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Trade Tax Evasion and the Tax Rate: Evidence from Transaction-level Trade Data

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Abstract

This paper explores the relationship between tax rates and tax evasion in a low-income country context: Ethiopia. By using transaction-level administrative trade data, we are able to provide an analysis that is largely comparable with the rest of the literature while also introducing two important innovations. First, we compare the elasticity of evasion to statutory tax rates and effective tax rates (ETRs). Most studies in the literature so far focused on the former. We show that ETRs are the most relevant parameter to explain evasion in contexts where exemptions are widespread, which results in a large divergence between ETRs and the statutory rates set out in the law. Second, we account for trade costs more precisely than the previous literature by adjusting the trade gap rather than controlling for proxies. We argue that this new approach to accounting for trade costs is superior to those previously adopted in the literature.

Keywords: tax evasion, import tariff, missing trade, Ethiopia
JEL classification: F13, H26, K42

1. Introduction

The tax compliance literature has long identified the tax rate as one of the key determinants of tax evasion. According to the seminal theoretical model in this literature, an increase in the tax rate should in principle increase tax evasion (Allingham & Sandmo, 1972). However, this theoretical result is sensitive to the model's assumptions and can be reversed under some circumstances (Slemrod & Yitzhaki, 2000, Yitzhaki, 1974)—making it important to explore it empirically. Doing so, however, presents at least two important challenges. First, tax evasion is, by definition, hard to measure. Very few taxpayers would willingly reveal dishonest behaviour. Second, the tax rate is a parameter that cannot be easily manipulated in the real world, unlike other instruments (Slemrod, 2019). When it does vary, it typically

does so for the whole population of relevant taxpayers—thus often precluding the possibility of large-scale behavioural experiments. The empirical literature has attempted to overcome these challenges in various ways, most notably by using quasi-experimental methods and laboratory experiments[1] . For example, the growing bunching literature has used changes in the tax schedule to estimate income responses to increases in tax rates (for a review, see Saez *et al*., 2012). The results largely show that taxpayers avoid higher rates by keeping their reported income low—a response that is, at least partly, linked to evasion. Laboratory experiments largely confirm the negative relationship between the tax rate and reported income. A laboratory setting, where it is possible to vary the tax rate and measure evasion precisely, reported that income decreases when the tax rate increases (Alm, 2012; Torgler, 2002).

Much of the compliance literature has focused on domestic taxes—for the most part, income taxes. However, the same question on tax rates and evasion has been central to the trade liberalisation debate too. While trade liberalisation refers to a broader set of issues, the reduction of tariff rates is a central element to it. A strand of the trade liberalisation literature has therefore investigated the revenue effects of such tariff reductions. The immediate mechanical effect of a decrease in tariffs is indisputably a revenue loss—assuming everything else remains the same. However, typically, everything else does not remain the same. Importantly, trade liberalisation is indeed meant to stimulate more trade flows. Such an increase in trade volume may compensate, at least partly, for the revenue loss from lower tariffs. At the same time, much like in the domestic tax compliance literature, decreases in the rate of trade taxes may reduce evasion at the border. Estimating this relationship is particularly important in low-income countries (LICs), which face great pressure to liberalise trade while struggling to raise the necessary revenue to fund basic public spending. As a share of their economy, LICs typically raise lower tax than their higher-income counterparts and face higher evasion (Besley & Persson, 2014). The literature so far has shown that LICs have found it particularly hard to recoup lost revenue from trade liberalisation, compared with their higher-income counterparts (Baunsgaard & Keen, 2010; Cage & Gadenne, 2018).

This paper contributes to these strands of literature and debates by providing new evidence on the relationship between the tax rate and trade tax evasion in an LIC: Ethiopia. We measure tax evasion as the trade gap. By comparing records of traded goods on the exporter and importer sides, we can identify the trade gap as the quantity or value of traded goods that appear to be exported from the trading partner but do not appear to have been received by the importing country (see Section 4 for more details). We then estimate the relationship between the trade gap, which captures trade tax evasion, and the tax rate. Thanks to a unique transaction-level dataset from the Ethiopian Revenue and Customs Authority, we are able to calculate the average effective tax rate (ETR) that each imported product faces at the border. We show that this measure is more relevant to explain tax evasion than the statutory tax rate, especially in countries where exemptions are widespread (see Sections 2

1 Other studies have looked at the relation between evasion and the tax rate using data from the US Taxpayer Compliance Measurement Program. In these studies, the main source of variation in tax rates comes from differential marginal tax rates across income levels. Examples of this literature are Clotfelter (1983) and Feinstein (1991) that find, respectively, a positive and a negative relation between evasion and the tax rate.

and 5.1). Our estimation benefits from a policy change that increases the statutory tax rates of different products differently as well as the existence of tax exemptions that introduce variations in the ETR across products and within products over time. This allows us to use a fixed effects (FE) model that is more robust than simple cross-product comparisons (see Section 3). Furthermore, we explore how trade-cost and product differentiation affect our main results. Besides, in Section 6, we test the robustness of our results by considering issues such as the role of foreign currency rationing, using a sample that includes a larger set of exporting countries and unmatched observations, and by employing a first-difference estimator.

Importantly, our unique dataset allows us to measure trade costs directly and take them into account in a more precise way than other studies in the literature (more details below and in Section 5.2). Once we adjust the trade gap measure for trade costs, the elasticity of evasion to the tax rate increases. Our key result is that a one-percentage point increase in the ETR increases evasion, measured by the trade gap, by over 1.1% (see Section 5). This result is robust to the inclusion of potential confounding factors. Section 5.4 shows that this effect is mostly driven by misreporting of imported quantities rather than misreporting of prices or mislabelling of items into similar, low-taxed items.

The literature most closely related to our paper uses a similar measure of the trade gap to analyse tax evasion and its relation with tariff rates. As in our case, the trade gap is typically calculated using international datasets, as the difference between the value of exports from country A to country B and the value of imports reported by country B from country A[2] . There is no reason, in principle, why these two values should be different, yet they are in many cases. One of the seminal papers in this literature suggests that part of the trade gap is due to tax evasion rather than being a simple measurement error (Bhagwati, 1964). The literature has then used the trade gap measure to estimate the relation between trade tax evasion and tax rates. To this common aim, studies have adopted two different methods: cross-sectional comparisons and panel data estimation. We briefly review papers from both strands below.

The cross-sectional literature uses variations in tax rates across products to analyse the relationship between tax rates and evasion, measured with the trade gap. One of our key reference points in this literature is Fisman & Wei (2004), which is based on highly disaggregated product-level trade data. They quantify the responsiveness of the trade gap to cross-product differences in statutory tax rates, namely tariff plus VAT collected at the border. They focus on trade flows between two countries, more specifically trade from Hong Kong (the exporter) to China (the importer). They find that a one-percentage point increase in the tax rate is associated with a 3% increase in the trade gap. In principle, this response could be due to three types of evasion: misreporting quantities, under-pricing or mislabelling imports as similar but lower-taxed products. In the case of China, these authors show that mislabelling is the most important mechanism of evasion, while they find little empirical support for the other ones. Expanding on this work, Rotunno & Vezina (2012) analyse trade flows into China from 130 exporting countries rather than focusing only in Hong Kong. While they still find a positive relationship between the tax rate and evasion, they also show that this relationship is stronger in the presence of Chinese networks in the exporting countries.

2 This datum is available from international databases such as the World Bank's World Integrated Trade Solution (WITS) database and UNCTAD's Trade Analysis Information System (TRAINS) database.

The cross-sectional strand of the literature also includes evidence from LICs. Looking at trade between Tanzania and Kenya, and between these countries and the UK, Levin & Widell (2014) confirm the positive relationship between the tax rate and evasion, with a comparable elasticity estimate as in Fisman & Wei (2004) for imports to Tanzania and a smaller, close-to-zero, elasticity estimate for Kenya. A similar result is found also in the case of trade between Mozambique and South Africa, where Van Dunem & Arndt (2009) report a 1.4% elasticity of tax evasion to the tax rate for imports into Mozambique. While in the case of Kenya and Tanzania there is no evidence of mislabelling, this seems to be a relevant mechanism in Mozambique.

The second strand of this literature uses panel data, exploiting over time variations of the tax rate. The advantage of this method is that it allows researchers to control for product FE, which may affect the elasticity in a potentially spurious way. For example, Javorcik & Narciso (2008) use panel data on ten Eastern European economies, and Germany as the partner country, to examine the relationship between the tariff rates and the trade gap. While they confirm a generally positive relationship, their main research interest lies in how product differentiation affects this elasticity. The correct price of differentiated products is harder for custom authorities to verify, compared with homogeneous products because it depends on a large number of attributes that they may not be familiar with. Consistent with expectations, the authors find that evasion for differentiated products is indeed more elastic to variations in the tax rate than for homogeneous products (1.7% and 0.4%, respectively). According to these authors, the main mechanism of evasion in the Eastern European case is under-pricing rather than misclassification or under-reporting quantities. Along similar lines, Mishra *et al.* (2008) look at trade into India from all of its trading partners and find a positive relationship between evasion and tax rate, with an estimated elasticity of 0.1% for all products and 0.28% for differentiated products.

