	0.004	0.013	−5.800	6.543	1.800	546
Taxes	0.364	0.400	0.000	0.750	0.125	767
–Import duty	0.177	0.200	0.000	0.250	0.088	767
–Excise duty	0.004	0.000	0.000	0.300	0.036	763
–VAT	0.183	0.200	0.000	0.200	0.057	767
Avg_sim_tax	0.366	0,440	0.000	0.750	0.128	549
Tax evasion Kenya	**Mean**	**Median**	**Min**	**Max**	**SD**	**N**
$Log(X_V)$	9.911	9.944	6.436	14.367	2.102	77
$Log(M_V)$	9.479	9.434	6.415	14.365	2.012	77
$Log(X_V/M_V)$	0.431	0.219	−4.106	5.513	1.980	77
$Log(X_Q)$	10.267	10.358	3.689	16.014	3.044	77
$Log(M_Q)$	10.274	10.221	3.912	16.005	2.670	58
$Log(X_Q/M_Q)$	0.724	0.446	−6.569	7.699	2.173	58
Taxes	0.275	0.230	0.000	1.480	0.211	77
–Import duty	0.170	0.150	0.000	0.400	0.102	70
–Excise duty	0.019	0.000	0.000	1.300	0.149	77
–VAT	0.172	0.180	0.000	0.180	0.038	45
Avg_sim_tax	0.230	0.230	0.000	0.530	0.150	32

Note: SD is standard deviation and N is number of observations.

high tax rates may increase incentives for exemption seeking (Fisman and Wei, 2004).[7]

The trade data used in the study is taken from the COMTRADE database, maintained by the United Nations (UN), and is recorded according to the Harmonised Commodity Description and Coding System (HS) at the six-digit level. The years used in this study are 2000 and 2004, and they are recorded according to HS (1996). The tax data (import duty rates, VAT rates and excise duty rates) were provided by the Tanzanian Tax Authority and the Kenya Institute for Public Policy Research Analysis (KIPPRA) at the six-digit HS level for the year 2000.[8, 9]

Table 1 describes some characteristics of the variables used in the study. An important difference between the two countries is the number of observations. Kenya has a more diversified export structure, which implies that a larger number of Kenyan products are entering the Tanzanian market compared to Tanzanian products entering the Kenyan market. Thus, a greater number of observations are used to measure tax evasion in Tanzania than in the Kenyan case. However, when analysing evasion between the UK and the two African countries separately, there are a wider range of products traded between the UK and Kenya compared with the UK and Tanzania (see Table A1 in Appendix A).

The average measurement error value (*the trade gap*) is lower in Tanzania (0.04) compared to Kenya (0.43) (Table 1). The average measurement error value in the trade between the UK and Tanzania is 0.06, and it is −0.16 between Kenya and the UK (Table A1). These results indicate that measurement errors (values) in the trade data are on average higher between Kenya and Tanzania or the UK compared with the

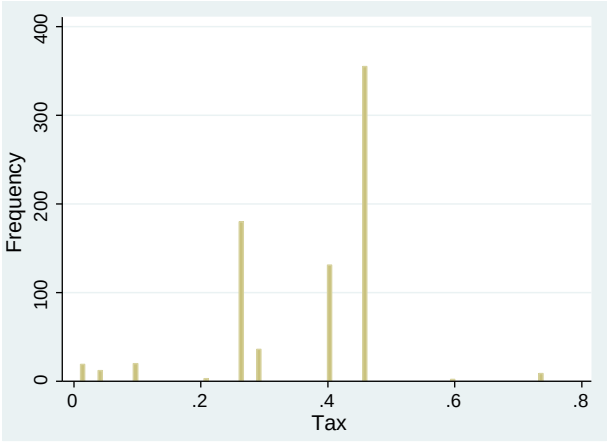

Fig. 1. Frequency distribution of tax rates by 6-digit HS category in Tanzania.

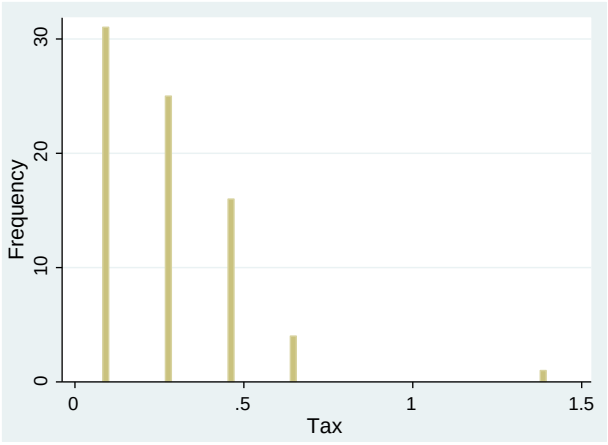

Fig. 2. Frequency distribution of tax rates by 6-digit HS category in Kenya.

average measurement errors between Tanzania and Kenya and the UK. With regard to quantities, we find a similar pattern except in the average measurement errors based on the trade flow between Tanzania and the UK. Here we find a higher (absolute) average measurement error value compared to the Kenya–UK case. Another observation is that the trade gap in values is not equal to that measured in quantities, indicating that some evasion might take the form of underreporting per unit values (Tables 1 and A1).

