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Tax Evasion and Missing Imports:
Evidence From Transaction-Level Data

Andualem T. Mengistu, Kiflu G. Molla and Giulia Mascagni

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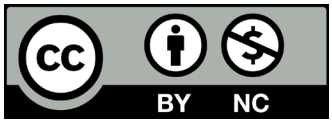

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Summary

It is well documented in the literature that developing countries raise less tax revenue as a share of their economy than their developed counterparts. Part of this gap can be explained by the relatively higher tax evasion in the former. Recent literature shows that increasing the availability of information reduces evasion, by increasing the probability of detection. However, there is little evidence to show how tax evasion responds to changes in tax rates.

Using highly disaggregated trade data, we show that there is more tax evasion when tax rates increase. However, this relationship only holds when we use the de facto effective tax rate, rather than the de jure effective tax rate. We also find that evasion takes place through under-reporting of the value of imports, as well as mislabelling highly-taxed products as similar lower-taxed products. Finally, we show that when trade costs are ignored, the level of evasion is underestimated; the degree of underestimation in the elasticity estimate depends on the way the trade cost is included in the estimation.

Keywords: tax evasion; tax rate; missing trade; Ethiopia.

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Acronyms

ERCA	Ethiopian Revenues and Customs Administration
ETR	Effective tax rate
LC	Letter of credit
NBE	National Bank of Ethiopia

Introduction

There is a clear pattern showing that developing countries collect less tax as a share of their GDP than their developed counterparts (Besley and Persson 2014). This is due to, among others, the large share of the informal sector, low tax morale, weak tax administration, and less developed financial sectors (Gordon and Li 2009; Besley and Persson 2014). The standard model of tax evasion of Allingham and Sandmo (1972) postulates that tax evasion is a function of the probability of detection and tax rate. Although the model predicts a negative relationship between evasion and probability of detection, its prediction regarding the relationship between tax evasion and tax rate is ambiguous. This is because the theoretical relationship between evasion and tax rate depends on assumptions about the utility function, the probability of detection, as well as the penalty rate and how this is taken into account in the model (see also Yitzhaki 1974).[1]

The empirical literature based on the seminal model of Allingham and Sandmo (1972) confirms that tax evasion declines with the probability of detection. For instance, Kleven *et al.* (2011) show that evasion declines for tax types where there is third-party information, which makes it easier for revenue authorities to detect wrongdoing. Similarly, Carrillo *et al.* (2017) and Shimeles *et al.* (2017) show that taxpayers respond to threats of an audit by the tax administration. Two recent studies on Ethiopia, Ali *et al.* (2015) and Mascagni *et al.* (2018), show that the introduction of sales registration machines, which increases the probability of detection, is associated with a substantial increase in VAT collection. In general, while there is extensive empirical research on the relationship between evasion and the probability of detection, there is still relatively little empirical evidence on the relationship between evasion and the tax rate. This relationship is indeterminate in the theoretical framework of Allingham and Sandmo, and it is difficult to test empirically largely due to the lack of data on exogenous changes in tax rates that match the tax evasion measure available to researchers.

In this paper, using transaction-level administrative data on Ethiopian imports, we estimate the response of evasion of import tax to changes in tax rates, using the trade gap as our measure of evasion. We take advantage of this detailed data to construct a value of the trade gap that takes into account trade costs,[2] construct an effective tax rate (ETR) that takes into account all exemptions and deductions. The data also provides us with exogenous changes in the tax rate that enable us to apply a quasi-experimental approach to estimate the relationship in question.

We find a strong positive relationship between the tax rate and the measure of tax evasion employed in this study. Specifically, a 1 percentage point increase in the de facto effective tax rate is associated with a 1 per cent increase in evasion (trade gap). However, we do not find a statistically significant relationship between evasion and tax rate when we use the de jure effective tax rate. In terms of channels, there is large, statistically significant and robust evidence of evasion through under-invoicing of import values. Although not robust to specification choice, we also find some evidence of evasion through misclassifying of items into similar, low-taxed items. Finally, we show that the elasticity of evasion to tax rate increases when we take trade costs out of the trade gap measure. How trade costs are taken into account affects the magnitude of the elasticity of tax evasion to tax rate.

[1] While a high tax rate may decrease compliance, by increasing the benefits of evading, it may also increase it, if the size of applicable penalty in turn depends on the tax rate. In general, it is difficult to disentangle the substitution effect (an increase in the tax rate means evading a given amount of income will have higher reward, making evasion more attractive) from an income effect (an increase in tax rate makes the taxpayer less wealthy and, under the assumption of decreasing absolute risk aversion, leads to less risk appetite and hence less evasion).

[2] In Section 2.2 we provide a detailed discussion of the sources and construction of the data set used in this paper.