Using a similar methodology, some studies have looked at how other factors of interest have affected the elasticity of evasion to the tax rate. Among these, Javorcik & Narciso (2017) focus on countries' accession to the World Trade Organisation (WTO). While confirming a positive elasticity, they show that WTO accession changed the mechanism of evasion. WTO rules effectively shut down the possibility to under-report prices, which was a significant mechanism before accession[3] . However, once this channel is not available anymore, importers resort to under-reporting quantities and misclassifying products as a way to evade trade taxes. Sequeira (2016) applies the same methodology, based on the trade gap and the estimate of elasticity to the tax rate, to investigate the role of corruption in Southern Africa. She shows that, while elasticities are positive, firms' responses to changes in the tax rate are highly limited in the presence of corruption. Under these circumstances, trade liberalisation may have weaker effects on evasion. Worku *et al.* (2016) also focus on corruption but find a different result. Using a panel of thirty-one sub-Saharan African (SSA) countries, they show that increases in corruption levels in the importing and exporting countries can enhance the positive relationship between evasion and tax rates. In a paper closely related to these studies, Rijkers *et al.* (2017) show that politically connected firms in

3 Here, the authors make use of the provision in WTO accession and of adopting its Customs Valuation Agreement (or Article VII of the GATT), which requires countries to accept the price stated on the invoice issued by the exporter.

Tunisia are more likely to evade taxes (via under-reporting of prices), and this relationship is stronger for products that are highly taxed.

Overall, the studies described here are highly comparable in terms of the key measures, both related to the trade gap and tax rates. The latter is typically the statutory tax rate, as set in the law. There is, however, a recognition that the statutory tax rate fails to take into account exemptions that are widespread in many of the countries analysed. In the case of China, Fisman & Wei (2004) show that industries that benefit from extensive exemptions are less elastic to the statutory tax rate—as expected. Other studies simply acknowledge that the estimated elasticity is likely to be biassed downwards due to exemptions (Van Dunem & Arndt, 2009). An interesting alternative is the ETR, which essentially measures the amount of tax paid at the border, divided by the value of imports. By focusing on actual tax payments, it takes into account all applicable deductions and exemptions. An application of this measure in the estimate of the trade gap elasticity can be found in Chalendard (2017), which, however, focuses more broadly on measures to decrease trade tax evasion in developing countries[4] . As part of this broader exercise, the author shows that higher ETRs are associated with a higher level of evasion and finds a relatively large elasticity estimate, in the range of 1.4–1.7%—similar to other cross-sectional studies. In general, cross-sectional studies that do not take into account product FE find a much larger elasticity estimate. While panel data studies that control for time FE find smaller elasticity estimates, those that control for both time and product FE find the smallest elasticity estimates. For example, in Mishra *et al.* (2008), the estimated elasticity decreases by half when they control for product FE.

Against the background of this literature, our paper provides evidence from a new context, Ethiopia, for which such analysis is not yet available. At the same time, our analysis is largely comparable with other studies—using a measure of the trade gap (see Section 4) and estimation methods (see Section 3) that are well established in the literature. In addition to reporting novel evidence from Ethiopia, we also provide two original contributions to the literature using the trade gap to estimate evasion elasticities to the tax rate. First, thanks to our unique transaction-level dataset, we are able to calculate ETRs very precisely for each product imported in Ethiopia over a relatively long period. As we show in Section 5.1, this measure of the tax rate is a lot more relevant to estimate elasticities than the statutory rate. Second, using the same transaction-level dataset, we are able to directly measure trade costs and adjust the trade gap accordingly. This is important because part of the trade gap is indeed due to such trade costs rather than evasion (see Section 5.2). To the extent that trade costs are related to the tax rate, as we show is the case in Ethiopia, the elasticity estimate resulting from equations that do not take them into account would be biassed. While some studies have tried to control for trade costs in indirect ways (Javorcik & Narciso, 2008), none has a direct measure that can be used to correct the gap measure. In this paper, we show that taking trade costs into account, and how this is done, matters for the results to a greater extent.

4 The paper is primarily focused on estimating the impact of increases in the frequency of imports of a product (internal source of information), as well as pre-shipment inspection (external source of information) on evasion.

2. Taxation and trade in Ethiopia

Ethiopia is one of Africa's largest markets, with a population of almost 110 million. Despite the fast economic growth rates in recent years, the government has been struggling to increase the tax to GDP ratio—which stood at 12% in 2017, well below the SSA average of 16% in the same year. Ethiopia does, however, collect comparatively more trade taxes than other countries in the region: 3.7% of GDP compared with 2.9% in SSA on average, in 2017[5] . This figure may be symptomatic of a relatively weak domestic tax administration and widespread evasion, since domestic taxes, and particularly those on income, are typically considered harder to collect than trade taxes. While the government is committed to increasing domestic revenue, trade taxes still represent one of the most important sources of public revenue in the country.

The entirety of the trade tax revenue comes from imports, as exports are completely exempt from tax. Imports into Ethiopia face four tax types: tariffs, VAT, excises and surtax that was introduced in 2007. Tariffs range from 0% to 35%, and excises from 10% to 100%, depending on the products. The VAT standard rate is 15%, but there are many goods that are either exempted or zero-rated. The surtax is applied with a rate of 10%, which comes on top of the value of imports plus all other taxes applicable. Since the surtax varies both over time (before and after 2007) and across products[6] , it is an important element in our methodology (see Section 3). The combination of these taxes means that some imports are indeed heavily taxed in Ethiopia. For example, imported luxury cars face a combined statutory tax rate of 240%. However, exemptions are also widespread, with the most common case of exemption being investment, both foreign and domestic. However, like in other LICs, exemptions are often granted in an *ad hoc* way and it is not easy to obtain a clear picture of all benefits available to investors. For this reason, the ETR is particularly relevant in our case. Even without having the detailed information on all available exemptions, we are able to observe what firms actually pay at the border net of all available benefits.

Ethiopia has embarked on a substantial process of trade liberalisation in the 1990s, through reductions in tariffs and other trade barriers. However, it has also somewhat lagged behind in some sectors, such as telecommunications and the financial sector, which have prevented further liberalisation of the economy. Perhaps indicative of this situation is the accession process to WTO. Started in 2003, negotiations have been ongoing since then without resulting, as yet, in draft agreements. However, it is clear that WTO accession, if agreed, would imply significant reductions in trade tax for several imported products. The combination of this ongoing trade liberalisation process, the low tax to GDP ratio and the relatively high importance of (reliance on) trade taxes make our analysis particularly relevant to Ethiopia. As the liberalisation process proceeds, it is increasingly important to estimate how reductions in tariffs may affect revenue, in a context of already limited public resources. As we show in Section 5, one effect of lower tax rates is a decrease in evasion (i.e., an increase in the tax base), which would contribute to contain the potential revenue losses from tariff reduction.

5 All figures were obtained from ICTD / UNU-WIDER Government Revenue Dataset, 2019.

6 Although the rate is 10% for most products, the fact that the surtax is charged on top of other taxes generates variations across products.

In terms of our analysis, there are two other elements of context that are particularly relevant. The first one is foreign currency rationing. Ethiopia runs a *de facto* crawl-like exchange rate regime with several foreign currency controls (IMF, 2017). Whenever there is a shortage of foreign currency in the country, goods that are deemed luxury and only destined to consumption do not receive as much foreign currency from the official market as they need—there is rationing. When this happens, firms importing these types of goods resort to buying part of their foreign currency needs in the parallel market. Since this is illegal, importers report the value of their imports to be in line with the (small) amount of foreign currency they receive from the official market. This shortage of foreign currency in Ethiopia influences the trade gap and is likely to be related to the tax rate too. For example, luxury goods face high tax rates while being more subject to rationing. We discuss how to take this issue into account in our empirical analysis in Section 3.