The average de facto tax rate in Tanzania is 36% with a maximum of 75%, and in Kenya, the average de facto value is 27% with a maximum tax rate at 148% (Tables 1 and A1).[10] The average de facto import duty rates are close to other studies on trade policy in Kenya and Tanzania (Morrissey and Jones, 2008). The higher average tax rate in Tanzania is due to wider coverage and a higher VAT compared to Kenya (Tables A3–A4).[11]

The distribution of tax rates (import and excise duties and VAT) in the Tanzanian and Kenyan tax data are shown in Figs. 1 and 2. The variation in the different tax rates in each country's data is low but acceptable according to the two graphs. Finally, in Figs. A1 and A2 (Appendix A), the distribution of the logarithmic trade gap is drawn for both Kenya and Tanzania using all observations with reported values for

[7] Fisman and Wei (2004) calculate the fraction of imports that is exempted for each six-digit product and add that as a control variable in the regressions. They found that higher exemption rates lower the incentives for evasion. Moreover, they also found that for a product with complete exemption, there is no effect on evasion from tax increases. By contrast, for industries with no exemptions, there is a significant effect on tax evasion.

[8] Because the COMTRADE database does not contain export and import data on a more disaggregated level than the 6-digit HS level, the tax data were collected on the same HS level. Because the World Customs Organisation governs the first six digits of the HS classification, it ensures that the same classification is used in all three countries addressed in this study.

[9] We have assumed no changes in the tax rates between 2000 and 2004 due to lack of data. Bouët and Devesh (2009) report small variation in Kenyan tariffs between 2000 and 2004.

[10] The products with a tax rate above 100% are exclusively tobacco products, and they comprise an infinitely small part of total imports into Kenya from the UK in 2000.

[11] Tables A3–A4 (in Appendix A) show the trade gap, tariff and tax structure and share of imports across groups of commodities. There is no clear correlation between trade gap and average duties and taxes in both countries.

Table 2
Results for the transformed baseline model in 2000.

Tax evasion Tanzania	Constant	Taxes	R^2	N
	β_0*	β_1		
Total sample	−0.911*** (0.214)	2.614*** (0.543)	0.044	767
Excluding first and last percentile	−0.916*** (0.178)	2.587*** (0.457)	0.052	751
Excluding first and last 0.05 quantile	−0.663*** (0.147)	1.850*** (0.374)	0.040	689
Excluding products lacking tax on similar products	−0.854*** (0.265)	2.407*** (0.656)	0.038	549
Excluding products lacking observations on quantities	−0.908*** (0.260)	2.763*** (0.671)	0.051	546
Excluding products lacking tax on similar products and observations on quantities	−0.723** (0.322)	2.203*** (0.810)	0.035	384
Tax evasion Kenya	Constant	Taxes	R^2	N
	β_0*	β_1		
Total sample	0.533 (0.422)	−0.371 (0.919)	0.002	77
Excluding first and last percentile	0.417 (0.367)	0.026 (0.840)	0.000	75
Excluding first and last 0.05 quantile	0.392 (0.274)	0.071 (0.635)	0.000	69
Excluding products lacking tax on similar products	0.365 (1.063)	−0.252 (2.943)	0.000	32
Excluding products lacking observations on quantities	0.652 (0.406)	−0.570 (0.749)	0.005	58
Excluding products lacking tax on similar products and observations on quantities	1.329 (1.120)	−3.110 (3.070)	0.037	24

Note: Robust standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Table 3
Results for the augmented model in 2000.

Tax evasion Tanzania	Constant	Taxes	$Taxes^2$	*Avg_sim_tax*	R^2	N
	β_0*	β_1	β_2	β_3		
Omitting $Taxes^2$	−0.827*** (0.268)	2.972** (1.230)	–	−0.641 (1.171)	0.039	549
Full regression	−0.702* (0.420)	2.035 (2.149)	1.664 (3.214)	−0.729 (1.232)	0.040	549
Excluding products lacking observations on quantities	−0.597 (0.545)	2.001 (2.906)	1.334 (3.685)	−0.696 (1.851)	0.036	384
Tax evasion Kenya	Constant	Taxes	$Taxes^2$	*Av_Tax_Sim*	R^2	N
	β_0*	β_1	β_2	β_3		
Omitting $Taxes^2$	0.365 (1.063)	−0.252 (2.943)	–	0 (0)	0.000	32
Full regression	−1.207 (1.020)	17.750** (8.132)	−34.420** (15.310)	0 (0)	0.136	32
Excluding products lacking observations on quantities	−0.713 (1.148)	19.300 (12.050)	−44.460* (24.090)	0 (0)	0.140	24

Note: Robust standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Table 4
Results for the quantity model in 2000.