This paper contributes to the literature on tax evasion and tax rate. In this regard, Clotfelter (1983) and Feinstein (1991) are two notable and yet contradictory studies in the area based on data from the US Taxpayer Compliance Measurement Program. While the former finds a positive relationship between tax evasion and tax rates, the latter compares reported taxable income with what auditors claim to be true taxable income, and finds the opposite. In both of these studies, the main source of variation in tax rates comes from differential marginal tax rates across income levels. Since taxpayers at different levels of income are likely to respond differently to changes in the tax rate, it is not possible to disentangle the tax rate effect from income effect - this is a common challenge for this type of studies.

Another strand of the literature that our paper closely relates to tries to fill in the aforementioned gap by analysing the relationship between tax rate and tax evasion using international trade data.[3] Tax evasion is by definition unobservable, and hence difficult to measure. In the case of trade, however, it is possible to do so thanks to the reporting of traded goods on both the exporter and importer sides. By comparing the two, one can identify the 'missing trade' or 'evasion gap': the quantity or value of traded goods that appear to be exported from the trading partner, but do not match with what is reported by the importing country. According to Bhagwati (1964), the seminal work in the area, tax evasion can explain observed discrepancies between exports reported by country A to country B, and imports reported by country B from country A. Applying this methodology to Turkey, Bhagwati (1964) shows that the discrepancy between imports reported by Turkey and exports to Turkey reported by its trading partners (the evasion gap) can be explained by tax evasion through under-invoicing of imports.

Fisman and Wei (2004) is another seminal work in the area that tries to quantify the effects of tax rates on tax evasion by analysing the responsiveness of the evasion gap to tariff rates (tariff plus VAT) using highly disaggregated product-level trade data. They define the evasion gap as the product-level difference in exports to China as reported by Hong Kong (the exporter) and imports of the same products from Hong Kong as reported by China (the importer). They find strong evidence of mislabelling of products, and limited evidence on underreporting of import prices. Overall, they find that a 1 percentage point increase in the tax rate is found to be associated with a 3 per cent increase in the evasion gap.[4] Rotunno and Vézina (2012) undertake a similar analysis on China using data on multiple exporting countries instead of focusing only on Hong Kong as a partner country. Using similar methodology - cross-sectional data and de jure tax rate - Levin and Widell (2014) present comparative evidence on missing imports for Kenya and Tanzania. They find a similar elasticity of tax evasion to tax rate as in Fisman and Wei (2004) for Tanzania, and a smaller, close-to-zero, elasticity estimate for Kenya. Following the same strategy, Van Dunem and Arndt (2009) finds a lower (1.4 per cent) elasticity of tax evasion to tax rate for Mozambique, using South Africa as the only source country.[5]

In recent years the literature in the area has been growing, and is also getting diversified. Some use panel data that enables them to control for product fixed effects, while another study uses the de facto tax rate, which takes into account exemptions. Javorcik and Narciso (2008) use panel data on 10 Eastern European economies, and Germany as the partner country, to examine how product differentiation affects the relationship between the tariff rates and misreporting of import prices. They find a positive relationship between the tariff rate and import price misrepresentation only in the case of differentiated products. Mishra *et al.* (2008) also conduct a

[3] This data 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.

[4] Fisman and Wei (2004) also estimate the impact of tax changes between 1997 and 1998, and find similar results.

[5] Van Dunem and Arndt (2009) point out the potential issue of not being able to capture official exemptions, which are very important in Mozambique. They specifically acknowledge that their elasticity estimate is likely to be biased downwards, given that exemptions are higher for highly-taxed items, and that the effective tax rate used in the estimation is an overstatement of the true tax rate agents face.

similar panel data analysis for India, considering all of its trading partners, and find a positive relationship between evasion and tax rate, with estimated elasticity of 0.1 per cent for all products and 0.28 per cent for differentiated products.

Other recent studies look into alternative factors that can influence the relationship between evasion and tax rate. For example, Javorcik and Narciso (2017) use data on 15 importing countries that joined the WTO between 1996 and 2008, and 3 exporting countries (USA, Germany and France), to analyse the sensitivity of evasion to changes in tariff rates. The authors point out an unintended consequence of WTO accession is shifting tariff evasion from undervaluation of imports to under-reporting of quantity and misclassification of imports.[6]

Sequeira (2016) uses the staggered phase out of tariffs associated with the SADC Trade Protocol in Southern Africa, focusing on a trade agreement between South Africa and Mozambique, to estimate the impact of changes in the tariff rate on corruption patterns in Mozambique using a difference-in-difference methodology.[7] Similarly, Worku *et al.* (2016), using a panel of 31 sub-Saharan African countries, show how 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 Tunisia are more likely to evade taxes (via under-reporting of prices), and this relationship is stronger for products that are highly taxed.