The second element is the customs valuation system in Ethiopia. These procedures evolved in several stages since the early 1990s. Perhaps, the most significant change happened in 2003 when the Ethiopian customs authority took over the task of price and standard-setting from a private international company. The customs authority's approach follows, in principle, the fair valuation method specified in the WTO agreement on Implementation of Article VII (ERCA, 2017). This method requires Ethiopian Revenue and Customs Authority (ERCA) to use the transaction value as the price on which to calculate duties and other associated taxes. In cases where the transaction value is not available or not clearly determined, the authority can apply five alternative methods, in the following order of preference: transaction value of identical goods, transaction value of similar goods, deductive value, computed value and fallback method. In practice, these alternative methods are used as the most common basis for valuation. In other words, in most cases, imported goods are evaluated based on a price that is known *ex-ante* rather than on the invoice declared by the importer. The implication for our analysis is that evasion through under-invoicing is unlikely to happen in Ethiopia since prices are pre-specified for most commodities. There is also a risk that this method creates an artificial (potentially negative) trade gap as we use the invoice price for the exporting country, and for Ethiopia (the importer), we use the price set by the Ethiopian customs authority, which is usually higher than the invoice price. As a result of this, a trade gap can arise simply because the two prices do not fully match. We explore this hypothesis in Section 5.4.

3. Methodology

As anticipated in Section 1, our measure of tax evasion is the trade gap, which we calculate based on the standard measure developed in this literature. In particular, we use highly disaggregated data to calculate the gap between exports from a set of countries into Ethiopia and imports that Ethiopia records from those same countries (more details in Section 4). More formally, the trade gap is calculated as follows:

$$Gap = (p_x * Q_x) - (p_i * Q_i). \tag{1}$$

In Equation 1, p_x and p_i are the prices charged by the exporter and declared to the customs authority by the importer, respectively, while Q_x and Q_i are the quantities reported by the exporter and by the importer, respectively. The total value gap would be given by the

difference in the value (quantity x price) as reported by the exporter and by the importer. The assumption in the literature is that the gap calculated in this way is primarily due to evasion on the importer's side. This is a realistic assumption, given that exports are typically not taxed or taxed very little—thus setting very little incentive for evasion[7] . Even if exporters do evade, such behaviour is unlikely to correlate with the tax rate of the importing country. On the other hand, importers have a strong incentive to evade when bringing goods into Ethiopia, particularly in light of relatively high ETRs for the goods that are not exempted (more on this in Section 3.1). As such, the literature has generally accepted the trade gap as a proxy for trade tax evasion (see Section 1).

Using the trade gap as a proxy measure to tax evasion, the literature has then related it to the tax rate. There are two sources of variation in the ETR that can be used to identify its impact on the trade gap: variations in the tax rate across products and variation across time for a given product. While the literature has traditionally relied more on cross-sectional variation, recent studies use panel data and exploit the variation in tax rates over time and within products (e.g., Javorcik & Narciso, 2017, Mishra *et al.*, 2008, Rijkers *et al.*, 2017, Sequeira, 2016). We follow the latter, a FE panel data model, and estimate the following equation, which represents our main specification:

$$Gap_{pct} = \alpha + \beta_1 Tax_{pct} + \gamma_{pc} + \delta_t + \varepsilon_{pct}. \quad (2)$$

In Equation 2, Gap_{pct} measures the difference between country c's exports to Ethiopia and what Ethiopia reports as imports of product p from country c at time t. Tax_{pct} is the ETR on commodity p in period t that is imported from country c (more on this in Section 3.1). β_1 is the coefficient of interest. Since the trade gap is measured in log (see Section 4), β_1 indicates the elasticity of tax evasion to the tax rate. γ_{pc} stands for time-invariant product-country specific characteristics that may be important in determining the level of trade gap. δ_t captures time-specific factors that affect the trade gap for all products in the same way. These include, for example, changes in the efficiency in tax administration or the incidence of corruption among border officials. ε_{pct} is the error term.

Importantly, Equation 2 includes product-country FE, which capture time-invariant, country-product-specific characteristics. If unaccounted for, these factors may result in biassed estimates as they are likely to be related to both the trade gap and the tax rate. Our model is therefore superior to cross-sectional estimations in identifying the relationship between tax rate and evasion, as it absorbs the potential impacts of all time-invariant, country-product-specific factors and relies only on the within-products and across-time variation in the tax rate. In our case, the main source of variation over time is the introduction of the surtax in 2007 (see Section 2). In addition, our ETR measure may also change over

7 One may argue that, from the exporters side, the corporate income tax system may provide a powerful incentive for transfer price manipulation. However, there are three reasons why this is not a significant issue for our analysis. First, the limited FDI amount, particularly from the developed countries that are included in our sample, means that so far there is little related-party trade in Ethiopia. Second, the corporate income tax in Ethiopia, a flat rate of 30%, is relatively higher and therefore reduces the incentive to under-invoice exports to Ethiopia in related-party trade. Third, even if exporters do understate their exports, it is not going to be related to the trade tax rate as the main driver for related-party under-invoicing is the corporate tax rate.

time due to variations in the exemptions available to investors (see Section 3.1). Exploiting the introduction of the surtax, and to check the robustness of our results, we also estimate a first difference model. In this case, we exclusively focus on changes in the tax rate resulting from the introduction of the surtax in 2007, using data on 2006 (before surtax) and 2008 (after surtax) (see Appendix B). A similar exercise was also carried out in Fisman & Wei (2004).

Although our FE model allows us to take into account several unobserved factors, there are others that can still affect our results. These are exemptions, trade costs, foreign currency rationing and product differentiation. In the next few paragraphs, we explain the empirical challenges that they pose and how we tackle them.

3.1 Extensive tax exemptions

As discussed in Section 1, tax exemptions are widespread in LICs especially (see Klemm & Van Parys, 2012 and Kinda, 2018). This is also the case in Ethiopia as there is substantial difference between statutory and ETRs (see World Bank Group, 2017; Mascagni & Mengistu, 2019, and Section 1). The immediate implication for our analysis is that the ETR that importers face at the border is substantially different than the statutory tax rate, as many products would be exempt altogether. If exemptions are widespread, estimates of the elasticity of evasion to the statutory rate would be biassed downwards, as evasion is less likely among products or importers that enjoy some level of exemption. Moreover, exemptions are typically granted in rather piecemeal and *ad hoc* ways, especially in LICs. This makes it difficult to track them precisely. Partly because of this reason, and partly because of a lack of administrative data, many studies in the literature use the statutory rate (see Section 1).

Thanks to our unique transaction-level dataset, we are able to tackle the issue of tax exemptions in a more precise way than most other studies in this literature. We do so by calculating the ETR that importers actually face at the border, which implicitly takes into account all exemptions available for each product imported into Ethiopia. We calculate the ETR, for each year and source country, as the total amount of tax over the value of imports for each product imported into Ethiopia over our data period (see Section 4).

3.2 Trade costs

Trade costs are a potential source of bias because they are embedded in the trade gap while also being potentially related to the tax rate. The trade gap typically compares FOB (free on-board) values of exports with costs, insurance and freight (CIF) values for imports. The difference between these two is partly due to evasion and partly due to the costs related to shipping goods from one country to another—trade costs. The usual assumption in the literature is that trade costs are unrelated to the tax rate and can, therefore, be absorbed in the error term without causing much concern, just like other measurement errors that might be included in the trade gap. However, trade costs and tax rates can be correlated either due to evasion on the value of trade costs or due to the nature of products. On the one hand, importers are likely to report lower trade costs on highly taxed items, to reduce the base on which taxes are calculated. That would generate a negative relationship between these two variables. On the other hand, luxury goods are normally expensive and are likely to require high trade costs (e.g., insurance), while also being highly taxed. This would create a positive relationship between tax rate and trade costs.

To a certain extent, FE panel data models can address concerns related to trade costs, as argued in Javorcik & Narciso (2008). However, this approach is only valid if trade costs are product-specific and time-invariant. As we show in Section 5.2, this is not always the case: in Ethiopia, there is a statistically significant negative relationship between trade costs and the ETR, even once product and year FE are taken into account. We therefore use our unique administrative dataset to address trade costs in a more precise way than other studies have been able to do so far. Using these data, we directly calculate trade costs for each product by source country and year. To maintain consistency with the rest of the literature, our main specification does not take trade costs into account. However, in Section 5.2, we use this measure in two ways. First, we control for trade costs in our regression, similar to the approach in Javorcik & Narciso (2008). Second, we adjust the trade gap by subtracting trade costs (more details in Section 4). This adjusted gap measure is unique in this literature and it represents a more precise way to deal with trade costs than has been possible in other studies. In fact, we show in Section 5.2 that controlling for trade cost by including a trade cost proxy among the regressors, as in Javorcik & Narciso (2008), may lead to a biassed result.