Tax evasion Tanzania	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0*	β_1	β_2		
Omitting Av_Tax_Sim (Eq. (6))	−1.001*** (0.288)	2.821*** (0.738)	–	0.039	546
Full regression (Eq. (7))	−1.023*** (0.367)	2.210 (1.608)	0.738 (1.618)	0.048	364
Excluding products lacking observations on Av_Tax_Sim (Eq. (6))	−0.995*** (0.355)	2.872*** (0.894)	–	0.048	364
Tax evasion Kenya	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	0.812* (0.427)	−0.325 (0.861)	–	0.001	58
Full regression (Eq. (7))	0.783 (0.961)	1.404 (2.798)	0 (0)	0.006	24
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	0.783 (0.961)	1.404 (2.798)	–	0.006	24

Note: Robust standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

both import and export. Both graphs show fairly normally distributed shapes, although the number of observations in the Kenyan data is somewhat restricted (Table A2).

4. Empirical results

Table 2 presents the regression results for the transformed baseline model in values (Eq. (4)). In the Tanzanian case (the upper part), the estimate of β_1 is positive and significant with an estimated value of 2.6, suggesting that if the tax rate increases by one percentage point, the trade gap increases by 2.6%.[12] The results appear to be robust to the test for the influence of outliers (rows 2 and 3). We also perform several robustness tests by creating sub-samples of the data (rows 4–6), and the resulting coefficient on tax rate, β_1, is unchanged. In the Kenyan regressions, β_1 is statistically insignificant, suggesting that there is no problem of tax evasion present in the data. When comparing these results with results from regressions performed on data from 2004, we find similar results (Table A7). The coefficient on tax rate is positive and significant in the Tanzanian case, whereas it is insignificant in the Kenyan case. The estimate for β_1 in 2004 is approximately 3.6 in the Tanzanian data, which is higher than that in 2000, indicating that evasion is increasing over time (Table 3).

Because tax evasion sometimes occurs as mislabelling a higher taxed product as a lower taxed similar variant, we make use of the augmented model in Eq. (5). We find no evidence of mislabelling in the data for Tanzania because the coefficients on squared tax rates ($\beta 2$) and on average tax rates ($\beta 3$) are insignificant.[13] Using data from 2004, we find results indicating that there is a problem from mislabelling in Kenya and that the relationship between tax rate and trade gap is linear due to insignificant $\beta 2$ values in both countries (Table A8).

So far, we have found evidence of underreporting in values in Tanzanian for both 2000 and 2004 and some evidence of mislabelling in Kenya. However, underreporting may not only occur in reported values but also in reported physical quantities. In Table 4, the results from Eq. (2) (the transformed baseline model in quantities) and Eq. (6) (the augmented model in quantities) are presented.

The results show that there is evidence of underreporting in quantities in Tanzania in 2000 of a magnitude (approximately 2.8) similar to that of values (see Table 2), and no evidence of mislabelling. In the Kenyan data, there is no indication of either underreporting or mislabelling, which is consistent with the case using values (Table 2). When comparing these results with the results from 2004, there are some differences (Table A9). The coefficient on tax rate is positive and significant in all three specifications for Tanzania. In Kenya the second specification (based on Eq. (7)), the coefficient on taxes (β_1) is positive and significant, and on average tax on similar products (β_2) is negative and significant, which is in accordance to our expectations (if mislabelling is occurring).

The results shown so far in this section contain several interesting features. There is evidence of underreporting of both values and quantities in the Tanzanian data and some evidence of mislabelling in Kenya. This result basically holds for both years of the study. Based on this result, we can interpret these results by stating that tax evasion is a larger problem in Tanzania compared to Kenya. However, to be able to compare the magnitude of the coefficient on tax rates between Kenya and Tanzania, we ran our regressions again using two other datasets linking the trade flow between the UK[14] and Kenya and the UK and Tanzania. The results from the various regressions are presented in Appendix A (Tables A4–A6 for 2000 and A10–A12 for 2004). Most of these results are similar to those we have presented so far, indicating that the Tanzanian Customs and Tax Authority are less efficient compared to its Kenyan counterparts.

Table 5
Estimation results from regressing the collected rate on the official rate.

Type of OLS regression	Kenya		Tanzania	
	Coefficient	R^2	Coefficient	R^2
Linear	0.73	0.24	0.68	0.09
	(0.10)		(0.04)	
Weighted by import values	0.73	0.24	0.68	0.09
	(0.10)		(0.04)	
Weighted by official rate	0.60	0.17	0.68	0.13
	(0.08)		(0.04)	
Linear, excl. obs. where the collected rate is zero	0.75	0.23	0.68	0.09
	(0.11)		(0.04)	

Note: Robust standard errors in parentheses. For the first three regressions, the number of observations for Kenya is 272 and for Tanzania is 1704. When the zero collected rates are excluded, the number of observations does not change for Tanzania and falls to 241 for Kenya.