All of the above papers use the de jure tax rate; Chalendard (2017) is the only paper that we are aware of using the de facto tax rate. In this recent paper the author used data from 2013 and all (52) viable exporters to a country whose name is kept confidential, to estimate impacts of tax rate on evasion.[8] As part of this exercise the author shows that higher tariff rates are associated with a higher level of evasion, and finds a relatively larger elasticity estimate, in the range of 1.4 to 1.7 per cent - similar to other cross-sectional studies.[9]

We build on and complement the above studies in several ways by using a unique dataset. First, using detailed transaction-level data, we separate the trade cost value out of the trade gap measure. Generally, the trade gap value constructed in the literature compares CIF value of importer data with FOB value of exporter data, and proceeds assuming that the embedded trade cost is not correlated with the associated trade tax rate. Second, unlike the focus on the de jure tariff rate, we take into account all trade taxes, as well as all exemptions and deductions applied to respective trade taxes. In this regard our measure of tax rate is unique to the literature, except for Chalendard (2017). Third, as an alternative approach to using data for 2005-2015, we have also used a quasi-experimental approach to estimate the elasticity of trade gap to changes in tax rate. In 2007, Ethiopia introduced a 10 per cent surtax on a large number of imported products, and this gives us variation in tax rates over time (before and after April 2007) and across products, which can be used to effectively identify the impact of tax rates on tax evasion.[10]

This study is structured as follows. Section 1 discusses the methodology employed in this

[6] 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.

[7] The main focus of this paper is to estimate the elasticity of trade with respect to tariff.

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

[9] In general, cross-sectional studies that do not take into account product fixed effect find a much larger elasticity estimate. While panel data studies that control for time fixed effect find smaller elasticity estimates, those that control for both time and product fixed effects find the smallest elasticity estimates. For example, in Mishra *et al.* (2008) the estimated elasticity decreases by half when they control for product fixed effect.

[10] Since the surtax is charged on top of other taxes (import duty, excise tax and VAT), the change in effective tax rate applicable on products varies significantly. In addition to the variation over time, this gives us another layer of variation to identify the effect of interest.

study. Section 2 describes the data and provides descriptive statistics. Section 3 presents the empirical results on the relationship between evasion and tax rate, taking into account the role of tax exemptions. The role of trade costs and its relationship with the estimated tax evasion parameter is explored in Section 4, and Section 5 looks at the different mechanisms for evasion. Section 6 gives concluding remarks.

1 Methodology

Suppose there are two trading partner countries A and B, and suppose country A exports a single product X to country B. The assumption in the literature, so far, is that since export is usually tax-free, traders tend to report the true amount they export. However, imports in countries like Ethiopia are highly taxed, with the effective tax rate reaching 240 per cent in some cases. To avoid payment of these taxes, an importer may report lower value of the imported item by reporting lower price, lower quantity, disguise the product as a similar but less-taxed item, or smuggle the entire shipment.

Suppose the price of the item the exporter charges is p_x and the quantity the exporter reports as sales is Q_x. If, however, the importer reports to customs authorities that the price of the item is p_i and the quantity imported is Q_i, the difference between the two is the missing trade (or trade gap).

$$Gap = (p_x * Q_x) - (p_i * Q_i)$$

The usual procedure in the literature is then to assume that this measure reflects the extent of evasion, and to relate it with the tax rate as follows.

$$Gap_{pct} = \alpha + \beta_1 Tax_{pct} + \varepsilon_{it} \quad (1)$$

In Equation 1, β_1 is the coefficient of interest and it indicates by how much missing trade changes with increases in the effective tax rate. There are two sources of variation in the effective tax rate that can be used to identify its impact on missing trade: variation in effective tax rate across products, and variation in effective tax rate across time for a given commodity. The literature mostly relies on the former variation using cross-sectional data. As indicated in the introduction, there are some recent studies that make use of panel data estimations including product fixed effect, and hence exploit the within product variation in tax rates on evasion (e.g. see Javorcik and Narciso 2017; Mishra *et al.* 2008; Sequeira 2016; Rijkers *et al.* 2017).

In the next subsection we illustrate how Equation 1 may lead to a biased estimate of the relationship between evasion and tax rate, and detail how we minimise the potential bias in estimating β_1.

1.1 Dealing with potential estimation issues

The usual procedure the literature follows, as mentioned above, relies on two crucial assumptions: (1) evasion only takes place on the import side; and (2) the unexplained variations in

missing trade values are unrelated to the tax rate. This is based on the argument that there is no a priori reason why factors that contribute to this gap, including measurement errors and trade costs, should be systematically correlated with the tax rate applied on a commodity.

The first assumption, that evasion only takes place on the import side, relies on the fact that exporters usually face very low taxes, if any, and therefore may not have an incentive to evade. Even if exporters evade, it is not likely to correlate with the tax rate of the importing country. The second assumption, however, is difficult to justify. The following examples illustrate the problem of this assumption.