3.3 Differentiated products

The ease with which one can evade trade taxes depends on the nature of products. One such characteristic of commodities is their degree of differentiation. Homogenous products such as gas, oil, coffee, etc., have known international prices. This enables honest customs officials to easily check the international prices with invoices presented by the importer. It also makes it difficult for corrupt customs officials to negotiate for lower invoice price (evasion through prices). Differentiated products, on the other hand, are those that are similar but not identical. Examples include cars, furniture, etc. As the price of cars varies by a significant margin depending on make and brand, it is difficult to detect true price vis-à-vis the price presented by the importer. As a result, one expects to see a stronger relationship between evasion and tax rate for these kinds of commodities. Following the literature, we use the classification first introduced in Rauch (1999) to categorise products into homogenous and differentiated products.

3.4 Foreign currency rationing

Ethiopian importers face constraints related to foreign currency rationing. Rationing can also bias our estimates since it is related both to evasion and to the tax rate, as discussed in Section 2. Since goods that are highly taxed also face a higher probability of rationing (e.g., luxury goods), estimating the relationship between evasion and the tax rate without controlling for rationing may lead to a downward bias in the estimated elasticity of evasion to tax rate[8] . At times of foreign exchange shortage, importers of highly taxed items may turn to the parallel currency market and will make it appear as if there is more evasion (i.e., decrease the value of imports they report, consistently with lower availability of official foreign currency), which means a larger evasion gap. On the other hand, it is also possible that importers who get access to the foreign currency might have the incentive to be honest, and

8 Conversely, items that are considered important for the economy are generally likely to face lower tax rates. At the same time, importers of these items are less likely to be affected by rationing, as they get priority in the allocation of foreign currency.

thus evade less, since the risk of losing their position of advantage is now higher (i.e., higher profitability and reduced competition). In this context, the relationship between evasion and tax rates also depends on the availability/shortage of foreign currency. The direction of bias is ambiguous as multiple effects may be at play.

We address the issue of rationing in two ways in our empirical analysis. First, part of the effect of rationing is captured by product and year FE. Depending on their characteristics, products may or may not be affected by the rationing, and since which products are affected and which ones are not is less likely to change over time, the effect of the rationing can be partly captured by product FE. Moreover, as long as the measure of rationing varies only across time (not across products), it will be absorbed by the year FE. Second, we include a proxy for rationing in our analysis, since a direct measure is not available. Our proxy is the parallel market premium, which reflects the degree of rationing of foreign currency in any given year. We then include this proxy in an interaction term with the tax rate, to check for a non-linear relationship between the tax rate and evasion that depends on rationing.

3.5 Mechanisms of tax evasion

As mentioned in Section 1, importers may adopt at least three different approaches to evade trade taxes: they may report lower price for the imported item, they can report having imported a lower quantity of the product, either of which leading to a decrease in its value, or disguise the product as a similar but lower-taxed item—or, of course, they can also smuggle entire shipments.

Distinguishing between the quantity and price mechanisms can be done by using alternative calculations of the trade gap that focus on the price gap and the volume gap. The volume gap is measured by the difference in the quantity of each six-digit HS product that each exporting country reports as its exports to Ethiopia and quantities of the same products that Ethiopia reports as its imports from these same countries. Similarly, the price gap is measured as the unit value of the product as reported by the exporting country minus the unit value as reported by Ethiopia for the same product imported from the same country.

To check for misclassification of products, we include, alternatively, the average or median tax rates of all other products within the product's four-digit category as an additional regressor. If misclassification of imports is an important factor in explaining evasion, tax on similar products will have a negative coefficient. Controlling for it can also lead to an increase in the coefficient of the ETR variable, as this will minimise the potential bias in estimating its coefficient.

4. Data sources and key variables

To estimate Equation 2, described in Section 3, we use two sources of data: the United Nations' COMTRADE database and administrative data from the ERCA. We use the former to compute the trade gap and the latter to calculate ETRs and trade costs (as discussed in Section 3). We describe these data and key variables in more detail in this section.

COMTRADE is an international database of trade flows, including data at the six-digit HS product classification for a large number of countries[9] . We focus our analysis on the years

9 HS stands for Harmonized System, short for Harmonized Commodity Description and Coding System.

between 2005 and 2015, as there is relatively more complete data for this period. The HS product classification was revised two times in our data period: it starts with HS-2002 and is then revised to HS-2007 and HS-2012. For each year, we take the respective HS revision codes used by ERCA, making sure that they are consistent across the imports, exports and administrative dataset.

We use the COMTRADE dataset to calculate the trade gap between imports reported by Ethiopia from a set of selected countries and exports from these same countries into Ethiopia. Our preferred approach is to only include matched product–country–year observations for which there is a record for both the exporting country and Ethiopia, as this is the most conservative option. However, as a robustness check, we also run our analysis using unmatched observations. In this case, we input zeroes where there is a missing value of imports to allow us to calculate the gap for unmatched observations as well.

The chosen set of countries includes ten of Ethiopia's major trading partners: USA, Germany, France, UK, Japan, Belgium, Switzerland, The Netherlands, Canada and Australia. These countries have relatively low levels of corruption and, as such, are less likely to issue fake invoices (as also argued in Javorcik & Narciso, 2017), making records of exports more reliable. Confirming this view, ERCA indicates that China and the United Arab Emirates are major sources of fake invoices, while Europe (because of strict regulations) and India (because of export incentives) are less likely to engage in this kind of practice (Gessesse, 2018). However, these ten countries account for only 20% of Ethiopia's imports. Therefore, to check for the robustness of our findings to this choice, we also present results from an analysis that includes China and Turkey. This set of twelve countries accounts for 60% of Ethiopia's imports.

Following standard practice in the literature (see, e.g., Fisman & Wei, 2004 and Javorcik & Narciso, 2017), we measure tax evasion at the product-level using the gap in the trade value figures as reported by the exporting country c and by the importing country (Ethiopia) from country c. This variable (the trade gap) is calculated using the formula given in Equation 3 for each source country c and each six-digit HS product category p at time t. To put this in the context of Equation 1, the value of imports or exports here is simply $quantity \times price$. This is our main measure of the trade gap. We further decompose the value gap into the quantity and price gap, for the analysis of the evasion mechanism (Section 5.4). An increase in the gap indicates an increase in tax evasion. Since the trade gap measure is expressed in log, the coefficient on the tax rate (Equation 2) can be directly interpreted as an elasticity.

$$ValueGap_{cpt} = log(Export\ Value_{cpt}) - log(Import\ Value_{cpt}). \tag{3}$$

Following other studies in this literature (for example, Javorcik & Narciso, 2017), we drop the bottom and top 1% of observations of the trade gap, for each year, to minimise the influence of possible errors in the data[10] . Having done this, we arrive at an unbalanced panel data of 2,842 products for our ten exporting countries over 11 years[11] .

10 Dropping both the top and bottom 1% is necessary because the trade gap can have positive or negative values.

11 Table A2 shows that the number of products varies a lot across the different source countries, while it ranges from 1,241 to 1,661 HS6 products between 2005 and 2016.

Trade costs can be measured directly using ERCA's administrative data, which contains information on freight, insurance and other trade costs for each import transaction in Ethiopia (i.e., at the firm, product, source country and date level)—a unique feature compared with international datasets. The administrative dataset also includes more disaggregated information than COMTRADE, recoding all imports coming into Ethiopia at the eight-digit HS product classification. In order to merge the trade cost information with the six-digit HS trade data (a more aggregated classification), we aggregate them up by taking the average within each six-digit product category, for each year and source country. The administrative data, therefore, allows us to measure trade costs directly and, importantly, to use them to adjust the trade gap measure. One way to do this is to subtract trade costs directly from the CIF values of imports reported in the administrative data or from the CIF values of imports reported in the COMTRADE data. However, this adjustment suffers from possible inconsistencies across datasets, which we cannot rule out. We therefore prefer to adjust the COMTRADE CIF import value using the ratio of trade costs to CIF value obtained from the administrative data[12] . Based on this measure, we build an adjusted trade gap measure as the difference between the FOB export value and the adjusted import value (CIF–trade costs). These two values are now fully comparable in the sense that both are measured in FOB basis. As such, the adjusted trade gap addresses possible concerns related to trade costs (see Section 3).

Table 1 presents summary statistics for our main variables, including the variations of the trade gap measure that are relevant to our analysis: the value gap (our main measure), the adjusted value gap (net of trade costs) and the price and value gaps, which disaggregate the two possible mechanisms for tax evasion (as discussed in Section 3). The first thing to note is that the trade gap is typically negative—suggesting that import values are generally higher than export values. This is a common result in the literature (for example, see Fisman & Wei, 2004 and Javorcik & Narciso, 2008). The main reason is that imports are recorded more strictly than exports, since they are taxed—unlike exports. Also, Ethiopia records as imports products that are not considered as exports in the origin country. This is the case, for example, for all products imported for personal use that face import taxes but are not strictly exports. Trade costs also play a role here, as CIF values are by definition higher than FOB values. However, this does not seem to be the main reason for the negative gap in our case since the adjusted gap is also negative—though, as expected, it is about ten percentage points lower than the unadjusted version. Table A2 reports figures for our key variables, disaggregated by trading partners, as well as the number of products imported from each country.