4.1. Robustness check

The results so far show that tax evasion is more severe in Tanzania compared to Kenya, even when using data on trade flows from the United Kingdom to the two countries. As a robustness check of these results, we follow Pritchett and Sethi (1994) and regress the collected tariff rate on the official tariff rate: i.e., (Eq. (8))

$$(Collective\ \ rate)_i = \beta_0 + \beta_1 \times (Official\ \ rate)_i + \varepsilon_i, \tag{8}$$

where the collected rate is calculated as the ratio of import tax revenues to import value. Bilateral trade data between Kenya and Tanzania are used together with Tanzanian tariff rates when estimating Eq. (8) for Tanzania and with Kenyan tariff rates when estimating for Kenya.

The results in Table 5 are based on regressing the collected rate for each tariff on products on the official rate. In the first row, a simple linear model is used, and for each country, the slope is statistically significant from one. An increase of 1 percentage point in the official rate produces only a 0.73 percentage point increase in the collected rate in Kenya and a 0.68 percentage point increase in Tanzania. The subsequent rows of Table 5 verify this basic result. The second and third rows show results from weighted ordinary least squares, using import values as weights in the second row and statutory tariff rates in the third row. These rows show coefficients that are the same or lower than the un-weighted results. The fourth row excludes those products for which the collection rate is zero even though recorded import values are positive. The coefficient rose slightly in the Kenyan case but remained constant in the Tanzanian case because no products were excluded. The results in Table 5 appear to support our previous results that the Kenyan customs authority is more efficient in tax collection compared to its Tanzanian counterpart.[15]

5. Conclusions

In this paper, we use the Fisman and Wei's (2004) and Dunem and Arndt's (2009) approach to measure the effect of tax rates on tax evasion using data on the trade flow between Kenya and Tanzania. We estimate the amount of tax evasion in the trade flows between the two

[12] Note that when the trade gap is low, the percentage effect is a small magnitude in terms of the level of trade.

[13] In the Kenyan case the coefficient on average tax on similar products (*Avg_sim_tax*) is zero due to either micronumerosity or too little variation in taxes among products similar products. The low number of observations in the Kenyan case (in the trade with Tanzania) is most likely one cause of the high magnitude in the coefficients on (*Avg_sim_tax*) in several tables in the text. Hereby, those coefficients need to be treated with some caution throughout the paper.

[14] The methodology used in this paper requires a certain amount of trade between the two countries used in the analysis. The United Kingdom has been chosen because it is an important trading partner for both Kenya and Tanzania.

[15] These results must be interpreted with some caution because we are using de facto tax rates in the regression (Eq. (8)), and legal exemptions might affect the results.

countries in both directions. In the Tanzanian case, on the one hand, we find evidence of the underreporting of unit value for both years. The coefficient on tax rate is approximately 2.6 in 2000 and approximately 3.5 in 2004. This result indicates that the problem of tax evasion has increased over time. Moreover, our results suggest that Tanzania is closer (in terms of tax evasion) to the Chinese case rather than the Mozambique case (Dunem and Arndt 2009; Fisman and Wei, 2004).

When utilising the data on quantities, the above stated results barely change. For the Kenyan case, on the other hand, we find no evidence of underreporting in unit values in either year. When utilising data on quantities, the coefficient is still insignificant for both years. Because tax evasion may not only take the form of underreporting but also of mislabelling imports, we investigate whether the measured trade gap is due to mislabelling of a higher taxed product as a lower taxed similar variant or not. In the Kenyan case, there is some evidence of mislabelling in 2004 but for Tanzania we do not find any evidence of mislabelling.

This paper also introduced a third country into the analysis, the United Kingdom. By taking this step, we are able to capture any difference in tax evasion behaviour in the trade between two developing countries and between a developed and two developing countries. In Tanzania, there is evidence of tax evasion in values with a coefficient on tax rate ranging between 0.9 and 1.3; for Kenya we do not find any significant results for 2000. However, in 2004 we find significant results for both countries and the tax evasion coefficient is higher for Tanzania compared to Kenya and in the Tanzanian case tax evasion is higher in 2004 compared to 2000. To discover whether these results are robust or not, we followed Pritchett and Sethi (1994) and examined the responsiveness of tariff revenues to tax rates for the two countries, and the results corroborated with our earlier results.

Overall, our results suggest that the Kenyan customs authority is more efficient than its Tanzanian counterpart for the period measured, although Kenya was more corrupt than Tanzania according to the Transparency International Corruption Perceptions Index. One policy recommendation, due to this result, is that one should not assume that an aggregate index such as the Transparency Index always corresponds between perceived institutional quality and evasion along the lines in Bouët and Roy (2012) and Javorcik and Narciso (2008). Our results suggest that institutional quality matters, but in those institutions that are closer to the target, which in our case is Customs Departments and Revenue Authorities.