1.1.1 *Confounding factors*

As long as the estimated equation omits other important determinants of the trade gap that are also correlated with tax rate, the estimated relationship between the tax rate and evasion will be biased. To avoid the bias emanating from a failure to take into account confounding factors in the estimated equation, we use theory and our knowledge of the local economy to incorporate potential explanatory variables.

Trade costs: Since exports are measured on an FOB basis, while imports are recorded on a CIF basis (including costs of insurance and freight), the value of trade costs is imbedded in the calculated value of the trade gap. If trade costs are correlated with import taxes, the estimated coefficient of tax rates will be biased. Trade costs and tax rates can be related either due to evasion on the amount of trade costs, or due to the nature of products. For example, if there is evasion on the reported amount of trade costs, importers are likely to report lower trade costs on highly-taxed items, generating a negative relationship between these two variables. On the other hand, since luxury goods are normally highly taxed and are also likely to be expensive and require high trade costs, there is a potentially positive relationship between tax rate and trade costs.

To test this empirically, one needs to have data on a measure of trade costs (component of the gap that is due to trade costs). As discussed in Section 4, we have used a transactions-level administrative data at the taxpayer-product-level to calculate trade costs for each eight-digit HS (harmonised commodity description and coding system) product by source country and year.[11] By combining this data with the tariff and international trade data sets, we are able to empirically test for any relationship between trade costs and tax rate, and take trade costs into account in our regression of evasion. This is unlike the standard practice in the literature, and represents an original contribution of our study.

Commodity fixed effects: There may other time-invariant, product-specific characteristics that are likely to be important determinants of the trade gap and also correlated with tax rates. To avoid the potential bias arising from this, we include product fixed effects in all of our regressions. This model is better in terms of identifying the relationship between tax rate and evasion, as it absorbs the potential impacts of all time-invariant, product-specific factors, and relies on within-product and across-time variation in tax rate. Importantly, these product fixed effects could take into account trade costs, but this will only be the case if trade costs are product-specific and time-invariant. However, as we show in Section 4, this is not the case, and there is a statistically significant negative relationship between trade costs and the effective tax rate, even once product and year fixed effects are taken into account.

[11] This data is aggregated up to a year-level HS6 products data by taking simple averages, in order to merge it with the other data sets.

In order to be able to implement this model, however, there need to be changes in the tax rate applied on a given commodity across periods. Otherwise the effect of the tax rate would be absorbed by the product fixed effects. In the Ethiopian context, the introduction of a 10 per cent surtax in April 2007 introduced changes in the effective tax rate of most commodities. Moreover, the over-time introduction of exemptions on certain products and importers creates variations in the effective tax rate that can be used to identify the impact of changes in the actual effective tax rate. We are able to use these within-product changes in the effective tax rate to estimate the fixed effects panel data model. Compared to other studies in the area, this is one clear advantage of using the Ethiopian trade and tax data. For robustness, we have also estimated a first difference model, by exclusively focusing on changes in the tax rate resulting from the introduction of the 2007 surtax, using data on 2006 (before surtax) and 2008 (after surtax) (see Appendix B).[12]

Role of 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 for consumption purposes will 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.[13] This influences the import gap for a different reason than which tax rate is applied to the commodity - a shortage of foreign currency in Ethiopia. Moreover, rationing can also be related to the tax rate, as goods that are deemed luxury and for consumption purposes face higher effective trade taxes, and are also more likely to face rationing. Thus, estimating the relationship between evasion and the tax rate without controlling for the effect of a shortage of foreign currency may lead to a downward bias in the estimated elasticity of evasion with respect to taxes.[14] This may also suggest a non-linear relationship between evasion and tax rates that depends on the availability/shortage of foreign currency. That is, at times of foreign exchange shortage, importers of highly-taxed items are more likely to request lower amounts of foreign currency (show smaller value of imports), which means a larger evasion gap when there is a shortage of foreign currency. To test for this potential non-linear relationship, we have included an interaction term between the effective tax rate and the proxy for availability of foreign exchange.

To capture the role of rationing of foreign currency on tax evasion and its interaction with the tax rate, we would ideally need a variable that captures trends in rationing across products and time. This, however, is not available. Instead, we have used the parallel market premium as a proxy for foreign currency rationing in the estimated equation. The reason for this is the following. If there is a shortage of foreign currency, it will be rationed. An important implication of this shortage is that the price of the foreign currency in the official market is lower than what people are willing to pay for it. The parallel market, on the other hand, reflects the true price people are willing to pay to buy the foreign currency, given rationing. The parallel market premium, given as the percentage difference in the official and parallel market rates, will therefore reflect the

[12] For a similar exercise, see Fisman and Wei (2004). To deal with concern that their results might be driven by certain unobserved product characteristics, these authors use two years of data (1997 and 1998) and estimate a first difference model, which is made possible because of the various tax reforms that China undertook in 1997 as part of its preparation to join the WTO. Unlike the case in Fisman and Wei (2004), the tax rate change in our case is not related to a major trade reform measure, and is likely to be free from confounding factors that are likely to bias the estimates.