We use ERCA's transaction-level administrative dataset also to calculate the ETRs as the amount of tax that importers pay for each product and source country, including all taxes levied at the border (see Section 2). Similarly, to trade costs, ETRs are calculated at the eight-digit HS product classification and then aggregated up to the 6-digit level to merge them with the trade gap data. As discussed in Section 3, measuring tax rates with the ETR has the

12 First, we generate a ratio of trade costs to CIF import value for each transaction. Second, we generate a weighted average of the ratio at the HS6-level for each year, up from the eight-digit level of the administrative data. Third, we adjust the CIF import value (from COMTRADE) using the ratio generated in step 2. Importantly, our results are not affected by whether we use either version of the adjustment, giving us confidence both in our results and in our data sources.

Table 1: Summary Statistics for Main Variables: Matched Observations for 2015

	No. of Obs	Mean	Std. Dev.	Min	Max
Statutory rate	3,960	0.46	0.24	0.00	2.42
Duty rate	3,960	0.15	0.10	0.00	0.35
Excise tax rate	3,960	0.02	0.09	0.00	1.00
VAT rate	3,960	0.15	0.02	0.00	0.15
Surtax rate	3,960	0.08	0.04	0.00	0.10
Effective rate	3,967	0.29	0.26	0.00	2.45
Effective duty rate	3,967	0.10	0.10	0.00	0.35
Effective excise rate	3,967	0.01	0.08	0.00	1.35
Effective VAT rate	3,967	0.10	0.08	0.00	0.40
Effective SURtax rate	3,967	0.07	0.06	0.00	0.31
Trade cost to CIF ratio(%)	3,967	10.37	9.10	0.00	98.60
Adj. value gap (log)	3,967	–0.40	2.32	–8.12	6.66
Value gap (log)	3,967	–0.49	2.30	–8.19	6.51
Volume gap (log)	3,752	–0.73	2.52	–7.88	6.69
Price gap (log)	3,705	0.33	1.63	–3.96	5.31
PM premium	3,967	12.41	0.00	12.41	12.41

Source: Own computation based on COMTRADE and ERCA's administrative data, for 2015.

advantage of including all available exemptions that importers enjoy on specific products. On the contrary, the statutory tax rate (the one set out in the law) abstracts from exemptions. Given our choice of countries, we calculate statutory rates for each product using the Most Favored Nation (MFN) import duty rates[13] . We then cumulatively add to these duty rates: excise tax, VAT and the surtax rates in order to generate the combined statutory tax rate that is applicable to each eight-digit HS product.[14] [15]

Figure 1 plots the effective and statutory rate, averaged for all products, over our data period. It shows clearly that the ETR is much lower than the statutory rate. As reported in Table 1, in the last year of our data their respective mean values are 29% and 46%—a sizeable and statistically significant difference[16] . Figure 1 visually confirms that both rates increased after the introduction of the surtax in 2007. As reported in Table A1, the increase is about ten percentage points in both cases and statistically significant, consistent with the 10% surtax rate[17] . The figure also confirms that statutory and effective rates do not follow

13 MFN status gives a country the benefit of receiving the best trading conditions that the relevant partner provides, including the lowest available import duty rates.

14 The statutory tax rate is calculated as $Statutory\ tax = (1 + Tariff) \times (1 + Excise) \times (1 + VAT) \times (1 + Sur) - 1$.

15 ERCA's data on import tax rates is preferred to the data that is available from UNCTAD's TRAINS database, as the latter dataset is available only for import duty rates. Moreover, for our sample period, this dataset is available only for 2006, 2008–2012 and 2015.

16 The 95% confidence interval for the statutory rate (between 45% and 47%) and the ETR (between 28% and 30%) do not overlap indicating that there is a statistically significant difference between the two.

17 While the statutory rate shows an increase of ten percentage points, just as the estimated average increase in the surtax rate, the ETR shows an increase of eight percentage points.

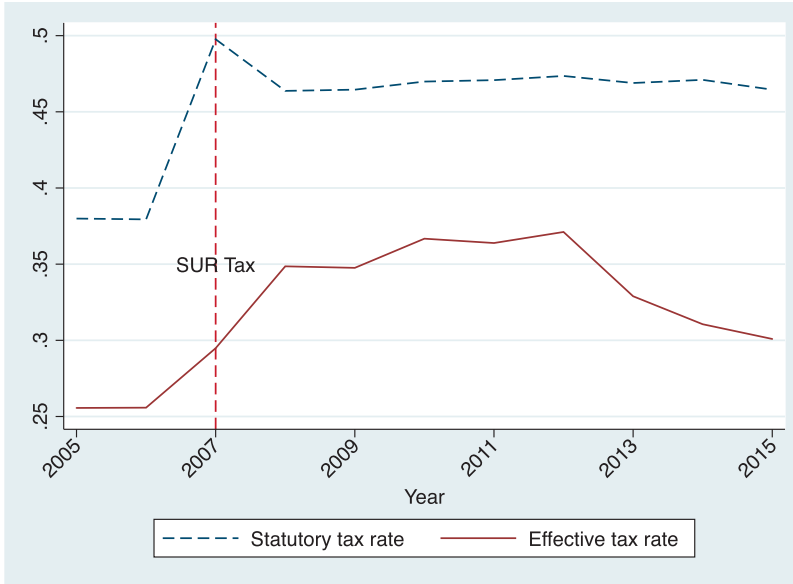

Figure 1: Effective versus Statutory Tax Rates *Source*: Own computation based on data from ERCA. All relevant countries included.

the same trend: after 2011, the ETR has decreased consistently while there was essentially no change in the statutory rates that shows the increased use of tax exemptions over time.

Finally, it is worth noting two other variables that we use in our analysis. First, to capture evasion that takes place through misclassification of products (see Section 3), we generate the average and median ETRs of all other products within the product's four-digit HS category. In Section 5.4, we use these variables to explore the mechanisms of evasion. Second, we use data from the National Bank of Ethiopia to capture the parallel market premium, which is used as a measure of the degree of foreign currency rationing (as discussed in Section 3). The parallel market premium is measured as the difference, in percentage terms, between the price of USD in the parallel and official markets. We use this variable in Section 6.

5. Results and discussion

5.1 Evasion responses to the tax rate

We start by estimating our equation of interest (Equation 2 in Section 3) using the main specification, with the (unadjusted) value gap as the dependent variable. The main relation of interest is between the trade gap and the tax rate. In Table 2, we include alternatively the statutory (Columns 1 and 2) or the effective (Columns 3 and 4) tax rates. As discussed in Section 3, we expect the latter to be more relevant because it represents the rate importers actually face at the border, which is quite different than the statutory one set out in the law (see Section 4). Table 2 confirms this expectation. The statutory rate presents an unexpected negative coefficient in column 1, which, however, disappears once year FE are included (Column 2). This is expected since the main variation of the statutory rate is the introduction

Table 2: Tax Rate and Tax Evasion

	Tax rate var: statutory rate		Tax rate var: effective rate	
	(1)	(2)	(3)	(4)
Statutory rate	–0.678	0.128		
	(0.250)***	(0.380)		
Effective rate			1.135	1.143
			(0.082)***	(0.083)***
Constant	0.284	0.169	–0.364	–0.059
	(0.111)**	(0.139)	(0.025)***	(0.046)
Year FE	No	Yes	No	Yes
No. of obs.	35,167	35,167	35,175	35,175
No. of groups	9,286	9,286	9,287	9,287

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE.*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

of the surtax in 2007 (Figure 1), which is almost fully absorbed by time FE[18] . Therefore, once we account for year FE, which is our preferred specification (see Section 3), the statutory rate does not seem to have any statistically significant relationship with trade tax evasion. On the contrary, the ETR presents the expected positive and statistically significant coefficient (Columns 3 and 4), which remains largely unaffected by the inclusion of year FE. These coefficients suggest that a percentage point increase in the ETR is associated with a 1.1% increase in tax evasion, based on our preferred specification (Column 4). The magnitude of this elasticity is in line with those found elsewhere in the literature (see Section 1). Given that the ETR has been declining in recent years in Ethiopia (see Section 4), our results suggest that this reduction would have been accompanied by decreasing levels of evasion. Indeed, our data confirm that the trade gap has been declining over the years.