Appendix A

Table A1
Summary statistics of the trade flows between the UK and Tanzania and the UK and Kenya in 2000.

Tax evasion Tanzania (UK)	Mean	Median	Min	Max	SD	N
$Log(X_V)$	9.821	9.786	6.810	15.967	1.754	759
$Log(M_V)$	9.755	9.767	6.227	15.783	1.785	759
$Log(X_V/M_V)$	0.065	−0.024	−5.628	5.921	1.771	759
$Log(X_Q)$	7.102	7.123	0.000	15.934	2.727	759
$Log(M_Q)$	7.910	7.931	0.693	16.184	2.219	756
$Log(X_Q/M_Q)$	−0.791	−0.550	−12.016	8.194	2.570	756
Taxes	0.368	0.400	0.000	0.750	0.127	759
Import duty	0.169	0.200	0.000	0.250	0.085	759
Excise duty	0.010	0,000	0,000	0.300	0.055	748
VAT	0.189	0.200	0.000	0.200	0.046	759
Avg_sim_tax	0.361	0.400	0.000	0.750	0.121	553
Tax evasion Kenya (UK)	**Mean**	**Median**	**Min**	**Max**	**SD**	**N**
$Log(X_V)$	10.023	9.905	6.810	16.946	1.841	1423
$Log(M_V)$	10.180	10.143	6.242	16.625	1.841	1423
$Log(X_V/M_V)$	−0.157	−0.198	−7.171	7.059	1.756	1423
$Log(X_Q)$	7.374	7.463	0.000	16.647	2.699	1423
$Log(M_Q)$	8.393	8.466	0.000	18.055	2.385	797
$Log(X_Q/M_Q)$	−0.637	−0.395	−11.394	9.673	2.371	797
Taxes	0.312	0.330	0.000	1.480	0.135	1423
Import duty	0.151	0.150	0.000	0.400	0.100	1346
Excise duty	0.003	0,000	0,000	1.300	0.420	1423
VAT	0.168	0.180	0.000	0.180	0.044	1398
Avg_sim_tax	0.311	0.330	0.000	0.930	0.130	1170

Note: SD is standard deviation and N is number of observations.

Table A2
Tanzania's import and tax structure from Kenya 2000.

Section	Section description (2-digit HS-numbers)	Gap value	Import value	Import duty	VAT	Import share
1	Live animals and animal products (01–05)	0.125	13206	24.52	6.67	0.53
2	Vegetable products (06–14)	0.007	149797	8.93	5.71	4.03
3	Fats and oils from animals and vegetables etc. (15)	0.024	303649	17.50	20.00	5.83
4	Prepared foodstuffs, beverages, spirits and tobacco etc. (16–24)	1.238	138747	22.29	20.00	9.33
5	Mineral products (25–27)	−0.027	72166	7.60	18.40	3.47
6	Products of chemical and allied industries (28–38)	−0.209	100786	11.22	16.49	28.66
7	Plastics and rubber (39–40)	−0.055	85236	19.05	20.00	10.32
8	Skin, leather and articles thereof (41–43)	−1.263	4137	17.00	20.00	0.04
9	Wood and articles of wood; Straw and other plaiting materials (44–46)	0.073	52159	22.81	20.00	1.60
10	Pulp of wood, paper and paperboard. (47–49)	−0.090	70462	19.18	18.37	6.63
11	Textiles and textile articles (50–63)	0.143	18991	22.63	19.65	2.08

(continued on next page)

Table A2 (*continued*)

Section	Section description (2-digit HS-numbers)	Gap value	Import value	Import duty	VAT	Import share
12	Footwear, headgear, umbrellas etc. (64–67)	−0.205	129188	24.41	20.00	4.22
13	Articles of stone, cement, glass etc. (68–70)	−0.062	49433	23.79	20.00	3.13
14	Pearls (natural or cultured), precious stones etc. (71)	N/A	N/A	N/A	N/A	N/A
15	Base metals and articles of base metals (72–83)	0.310	55115	20.85	19.69	13.77
16	Machinery and mechanical appliances, electrical equipment etc. (84–85)	−0.292	21879	13.83	19.15	3.95
17	Vehicles, aircraft, vessels etc. (86–89)	0.180	24506	16.11	20.00	0.42
18	Optical, photographic etc. instruments and apparatus (90–92)	−0.095	17940	14.38	12.50	0.28
19	Arms and ammunition etc. (93)	N/A	N/A	N/A	N/A	N/A
20	Miscellaneous manufactured articles (94–96)	0.393	26993	23.79	19.39	1.71
21	Works of art, collectors' pieces and antiques (97–99)	N/A	N/A	N/A	N/A	N/A
	2-digit mean value	*0.040*	*67864*	*0.177*	*0.183*	

Notes: Section refers to the section division of the World Customs Organisation harmonized commodity description and coding system (HS-codes) with two-digit HS-numbers within parenthesis in the section description. Gap value, import value, import duty and VAT are the mean unweighted average for the six-digit products within each section. Import duty, VAT and import share are presented in percent. N/A means not applicable.