[13] Recently, the National Bank of Ethiopia (NBE) issued a directive (Directive FXD/52/2017 and amended in FXD/53/2018) that aims to stop this practice, and it also instructs private banks to give priority to selected sectors in their allocation of foreign currency.

[14] e.g. items that are considered important for the economy are exempted from surtax and are generally likely to face lower tax rates. At the same time, importers of these items are likely to be relatively less affected by foreign currency rationing, as they get priority in the allocation of foreign currency. As indicated above, part of this potential bias, to the extent that it is time-invariant, can be effectively captured using commodity fixed effects.

degree of rationing (shortage) of foreign currency in any given year.

Since the parallel market premium will only vary across time, it is perfectly correlated with the time fixed effects. In our estimations that include year fixed effect, we are only able to test if the impact of the tax rate depends on the level of currency rationing/shortage by including an interaction term between the parallel market premium and the effective tax rate.

1.1.2 *Taking product-level tariff exemptions into account*

The Ethiopian foreign trade tax system offers special tax exemptions for certain types of products and importers as a way of encouraging investment in general, promoting activities in some sectors, as well as protecting the welfare of the disadvantaged. This results in deviation between the actual (de facto) effective tax rate importers pay in practice, and the statutory tax rate that is set in law (de jure). In order to properly estimate the relationship between evasion and tax rates, it is important to take this into account - exemptions are likely to influence the likelihood of taxpayers evading tax. Evasion is less likely among products or importers that enjoy some level of exemption. Since the statutory tax rate does not properly account for the actual level of tax rate that importers face, it is less likely to influence their decision to evade tax. Van Dunem and Arndt (2009) also indicate that not taking this into account will cause a downward bias in the elasticity estimate, since the statutory effective tax rate is an obvious overstatement of the actual effective tax rate importers face, and also because exemptions are higher for highly-taxed items. The literature in the area, for lack of administrative data, normally uses the statutory rate - the one that is stated in the law. Some studies, however, tried to investigate to what extent the issue of exemption matters for their results by calculating, for each six-digit HS product, the proportion of imports that are exempt, and controlling for this in their evasion regression (e.g. see Fisman and Wei 2004).

In this study we take advantage of the availability of administrative data to calculate the actual effective tax rate that each importer pays on each eight-digit product. We then take the average of this over importers, for each year and source country, to get a measure of an actual effective tax rate that is applied on each six-digit product. This is our preferred measure of the tax rate variable - it is better at capturing the tax rate importers actually face, and takes into account the issue of exemption in a more precise way than previous studies.

Taking into account all these methodological considerations, the fixed effects model that we estimate in this paper takes the following general form:

$$Gap_{pct} = \alpha + \beta_1 Tax_{pct} + \beta_3 Tax_{pct} \times BMP_t + \gamma_{pc} + \delta_t + \varepsilon_{pct} \quad (2)$$

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. γ_{pc} stands for time invariant $commodity \times country$ specific characteristics that may be important in determining the level of trade gap. δ_t captures time-specific factors that affect the trade gap in all commodities in similar way. These include increased efficiency in tax administration, decreased corruption, etc. Tax_{pct} is the effective tax rate on commodity i in period t that is imported from country c. β_1 measures the elasticity of evasion to the tax rate. BMP_t refers to the parallel market premium in period t. β_3 measures the potential non-linear impact of tax rates on evasion depending on the parallel market premium prevailing in year t.

Finally, evasion does not only take place through misreporting of the price and/or value of imports, but can also take place through misclassification of products, from higher-taxed to similar lower-taxed products. To this end we have included, alternatively, the average and 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, as is argued in other studies, tax on similar products $(TaxSim_{pt})$ will have a negative coefficient. Controlling for $(TaxSim_{pt})$ can also lead to an increase in the coefficient of the effective tax rate (Tax_{pt}) variable, as this will minimise the potential bias in estimating the coefficient of Tax_{pt}.

$$Gap_{pct} = \alpha + \beta_1 Tax_{pt} + \beta_2 TaxSim_{pt} + \beta_4 Tax_{pt} \times BMP_t + \gamma_{pc} + \delta_t + \varepsilon_{pct} \quad (3)$$

Although the main objective of this paper is to contribute to the literature regarding precise measurement of tax evasion in the trade sector, an additional output results from the fact that we rely on data from Ethiopia.

Specifically, using the six-digit HS data we will be able to provide commodity-level measure of tax evasion - the value of each commodity the chosen trading partner reports as export and the amount of import of the same commodity reported in the country. By doing this, we show which sectors and specific products are more prone to evasion.

Our analysis will be highly relevant for policy for the following two reasons.