One of our key contributions to the literature is to provide evidence on how the elasticity of the trade gap to the statutory rate compares with the elasticity to the ETR in a LIC. Our results confirm that the ETR that importers face at the border is more relevant than the statutory rate in explaining importers' evasion behaviour in this context. This distinction is particularly important in LICs, like Ethiopia, that relies heavily on tax exemptions to attract investment—a strategy on which, however, the literature has cast doubts (Kinda, 2018). Furthermore, this result suggests that there might be considerable bias in estimates of evasion parameters that use data on statutory rates from international databases, such as WITS.

5.2 Taking trade costs into account (and how)

Trade costs are embedded in the trade gap measure used in the literature, which is also the one we use in our main results as reported in Table 2. As discussed in Section 3, although

18 The model that uses the statutory tax rate omits exemptions, thus potentially leading to a downward bias in the estimated coefficient of the statutory tax rate since the ETR has been decreasing over the period, suggesting an increased incidence of exemptions.

Table 3: Tax Rate and Tax Evasion: Adjusting the Value Gap Using Information on Trade Costs

	Without year FE			With year FE		
	Baseline	Adj. gap	TC	Baseline	Adj. gap	TC
Effective rate	1.135	1.152	0.421	1.143	1.159	0.437
	(0.082)***	(0.082)***	(0.070)***	(0.083)***	(0.084)***	(0.071)***
Trade cost (log)			–0.550			–0.548
			(0.008)***			(0.009)***
Constant	–0.364	–0.265	3.601	–0.059	0.038	3.651
	(0.025)***	(0.025)***	(0.064)***	(0.046)	(0.046)	(0.073)***
Year FE	No	No	No	Yes	Yes	Yes
Country × Prod. FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	35,175	35,175	35,175	35,175	35,175	35,175
No. of groups	9,287	9,287	9,287	9,287	9,287	9,287

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. In the third and sixth columns, we run the same regression as the baseline case but explicitly controlling for trade cost. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

almost all the studies cited in this paper recognise the importance of accounting for trade costs, lack of data means that they have largely abstracted from the potential bias of trade costs. As a result, trade costs are either treated as errors in the trade gap that are uncorrelated with the tax rate or it is argued that they are captured by product and year FE (Javorcik & Narciso, 2008). The latter approach is indeed perfectly valid if trade costs are product-level characteristics that are not changing over time. However, in the case of Ethiopia, we can show that trade costs not only are negatively related to the tax rate (see Figure B1) but also change over time. Table B1 shows that there is a statistically significant relationship between the ETR and trade costs, even once year and product FE are controlled for. This implies that an FE panel data model does not completely address the bias. It is therefore important to explicitly take trade costs into account in the estimation of the relationship between evasion and tax rates—which we do in this section using our adjusted trade gap measure (see Section 4).

Table 3 compares our baseline results (from the main specification, as reported in Table 2) with two alternative specifications that take trade costs into account in different ways. The first one follows the approach, adopted elsewhere in the literature (Javorcik & Narciso, 2008), to control for trade costs. We do so by adding log trade costs as an additional explanatory variable. Table 3 (see Columns 3 and 6) shows that, when we do this, the coefficient on the ETR decreases substantially—though it remains highly statistically significant[19] .

The second approach is to use the adjusted trade gap, as defined in Section 4, as the dependent variable, instead of the standard value gap. We would argue that this is a more direct and proper way to account for this issue, and our preferred approach given that the

19 Controlling for trade costs in this way is equivalent to adjusting the trade gap (the dependent) variable by deducting log trade costs and generating the dependent variable using the formula $AdjGap = log(ExpVal) - (log(ImpVal) - log(tradec)$. However, given the non-linear nature of the log transformation (function), this is not a proper adjustment.

necessary data are available. When we use the adjusted trade gap, the elasticity of evasion to the ETRs increases from 1.144 to 1.60 (in the preferred specification using year FE). This result confirms the presence of a downward bias related to trade costs, which can be addressed by using the adjusted trade gap measure.

Our approach to taking trade costs into account, through the adjusted trade gap, represents an original contribution to the methods used in this literature. Perhaps, most importantly, it shows that trade costs do affect the elasticity of evasion to the tax rate and should, therefore, be taken into account to avoid bias. In our case, the bias is relatively small (0.16 percentage points), which is consistent with multiple biases going in opposite directions (see Section 3). Also, our results show that the way in which trade costs are taken into account matters. Simply controlling for trade costs linearly may lead to a significant downward bias in the elasticity estimates. In fact, elasticity estimates that ignore trade costs may be less biassed than those that control for it by including a trade cost proxy among the regressors.

5.3 Role of product differentiation

Product characteristics, specifically whether a product is homogeneous or differentiated, can make it either easier or harder to evade taxes at the border. In the case of differentiated goods, there is no single internationally set price and there tends to be a large variation in quality. This makes it easier for traders to submit lower prices and/or for customs officials to assign a lower price on the imported item and pocket a bribe. In the case of homogeneous products, it is normally difficult to evade taxes as these imported products have a standard price and less variation in product attributes. Javorcik & Narciso (2008) show that almost all trade tax evasion takes place through differentiated goods, whereas there is little or no evasion in the case of homogeneous goods. We use the same product classification, following Rauch (1999), to identify these two types of goods in the case of Ethiopia. By doing this, we can separate product types that may have a different responses to the tax rate, thus identifying more precisely the elasticity for those products that are potentially more prone to evasion.

In the Ethiopian context, however, there does not seem a substantial difference in evasion across homogeneous and differentiated products. Although the estimated relation between the ETR and evasion for differentiated products is 0.1–0.2 percentage points higher than the corresponding estimates for homogeneous products, the difference is not statistically significant, as shown in Columns 5 and 6 of Table 4. Columns 1 and 2 of Table 4 show the results of a regression that relates tax rates and evasion for differentiated products only, while Columns 3 and 4 do this for homogeneous goods only. In Columns 5 and 6, we report results based on regressions that include an interaction term between the ETR and a dummy variable for differentiated goods. Although the comparison of coefficients in Columns 2 and 4 suggests that tax evasion is greater in differentiated goods, a formal statistical test shows that the coefficients are not significantly different in statistical terms (see Columns 5 and 6). In other words, contrary to the findings in the literature, we do not find enough evidence to suggest that the impact of the ETR is different for homogeneous and differentiated goods. This finding is consistent with the valuation system applied in Ethiopia, as discussed in Section 3, where invoice prices that do not align with the pre-specified prices of these commodities are not accepted for tax purposes, and that the main channel of evasion is through under-reporting of import quantities that is less likely to be affected by the nature of products.

Table 4: Tax Rate and Tax Evasion: The Role of Product Differentiation

	Differentiated		Homogenous		Difference	
	(1)	(2)	(3)	(4)	(5)	(6)
Effective rate	1.064	1.195	0.953	0.980	0.953	1.009
	(0.115)***	(0.120)***	(0.223)***	(0.226)***	(0.223)***	(0.224)***
ETR × diff prod.					0.001	0.002
					(0.003)	(0.003)
Constant	–0.224	–0.083	–0.072	0.012	–0.198	–0.063
	(0.036)***	(0.054)	(0.072)	(0.127)	(0.032)***	(0.050)
Year FE	No	Yes	No	Yes	No	Yes
Country × product FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	18,005	18,005	3,704	3,704	21,709	21,709
Number of groups	5,737	5,737	1,478	1,478	7,215	7,215

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

5.4 Understanding the mechanisms of evasion

Having established that the ETR has the expected positive impact on evasion, we now turn our attention to the mechanisms that importers adopt to evade trade taxes. As discussed in Section 3, this could happen through under-pricing, under-declaring quantities or misclassification of products. All these mechanisms would be captured in the aggregate value gap that we used in our main specification (Section 5.1), as well as in the adjusted value gap (Section 5.2).

We first look at the decomposition of the total value gap into the price and volume gap, capturing respectively evasion through under-reporting prices and quantities. Table 5 shows that there is no statistically significant relationship between the price gap and the tariff rate. On the contrary, we find a large, positive and statistically significant relationship between the quantity (volume) gap and the tax rate, which is comparable in magnitude to the baseline result reported in Table 2. These results suggest that almost all trade tax evasion in Ethiopia takes place through the quantity channel. This is fully consistent with the valuation system applied in Ethiopia, which severely limits the possibility to manipulate prices (see Section 3).

Second, we check for the possibility of misclassification of imports as lower-taxed but similar products. As mentioned in Section 4, for each HS six-digit product category, we generate the average and median tax rates of other products that fall in the same HS four-digit category (one level of aggregation up from six-digit). This captures the tax rate of similar products, which may influence the extent of misclassification. Table 6 includes alternatively the average and median ETR for similar products as described above. It shows that, although the coefficients are of the right sign, indicating the presence of evasion through mislabelling of products with increases in the tax rates, the estimated coefficients are very small and are not robust to the inclusion of year FE. These results seem to confirm that the main mechanism for trade tax evasion in Ethiopia is under-reporting of imported quantities, with under-pricing and misclassification playing minor roles, if any.