Table A3
Kenya's import and tax structure from Tanzania 2000.

Section	Section description (2-digit HS-numbers)	Gap value	Import value	Import duty	VAT	Import share
1	Live animals and animal products (01–05)	1.734	9887	17.50	0.00	0.94
2	Vegetable products (06–14)	0.501	74201	17.08	0.00	11.41
3	Fats and oils from animals and vegetables etc. (15)	N/A	N/A	N/A	N/A	N/A
4	Prepared foodstuffs, beverages, spirits and tobacco etc. (16–24)	0.240	139348	17.22	18.00	19.78
5	Mineral products (25–27)	N/A	N/A	N/A	N/A	N/A
6	Products of chemical and allied industries (28–38)	0.177	5880	21.43	15.43	0.49
7	Plastics and rubber (39–40)	−0.777	408177	29.00	18.00	24.15
8	Skin, leather and articles thereof (41–43)	0.735	16626	5.00	0	0.39
9	Wood and articles of wood; Straw and other plaiting materials (44–46)	−0.191	12502	20.00	18.00	0.30
10	Pulp of wood, paper and paperboard. (47–49)	0.659	2764	20.00	9.00	0.07
11	Textiles and textile articles (50–63)	1.820	163461	17.14	18.00	19.34
12	Footwear, headgear, umbrellas etc. (64–67)	N/A	N/A	N/A	N/A	N/A
13	Articles of stone, cement, glass etc. (68–70)	−0.657	448091	25.00	18.00	15.90
14	Pearls (natural or cultured), precious stones etc. (71)	N/A	N/A	N/A	N/A	N/A
15	Base metals and articles of base metals (72–83)	−0.340	11842	10.83	18.00	0.42
16	Machinery and mechanical appliances, electrical equipment etc. (84–85)	−0.590	70226	3.33	18.00	4.98
17	Vehicles, aircraft, vessels etc. (86–89)	−0.424	8033	15.00	18.00	0.19
18	Optical, photographic etc. instruments and apparatus (90–92)	3.469	3579	5.00	18.00	0.04
19	Arms and ammunition etc. (93)	N/A	N/A	N/A	N/A	N/A
20	Miscellaneous manufactured articles (94–96)	−4.106	135438	25.00	18.00	1.60
21	Works of art, collectors' pieces and antiques (97–99)	N/A	N/A	N/A	N/A	N/A
	2-digit mean value	*0.431*	*109774*	*17.04*	*17.20*	

Notes: Section refers to the section division of the World Customs Organisation harmonized commodity description and coding system (HS-codes) with two-digit HS-numbers within parenthesis in the section description. Gap value, import value, import duty and VAT are the mean unweighted average for the six-digit products within each section. Import duty, VAT and import shares are presented in percent. N/A means not applicable.

Table A4
Results for the transformed baseline model in 2000 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	-0.425^{**} (0.202)	1.333^{***} (0.503)	0.009	759
Excluding first and last percentile	-0.397^{**} (0.195)	1.244^{**} (0.488)	0.009	743
Excluding first and last 0.05 quantile	-0.300^{**} (0.163)	0.936^{**} (0.416)	0.008	683
Excluding products lacking tax on similar products	-0.618^{***} (0.219)	1.695^{***} (0.547)	0.015	553
Excluding products lacking observations on quantities	−0.092 (0.245)	0.617 (0.644)	0.002	456
Excluding products lacking tax on similar products and observations on quantities	−0.330 (0.259)	1.128 (0.692)	0.007	304
Tax evasion Kenya	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	−0.150 (0.122)	−0.022 (0.354)	0.000	1423
Excluding first and last percentile	−0.144 (0.105)	−0.065 (0.306)	0.000	1393
Excluding first and last 0.05 quantile	-0.193^{**} (0.081)	0.055 (0.237)	0.000	1279
Excluding products lacking tax on similar products	−0.122 (0.136)	−0.121 (0.396)	0.000	1171
Excluding products lacking observations on quantities	−0.122 (0.137)	−0.126 (0.413)	0.000	1197
Excluding products lacking tax on similar products and observations on quantities	−0.113 (0.145)	−0.138 (0.435)	0.000	998

Note: Robust standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$ and $^{*}p < 0.10$.