First, Ethiopia is currently negotiating to join the WTO, which almost certainly involves reducing tariffs on several items. One issue the authorities will consider when looking at whether to speed up the process is the amount of revenue lost from these tariff reductions. Finding out which commodities have the highest rate of evasion, and how the tax rate affects the observed evasion, helps better calculate the revenue lost from reducing import taxes on that specific commodity. For example, we might find that for a certain commodity the tax rate is highly related with evasion, indicating that reducing it (i.e. decreasing tariffs and other taxes) may in fact lead to an increase in the tax base through a reduction in evasion.

Second, the correct calculation of evasion also sheds light on the gap in tax enforcement in the country. Specifically, it sheds light on how much of the limited fiscal capacity in the country is due to an inability to enforce or sufficiently control taxes at the border. Importantly, we are able to show in which sector and for which commodities this problem is more acute, and therefore are able to offer specific recommendations on where enforcement efforts should be targeted.

2 Data and descriptive analysis

2.1 Background on the customs valuation system in Ethiopia

The customs valuation procedures applied in Ethiopia have evolved in a number of stages since the early 1990s. Between 1994 and 2003, SGS (https://www.sgs.com/), under contract from the Ethiopian government, used to conduct the tasks of price and standard setting. Since 2003, the customs authority took over the task of price setting. To this end, successive proclamations and directives are issued by relevant government bodies - the latest are Proclamation 859/2014 and Directive 111/2015.

The series of proclamations and directives issued since taking over the price-setting role by the Ethiopian Revenues and Customs Authority (ERCA), to a large extent, follow the fair valuation method specified in the WTO agreement on Implementation of Article VII (ERCA 2017). Accordingly, ERCA in principle uses the transaction value as the price on which to calculate duties and other associated taxes. In cases where the transaction value is not available, the following five alternative methods are supposed to be applied in a strictly hierarchical fashion. (1) transaction value of identical goods; (2) transaction value of similar goods; (3) deductive value; (4) computed value; and (5) fallback method.

The practice of reference price-setting has been different from the spirit specified in the proclamations and directives. In principle, the other valuation methods are meant to be used in cases where the transaction value of the good cannot be determined. In practice, however, the ex-ante value of the good included in compact discs distributed by ERCA has been used as the basis for valuation. In other words, all imported goods have a price assigned to them that is ex-ante known, and does not depend on the invoice declared by an individual importer.

Since December 2015, ERCA changed its price-setting system from one based on pre-specified CD-based price database to a web-based automated database known as the Ethiopian Customs Valuation System (ECVS) (ERCA 2017). The database that is the basis for the web system keeps a record of accepted price data fed by the customs clearing agents. When there are sufficient records, the system summarises the weighted average price of imported items every three months, and removes outdated prices automatically. In this new system, only prices that are deemed to fulfill all the criteria set by the customs authority are included in the price database.

The new system has most of the same issues as the old system regarding acceptance of transaction values. For instance, if the stated value of the good is lower than the value of an identical or similar good by more than 10 per cent of the reference price recorded in the customs valuation database, ERCA uses the other valuation methods. Even if it is not lower by 10 per cent or more, ERCA may use the other methods if it has doubts about the validity of the documents presented by the importer.

The above observation, as well as qualitative survey of customs officials, shows that even under the new system, the price of declared items overwhelmingly reflects the ex-ante price that populates the ERCA database. Since prices are pre-specified for most commodities, evasion through under-invoicing is likely to be less of a problem in Ethiopia compared to other places.

2.2 Data

For data on trade flows (value of imports reported by Ethiopia as well as value of exports to Ethiopia as reported by each of the selected source countries), we have used data from the United Nations' COMTRADE database - this is available at six-digit HS product classification. We focus our analysis between 2005 and 2015, as there is relatively more complete data for this period.

We made a selection of 10 partner countries that are major sources of imports for Ethiopia including the USA, Germany, France, United Kingdom, Japan, Belgium, Switzerland, Netherlands, Canada and Australia. These are also countries that are relatively less corrupt, and therefore less likely to have exporters that issue fake invoices (see also Javorcik and Narciso 2017). ERCA indicates that China and UAE 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).

The data on import taxes comes from ERCA. This information is available at eight-digit HS product classification. Given our selection of partner countries, we focus on the Most Favoured Nation (MFN) duty rates, and we have added to this the excise tax, VAT and the surtax rates in order to generate a statutory tax rate that is applicable to each eight-digit HS product.[15] This statutory tax rate, however, does not take into account exemptions that are given to some importers, depending on the sector they are operating in and/or firm characteristics. In order to take these exemptions into account we use ERCA's administrative data, and generate the effective tax rate based on the actual tax that importers pay for each HS8 commodity and source country. This is then averaged to get an average de facto effective tax rate for each commodity and source country by year. In order to merge the tax data, which is available on eight-digit HS product classification level, with the six-digit HS trade data, we aggregate up the effective tax rate data by taking the average within each six-digit product categories.