Table 5: Tax Rate and Tax Evasion: Evasion through Price versus Quantity

	Without year FE			With year FE		
	Value	Volume	Price	Value	Volume	Price
Effective rate	1.135	1.052	0.063	1.143	1.135	–0.008
	(0.082)***	(0.089)***	(0.049)	(0.083)***	(0.092)***	(0.050)
Constant	–0.364	–0.744	0.379	–0.059	–0.337	0.247
	(0.025)***	(0.027)***	(0.015)***	(0.046)	(0.052)***	(0.028)***
Year FE	No	No	No	Yes	Yes	Yes
Country × product FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	35,175	33,749	33,317	35,175	33,749	33,317
Number of groups	9,287	8,976	8,885	9,287	8,976	8,885

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 6: Tax Rate and Tax Evasion: The Role of Mislabelling

	Without year FE		With year FE	
	(1)	(2)	(3)	(4)
Effective rate	1.203	1.198	1.161	1.155
	(0.084)***	(0.085)***	(0.084)***	(0.084)***
Med ETR sim pro.	–0.005		–0.002	
	(0.002)***		(0.002)	
Avg ETR sim pro.		–0.006		–0.002
		(0.002)***		(0.003)
Constant	–0.173	–0.168	0.004	–0.012
	(0.059)***	(0.073)**	(0.066)	(0.081)
Year FE	No	No	Yes	Yes
Country × product FE	Yes	Yes	Yes	Yes
No. of obs.	35,175	35,175	35,175	35,175
Number of groups	9,287	9,287	9,287	9,287

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE.$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

6. Robustness

In this section, we consider additional elements as a way of testing the sensitivity of our elasticity estimates. Specifically, we look at the role of foreign currency rationing (as discussed in Section 3), using all observations (including unmatched) rather than just matched data only, the inclusion of developing countries among trade partners, and using the first difference estimator.

6.1 Role of foreign currency rationing

As indicated in Section 3, whenever there is a shortage of foreign currency in Ethiopia, the government rations access to foreign currency. We capture rationing by using the parallel

market premium as a proxy (as described in Section 4). In principle, rationing can have two opposite effects (as highlighted in Section 3). On the one hand, it may increase evasion because importers may only want to declare import values that are consistent with the limited foreign currency available to them from official sources. On the other hand, the 'lucky' traders who managed to obtain the amount of foreign currency they need may have an incentive to be more honest than usual, to avoid losing their advantage.

Table C1 shows that evasion decreases as the parallel market premium increases, in line with the second effect highlighted above. This result is consistent with our hypothesis that foreign currency shortages, as proxied by increases in the parallel market premium, lead to an increase in the returns to imports (subsidy in the form of reduced foreign exchange rate) and encourage honesty in declaring imports and/or reduce the incentive to evade taxes. However, as can be seen from the statistically insignificant coefficient of the interaction term between the two variables, we do not find enough evidence to show that the impact of tax rates on evasion depends on the level of foreign currency shortage. More importantly, even after controlling for this potentially confounding factor, the estimated elasticity of evasion to tax rates remains qualitatively similar.

6.2 Including unmatched observations

As indicated in Section 4, the main analysis in this paper is done using only matched observations—those with non-missing values from both the exporter and importer sides. Since this might exclude observations that potentially capture cases of smuggled products, among others, we estimate our model again by including such unmatched observations (cases of entirely 'missing imports')[20] . These are products for which we observe non-zero exports to Ethiopia but imports of these same products are missing from the importer (Ethiopian) side. As the results reported in Table C2 show, our results based on the full dataset, including unmatched observations, remain largely similar with a slight increase in the estimated elasticity estimate[21].

6.3 Trading partners: including developing countries

By restricting the selected partner countries to ten major trading partners that are more developed and less likely to issue fake invoices, we have excluded the other major trading partners of Ethiopia—such as China and Turkey[22] . We check the sensitivity of our results by estimating Equation 2, including these two developing countries in our list of partner countries. As indicated in Table C3, our results largely remain the same. A notable exception is that now the price gap (undervaluation) becomes relatively more important compared with the baseline case. This might be because it is relatively easier to get fake invoices from these two additional countries and importers with fake invoices might find ways of getting their

20 The other potential reason for these mismatched observations is differences in how countries classify/code products, and as in the case of measurement errors, such honest misclassification of products should not be systematically related with tax rates.

21 For cases where imports are zero, we report only estimates for the value and volume gaps because computing export and import unit values (prices) does not seem sensible.

22 The ten developed countries account for 20% of Ethiopia's imports, and when we include China and Turkey, this share increases to 60%.

under invoiced products accepted by ERCA. Indeed, ERCA designated China as one of the major sources for fake invoices in terms of imports to Ethiopia.

6.4 First difference estimator

As a final robustness check, we analyse the change in the elasticity estimates using a first difference estimator, by restricting the data to 2006 (before the introduction of the surtax) and 2008 (after the introduction of the surtax. This model mainly exploits changes in the ETRs induced by the introduction of a 10% surtax in April 2007. Differencing eliminates the time-invariant product and source country-specific characteristics. The estimated elasticity coefficients remain essentially the same, thus again confirming the robustness of our results (see Table C4).

7. Conclusion

This paper aimed to explore the relationship between the tax rate and evasion in the context of trade flows into Ethiopia. By using a combination of international and local administrative data, we are able to run an analysis that is largely comparable with the previous literature, while measuring more precisely ETRs and trade costs—both of which have important implications for this kind of analysis.

Our main result is that trade tax evasion in Ethiopia is largely unaffected by statutory tax rates, but it responds to changes in ETRs. More specifically, we find that a one percentage point increase in the ETR is associated with a 1.14% up to 1.16% increase in evasion as measured by the trade gap. On the other hand, we do not find any statistically significant relationship between the statutory tax rate and the trade gap. These results suggest that statutory rates are not the parameter used in importers' decisions on evasion, which is entirely reasonable in the presence of widespread exemptions. In this case, the ETR is substantially lower than the statutory rate (by about ten percentage points in Ethiopia). Importantly, as we show in Section 4, the two rates also follow different patterns over time. While ETRs have been decreasing over our period of analysis, probably due to the increased incidence of exemptions, the statutory tax rate has been largely stable—except for the jump after the introduction of the surtax in 2007.

This result is relevant both for policy and for future research. For policymakers, it shows that taxpayers respond to a multitude of provisions and measures that eventually determine their ETR, rather than the statutory one set out in the law. As such, policymakers need to have a clear picture of all these exemptions and benefits—something that is far from obvious in many contexts. For researchers, our results show that estimating elasticity using statutory rates, like the majority of the literature does, would result in a severe underestimation, especially in cases where exemptions are widespread.

Digging deeper into our main result, we show that the mechanism of evasion in Ethiopia is mostly related to under-reporting quantities, rather than mispricing or misclassification. That result is largely consistent with the valuation system adopted in Ethiopia, which leaves little scope for discretion in setting prices. However, under-invoicing seems to be a more relevant channel of evasion for imports coming from emerging countries, such as China and Turkey, where it is believed that the incidence of fake invoices is higher than in high-income countries (see Section 6).

Furthermore, we make a methodological contribution by suggesting a new way to account for trade costs. As explained in Section 3, thanks to our detailed administrative data available at the transaction level, we can compute trade costs directly for each imported product. This information is then used to adjust the trade gap accordingly. Using the adjusted trade gap yields a similar elasticity estimate to our main specification. However, we show in Section 5 that controlling for trade costs as an additional regressor, an approach previously adopted in the literature, yields a potentially severe downward bias. This result might inform future research in this literature and encourage the use of local administrative data, which is increasingly available for a wider set of countries than ever before.

Finally, we check the robustness of our results to a number of factors that might affect the elasticity of evasion to the tax rate. As we show in Section 6, our results are robust to alternative specifications and choices on data, thus giving us confidence in their validity in the case of Ethiopia.

From a policy perspective, our results provide robust evidence that lower tax rates can result in lower evasion. This is particularly relevant in the case of Ethiopia that, like other LICs, is trying to strike a delicate balance between liberalising its economy further and preserving the limited revenue that it currently collects. For Ethiopia in particular, the ongoing negotiations for WTO accession would almost certainly result in lower tax rates on imports and thus lower revenue. Our analysis shows that at least part of that revenue loss might be recouped through lower evasion.

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Supplementary material

Supplementary material is available at *Journal of African Economies* online.