Table A5
Results for the augmented model in 2000 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	$Taxes^2$	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting $Taxes^2$	−0.537** (0.242)	2.814** (1.210)	–	−1.347 (1.341)	0.017	553
Full regression	−0.088 (0.329)	0.345 (1.607)	3.904** (1.828)	−1.710 (1.348)	0.022	553
Excluding products lacking observations on quantities	0.243 (0.356)	0.385 (2.422)	4.538* (2.459)	−2.709 (2.280)	0.018	304
Tax evasion Kenya	Constant	Taxes	$Taxes^2$	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting $Taxes^2$	−0.084 (0.142)	0.421 (0.724)	–	−0.668 (0.748)	0.001	1171
Full regression	−0.051 (0.182)	0.177 (1.164)	0.431 (1.622)	−0.690 (0.755)	0.001	1171
Excluding products lacking observations on quantities	−0.140 (0.196)	0.349 (1.285)	−0.526 (1.816)	−0.206 (0.838)	0.000	998

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A6
Results for the quantity model in 2000 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.480 (0.331)	−0.847 (0.838)	–	0.002	756
Full regression (Eq. (7))	−0.481 (0.391)	3.151* (1.641)	−4.090** (1.746)	0.009	553
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	−0.720** (0.364)	−0.261 (0.919)	–	0.000	553
Tax evasion Kenya	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.523*** (0.191)	−0.352 (0.560)	–	0.000	797
Full regression (Eq. (7))	−0.605*** (0.220)	−0.518 (1.161)	0.289 (1.138)	0.000	623
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	−0.592*** (0.212)	−0.266 (0.618)	–	0.000	623

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A7
Results for the transformed baseline model in 2004.

Tax evasion Tanzania	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	−0.824*** (0.206)	3.861*** (0.525)	0.057	1010
Excluding first and last percentile	−0.652*** (0.189)	3.370*** (0.481)	0.054	988
Excluding first and last 0.05 quantile	−0.475*** (0.152)	2.766*** (0.384)	0.056	908
Excluding products lacking tax on similar products	−0.851*** (0.248)	3.942*** (0.624)	0.058	765
Excluding products lacking observations on quantities	−0.769*** (0.220)	3.642*** (0.554)	0.053	885
Excluding products lacking tax on similar products and observations on quantities	−0.786*** (0.266)	3.656*** (0.662)	0.053	666
Tax evasion Kenya	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	−0.231 (0.370)	0.879 (1.240)	0.004	176
Excluding first and last percentile	−0.505 (0.314)	1.883* (1.053)	0.023	172
Excluding first and last 0.05 quantile	−0.106 (0.236)	0.474 (0.813)	0.002	158
Excluding products lacking tax on similar products	−0.045 (0.547)	−0.259 (2.041)	0.000	82
Excluding products lacking observations on quantities	−0.168 (0.429)	0.653 (1.373)	0.002	145
Excluding products lacking tax on similar products and observations on quantities	0.287 (0.659)	−1.531 (2.162)	0.009	64

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A8
Results for the augmented model in 2004.

Tax evasion Tanzania	Constant	Taxes	Taxes^2	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting Taxes^2	−0.837*** (0.256)	4.276*** (1.066)	–	−0.373 (1.061)	0.059	765
Full regression	−0.579 (0.371)	2.475 (1.854)	3.125 (2.713)	−0.559 (1.089)	0.060	765
Excluding products lacking observations on quantities	−0.668* (0,399)	2.324 (1.770)	1.608 (2.508)	0.352 (0.960)	0.054	666
Tax evasion Kenya	Constant	Taxes	Taxes^2	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting Taxes^2	0.442 (0.620)	4.887*** (1.490)	–	−7.175*** (1.692)	0.088	82
Full regression	−0.011 (0.571)	9.981** (4.780)	−9.560 (9.639)	−7.329*** (2.243)	0.100	82
Excluding products lacking observations on quantities	0.009 (0.715)	11.360** (5.404)	−15.770 (11.120)	−6.669*** (2.243)	0.105	64

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A9
Results for the quantity model in 2004.

Tax evasion Tanzania	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.851*** (0.271)	3.142*** (0.822)	–	0.029	755
Full regression (Eq. (7))	−0.806** (0.333)	2.051** (0.857)	1.098 (0.742)	0.030	550
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	−0.773** (0.326)	3.051*** (0.822)	–	0.029	550
Tax evasion Kenya	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.219 (0.593)	0.204 (1.950)	–	0.000	119
Full regression (Eq. (7))	0.666 (1.171)	6.060***(2.152)	−9.818***(3.631)	0.062	55
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	0.065 (1.055)	−1.508 (3.631)	–	0.003	55