Since our data spans from 2005 to 2015 it falls under different HS product classification revisions: HS-2002, HS-2007 and HS-2012. For each year, we used the respective HS revision codes used by ERCA, making sure that the HS revision codes are consistent across imports, exports of partners, and import tax rate data sets.

In addition, we also 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. The parallel market premium is measured as the difference, in percentage terms, between the price of USD in the parallel and official markets.

Measure of the evasion gap: Following standard practice in the literature (see e.g. Fisman and Wei 2004; Javorcik and Narciso 2017), we measure tariff 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 4 for each source country and each six-digit HS product category (p) at time t:

$$ValueGap_{cpt} = log(Export\ Value_{cpt}) - log(Import\ Value_{cpt}) \tag{4}$$

Due to the way the trade gap variable is measured, an increase in $ValueGap$ indicates higher import tariff evasion. Since trade gap measured in this way compares FOB values of exports to Ethiopia against CIF values of imports reported by Ethiopia, the trade cost value is embedded in this gap measure. Since this might have important implications in the estimated relationship between evasion and tax rate, we have used transaction-level data on trade costs to generate a value gap measure that takes trade costs into account (see Section 4). To capture evasion that takes place through misclassification of products, from higher-taxed products to similar lower-taxed products, we have generated the average and median effective tax rates of all other products within the product's four-digit HS category.

For each year, we have dropped the bottom and top 1 per cent of observations, in terms of the value gap variable, in order to minimise noise due to data coding and related errors (see also Javorcik and Narciso 2017). Having done this, we arrive at an unbalanced panel data of 2842 unique HS6 products for five countries over an eleven-year period, suitable to test the relationship between tax rate and evasion.[16]

[15] ERCA's data on import tax rates is preferred to the data that is available from UNCTAD's Trade Analysis and Information System (TRAINS) database, as the latter data set is available only for import duty rates. Moreover, for our sample period, this data set is available only for 2006, 2008-2012 and 2015.

[16] As can be seen from Table 2.5, the number of products varies a lot across the different source countries, while it ranges from 1241 to 1661 HS6 products between 2005 and 2016.

2.3 Descriptive statistics

Table 2.1 presents summary statistics on main variables, including effective tariff rate and the measures of trade gap (import value gap and adjusted import value gap), used in the paper. This is done using matched observations - those with non-missing import and export values. Summary statistics for the different gap measures calculated based on all observations is presented for comparison in Table 2.2. In this case, since we have replaced the missing values with zero, we have added 1 to calculate the log values of these variables.

In the absence of evasion, Ethiopia's import values are expected to be higher than what its partners report as their exports to Ethiopia, and the gap thus defined to be negative. This is mainly because: a) imports are reported in CIF terms (including insurance, freight and other trade costs) whereas exports are reported in FOB terms; and b) Ethiopia, as in most countries, is likely to record imports more strictly than exports.

Table 2.3 makes a mean comparison of the main variables over a period two years before and after the introduction of surtax in 2007 - showing a large and statistically significant increase in both the effective and statutory tax rates after the introduction of 10 per cent surtax in 2007. While the statutory rate shows an increase of 10 percentage points, just as the estimated average increase in the surtax rate, the effective tax rate shows an increase of 8 percentage points. The excise tax rate, on the other hand, shows a small but statistically significant decrease of about 1 percentage points.

In Table 2.4, we provide a description about the time series property of the variables employed in this study. While the average statutory rate increases over time, the average effective tax rate declines, thus widening the difference between the two. We also observe that the number of products imported to Ethiopia has increased. Another noticeable trend is that the volume gap has steadily decreased in the sample period, while the price gap fluctuates without a clear trend.

Figure 2.1 plots trends in the statutory and effective tax rates. As is also indicated in Table 2.1, the statutory rate is on average 17 percentage points higher than the actual effective tax rate that is generated based on the actual taxes paid, and displays a somewhat different trend from the actual effective tax rate. Similarly, excluding 2007, the average statutory tax rate for the two years before introduction of the surtax is 10 percentage points higher, while it is 12 percentage points higher in the two years (2008 and 2009) after introduction of the surtax. Trend-wise, Figure 2.1 shows that the gap between the statutory tax rate and the effective tax rate increases after 2011. This is mainly as a result of the effective tax rate declining, while the statutory rate is largely stable, and can thus be explained by the increased level of exemptions given to importers. Figure 2.2 shows trends in the parallel market premium, which has been steadily increasing since 2011.