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Appendix A. Additional descriptive statistics

Table A1: Comparison Before and After Introduction of Surtax in 2007

	After (2008–09)		Before (2005–06)		Difference			
	Obs.	Mean	Obs.	Mean	Mean	SE		p-val
Statutory rate	5,685	0.45	5,355	0.35	0.10	0.00	***	0.000
Duty rate	5,685	0.15	5,355	0.16	–0.00	0.00		0.169
Excise tax rate	5,685	0.01	5,355	0.02	–0.01	0.00	**	0.003
VAT rate	5,685	0.14	5,355	0.14	–0.00	0.00		0.859
Surtax rate	5,685	0.08	5,355	0.00	0.08	0.00	***	0.000
ETR	5,685	0.33	5,355	0.25	0.08	0.00	***	0.000
ETR duty rate	5,685	0.11	5,355	0.11	–0.00	0.00	*	0.040
ETR excise rate	5,685	0.01	5,355	0.01	–0.00	0.00		0.430
ETR VAT rate	5,685	0.12	5,355	0.12	–0.00	0.00	**	0.002
ETR SURtax rate	5,685	0.08	5,355	0.00	0.08	0.00	***	0.000
TC to CIF Ratio(%)	5,685	8.94	5,355	8.40	0.54	0.17	**	0.001
Adj. value gap (log)	5,626	0.26	5,175	0.24	0.02	0.04		0.692
Value gap (log)	6,029	0.29	5,660	0.21	0.08	0.04		0.050
Volume gap (log)	5,851	–0.19	5,599	–0.13	–0.06	0.05		0.224
Price gap (log)	5,733	0.46	5,543	0.32	0.14	0.03	***	0.000
PM premium	6,189	10.08	5,786	2.69	7.39	0.03	***	0.000

Note: Own computation. TC to CIF is the trade cost to CIF ratio in (%) $*p < 0.05, **p < 0.01, ***p < 0.001$.

Table A2: Key Variables by Source Country (2015)

Source ctry	#HS6 prod	Stat. rate	ETR	Value gap	Volume gap	Price gap
Australia	138	0.38	0.24	–0.58	–0.56	1.16
Belgium	1,034	0.43	0.32	–0.28	–0.20	–0.05
Canada	293	0.41	0.11	–0.53	–0.21	–0.08
France	664	0.43	0.30	–0.70	–1.06	0.32
Germany	2,129	0.44	0.31	–0.34	–0.75	0.52
Japan	1,083	0.48	0.32	–0.69	–0.90	0.24
Netherlands	1,477	0.44	0.27	0.13	–0.71	0.72
Switzerland	575	0.44	0.39	–0.75	–1.66	0.87
UK	1,223	0.44	0.26	–0.79	–0.76	0.44
USA	1,292	0.44	0.22	–0.37	–0.12	–0.27

Source: Own computation based on data from ERCA.

Appendix B. Trade cost and ETR

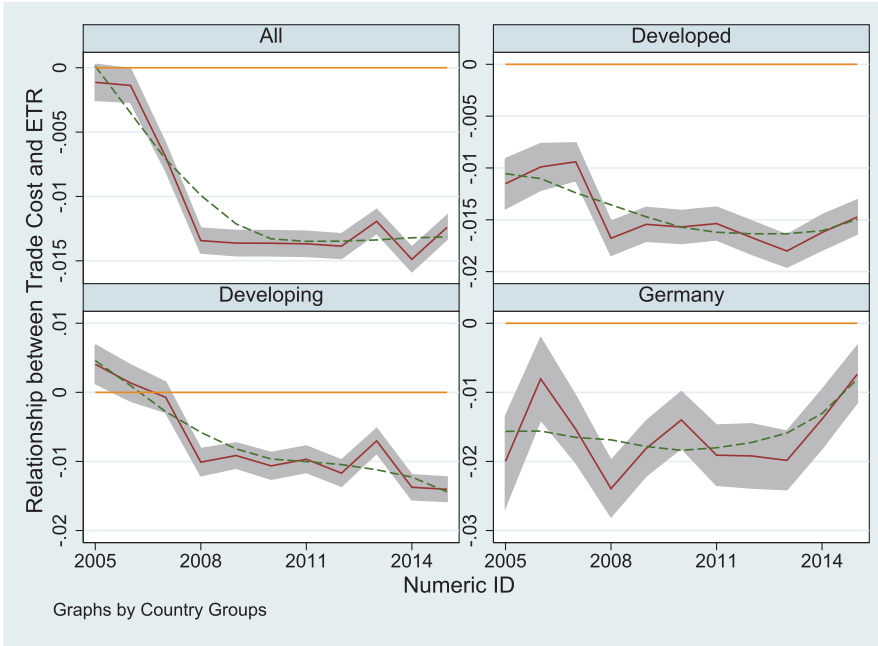

Figure B1: Relationship between Trade Cost and ETR

Table B1: Relationship between Trade Cost and ETR: Controlling for Product and Time FE

	Dep. var: trade cost
Effective rate	–0.295
	(0.065)***
Constant	7.606
	(0.026)***
Year FE	Yes
Country × product FE	Yes
No. of obs.	353,789
No. of groups	5,857

Robust SEs clustered at HS8 level given in parentheses. All regressions include source country × product and year FE.*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Appendix C. Robustness

Table C1: Tax Rate and Tax Evasion: Role of the Parallel Market Premium

	Without year FE			With year FE		
	Val. gap	Vol. gap	Pr. gap	Val. gap	Vol. gap	Pr. gap
Effective rate	1.043	1.036	0.007	1.117	1.221	–0.104
	(0.114)***	(0.132)***	(0.072)	(0.119)***	(0.139)***	(0.074)
PMP	–0.032	–0.030	–0.001	–0.061	–0.067	0.006
	(0.005)***	(0.006)***	(0.003)	(0.007)***	(0.007)***	(0.004)
ETR × PMP	0.000	–0.000	0.000	–0.000	–0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)*
Constant	–0.174	–0.559	0.384	0.015	–0.237	0.252
	(0.041)***	(0.047)***	(0.026)***	(0.058)	(0.067)***	(0.037)***
Year FE	No	No	No	Yes	Yes	Yes
Country×prod. FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	33,076	33,076	33,076	33,076	33,076	33,076
No. of groups	8,853	8,853	8,853	8,853	8,853	8,853

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. The dependent variables are defined as the value gap (val. gap), the volume gap (vol. gap) and the price gap (pr. gap). PMP is the parallel market premium. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C2: Tax Rate and Tax Evasion: Including Unmatched Observations

	Value gap	Volume gap	Value gap	Volume gap
ETR	1.094	1.594	1.663	1.082
	(0.067)***	(0.104)***	(0.108)***	(0.068)***
Constant	0.237	0.789	1.352	0.468
	(0.021)***	(0.033)***	(0.062)***	(0.036)***
Year FE	No	No	Yes	Yes
Country × Product FE	Yes	Yes	Yes	Yes
No. of Obs.	52,136	52,136	52,136	52,136
Number of Groups	14,160	14,160	14,160	14,160

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C3: Tax Rate and Tax Evasion: Including China and Turkey

	Val. gap	Vol. gap	Pr. gap	Val. gap	Vol. gap	Pr. gap
ETR	1.090	0.830	0.261	1.162	0.937	0.225
	(0.065)***	(0.069)***	(0.039)***	(0.067)***	(0.071)***	(0.040)***
Constant	–0.630	–0.944	0.313	–0.346	–0.610	0.264
	(0.022)***	(0.023)***	(0.013)***	(0.036)***	(0.040)***	(0.021)***
Year FE	No	No	No	Yes	Yes	Yes
Country × product FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	57,275	57,275	57,275	57,275	57,275	57,275
No. of groups	13,542	13,542	13,542	13,542	13,542	13,542

Note: Robust standard errors clustered on at HS6 level given in parentheses. All regressions include source country × product FE. The dependent variables are defined as the value gap (val. gap), the volume gap (vol. gap) and the price gap (pr. gap). $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table C4: Tax Rate and Tax Evasion: Based on a First Difference Model Data for 2006 (Before Surtax) and 2008 (After Surtax)

	Δ Val. gap adj.	Δ Val. gap	Δ Vol. gap	Δ Pr. gap
Δ Effective rate	1.249	1.019	1.290	–0.087
	(0.322)***	(0.299)***	(0.373)***	(0.181)
Constant	0.059	0.017	–0.081	0.069
	(0.083)	(0.081)	(0.095)	(0.046)
No. of Obs.	1,467	1,494	1,449	1,433
Adj. R2	0.011	0.007	0.009	–0.001

Note: Robust standard errors clustered on at HS6 level given in parentheses. The dependent variables are defined as first differences of the value gap (val. gap), the volume gap (vol. gap) and the price gap (Pr. Gap). $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.