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A10
Results for the transformed baseline model in 2004 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	−0.150 (0.317)	2.182** (0.873)	0.018	797
Excluding first and last percentile	0.009 (0.251)	1.703** (0.659)	0.012	781
Excluding first and last 0.05 quantile	−0.056 (0.195)	1.410*** (0.522)	0.013	717
Excluding products lacking tax on similar products	−0.076 (0.371)	1.892* (1.037)	0.014	596
Excluding products lacking observations on quantities	−0.067 (0.323)	1.887** (0.859)	0.013	715
Excluding products lacking tax on similar products and observations on quantities	0.016 (0.376)	1.600 (1.007)	0.010	524
Tax evasion Kenya	Constant	Taxes	R^2	N
	β_0^*	β_1		
Total sample	−0.141 (0.126)	0.981*** (0.369)	0.006	1333
Excluding first and last percentile	−0.079 (0.117)	0.770** (0.343)	0.005	1305
Excluding first and last 0.05 quantile	0.048 (0.101)	0.329 (0.290)	0.001	1199
Excluding products lacking tax on similar products	−0.223 (0.139)	1.255*** (0.402)	0.010	1105
Excluding products lacking observations on quantities	−0.225* (0.128)	1.226*** (0.384)	0.009	1212
Excluding products lacking tax on similar products and observations on quantities	−0.281* (0.138)	1.443*** (0.403)	0.014	1001

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A11
Results for the augmented model in 2004 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	$Taxes^2$	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting $Taxes^2$	−0.149 (0.408)	0.534 (1.450)	–	1.565 (1.722)	0.016	596
Full regression	0.335 (0.492)	−1.888 (3.029)	3.790 (4.251)	1.083 (1.622)	0.020	596
Excluding products lacking observations on quantities	0.408 (0.558)	−1.764 (3.147)	3.457 (4.119)	0.861 (1.736)	0.014	524
Tax evasion Kenya	Constant	Taxes	$Taxes^2$	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2	β_3		
Omitting $Taxes^2$	−0.198 (0.148)	1.658** (0.722)	–	−0.484 (0.735)	0.010	1105
Full regression	−0.144 (0.186)	1.366 (0.853)	0.450 (0.558)	−0.533 (0.746)	0.011	1105
Excluding products lacking observations on quantities	−0.215 (0.186)	1.202 (0.861)	0.514 (0.531)	−0.166 (0.797)	0.014	1001

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

Table A12
Results for the quantity model in 2004 (UK to TZ/KY).

Tax evasion Tanzania	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.171 (0.347)	−0.388 (0.939)	–	0.000	795
Full regression (Eq. (7))	−0.187 (0.435)	−0.527 (1.531)	−0.086 (1.777)	0.001	594
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	−0.191 (0.395)	−0.602 (1.112)	–	0.001	594
Tax evasion Kenya	Constant	Taxes	*Avg_sim_tax*	R^2	N
	β_0^*	β_1	β_2		
Omitting Avg_sim_tax (Eq. (6))	−0.479** (0.233)	1.199* (0.681)	–	0.006	836
Full regression (Eq. (7))	−0.498* (0.279)	1.192 (1.316)	0.003 (1.351)	0.006	652
Excluding products lacking observations on Avg_sim_tax (Eq. (6))	−0.497* (0.262)	1.194 (0.756)	–	0.006	652

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05 and *p < 0.10.

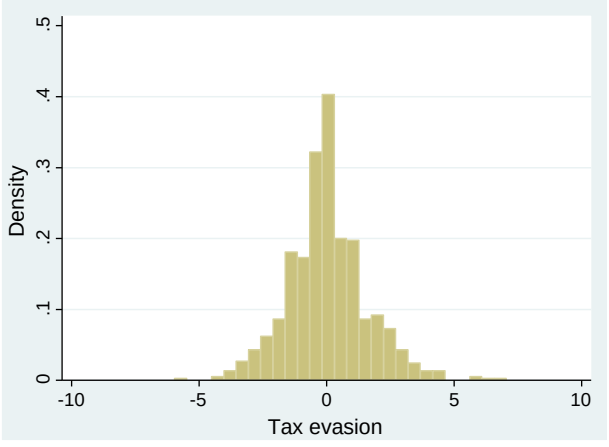

Fig. A1. Density distribution of the logarithm of the evasion ratio in the trade flow from Kenya to Tanzania in 2000.

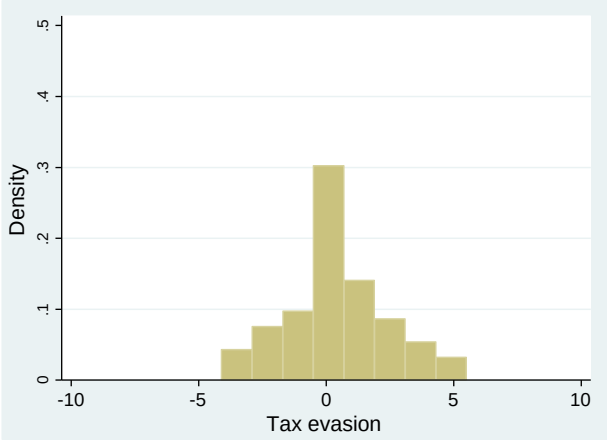

Fig. A2. Density distribution of the logarithm of the evasion ratio in the trade flow from Tanzania to Kenya in 2000.

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