Table 2.1 Summary statistics for main variables: matched observations for 2015

	No. of Obs	Mean	Std. Dev.	Min	Max
Duty Rate	4043	0.15	0.10	0.00	0.35
Excise Tax Rate	4043	0.01	0.09	0.00	1.00
VAT Rate	4043	0.15	0.02	0.00	0.15
Sur-Tax Rate	4043	0.08	0.04	0.00	0.10
Statutory ETR	4043	0.46	0.24	0.00	2.42
Actual ETR	4051	0.29	0.26	0.00	2.45
Log Trade Cost	4051	7.14	2.59	0.00	17.24
FOB to CIF Ratio	4051	0.90	0.09	0.01	1.00
Trade Cost-CIF Ratio (%)	4051	10.35	9.10	0.00	98.60
Log Import Val	4051	3.08	2.61	-5.12	12.56
Log Import Val (Mirror)	4051	2.50	2.84	-6.91	11.69
log TC Adj Value Gap	4051	-0.49	2.66	-14.39	10.51
log Value Gap	4051	-0.58	2.64	-14.39	10.28
log Volume Gap	4051	-0.58	2.64	-14.39	10.28
log Unit Val Gap	3856	0.31	1.89	-9.26	9.78
Para. Mkt. Premium	4051	12.41	0.00	12.41	12.41
Para. Mkt. ExRate	4051	23.13	0.00	23.13	23.13
Official ExrRate	4051	20.58	0.00	20.58	20.58

Source: Own computation based on data from ERCA for 2015.

Table 2.2 Summary statistics for main variables: all observations for 2015

	No. of Obs	Mean	Std. Dev.	Min	Max
Log (1+Import Val)	6272	2.25	2.38	0.00	12.56
Log (1+Import Val) (Mirror)	6272	2.49	2.06	0.00	11.69
log Value Gap All Obs	6272	0.24	2.09	-9.86	10.01
log Volume Gap All Obs	6272	0.24	2.09	-9.86	10.01
log Unit Val Gap All Obs	6132	-0.58	2.50	-12.83	8.65

Source: Own computation based on data from ERCA for 2015.

Table 2.3 Mean comparison: two years before and after introduction of surtax in 2007

	After (2008-09)		Before (2005-06)		Difference			
	Obs	Mean	Obs	Mean	Mean	SE		p-val
Duty Rate	5626	0.15	5179	0.16	-0.00	0.00		0.186
Excise Tax Rate	5626	0.01	5179	0.02	-0.01	0.00	**	0.002
VAT Rate	5626	0.14	5179	0.14	-0.00	0.00		0.885
Sur-Tax Rate	5626	0.08	5179	0.00	0.08	0.00	***	0.000
Statutory ETR	5626	0.45	5179	0.35	0.10	0.00	***	0.000
Actual ETR	5626	0.33	5179	0.25	0.08	0.00	***	0.000
Log Trade Cost	5626	6.66	5179	6.63	0.03	0.05		0.593
FOB to CIF Ratio	5626	0.91	5179	0.92	-0.01	0.00	***	0.001
Trade Cost-CIF Ratio (%)	5626	8.90	5179	8.33	0.57	0.17	***	0.001
Log Import Val	5626	2.87	5179	2.85	0.03	0.05		0.566
Log Import Val (Mirror)	5626	3.05	5179	2.96	0.08	0.04	*	0.042
log TC Adj Value Gap	5626	0.26	5179	0.24	0.02	0.04		0.666
log Value Gap	5626	0.17	5179	0.12	0.05	0.04		0.216
log Volume Gap	5626	0.17	5179	0.12	0.05	0.04		0.216
log Unit Val Gap	5437	0.44	5116	0.32	0.12	0.03	***	0.000
Para. Mkt. Premium	5626	10.07	5179	2.69	7.38	0.04	***	0.000
Para. Mkt. ExRate	5626	11.80	5179	8.92	2.88	0.02	***	0.000
Official ExrRate	5626	10.70	5179	8.68	2.02	0.01	***	0.000

NOTE: Own computation. $*p < 0.05, **p < 0.01, ***p < 0.001$

Table 2.4 Number of products and averages of main variables by year

Year	Num. HS6 Prod	Statutory ETR	Actual ETR	Log Trade Cost	Val Gap	Vol Gap	Price Gap
2005	1241	0.35	0.25	6.70	0.24	-0.06	0.26
2006	1397	0.35	0.24	6.66	0.18	-0.24	0.36
2007	1299	0.47	0.29	6.82	0.26	-0.18	0.41
2008	1333	0.45	0.33	6.76	0.27	-0.18	0.41
2009	1355	0.45	0.33	6.60	0.31	-0.23	0.49
2010	1357	0.46	0.34	6.69	0.16	-0.33	0.45
2011	1384	0.46	0.34	6.70	0.26	-0.29	0.49
2012	1593	0.46	0.35	6.60	0.08	-0.44	0.49
2013	1623	0.46	0.31	6.87	-0.14	-0.58	0.42
2014	1661	0.46	0.29	7.14	-0.17	-0.56	0.35
2015	1611	0.46	0.29	7.15	-0.42	-0.69	0.36

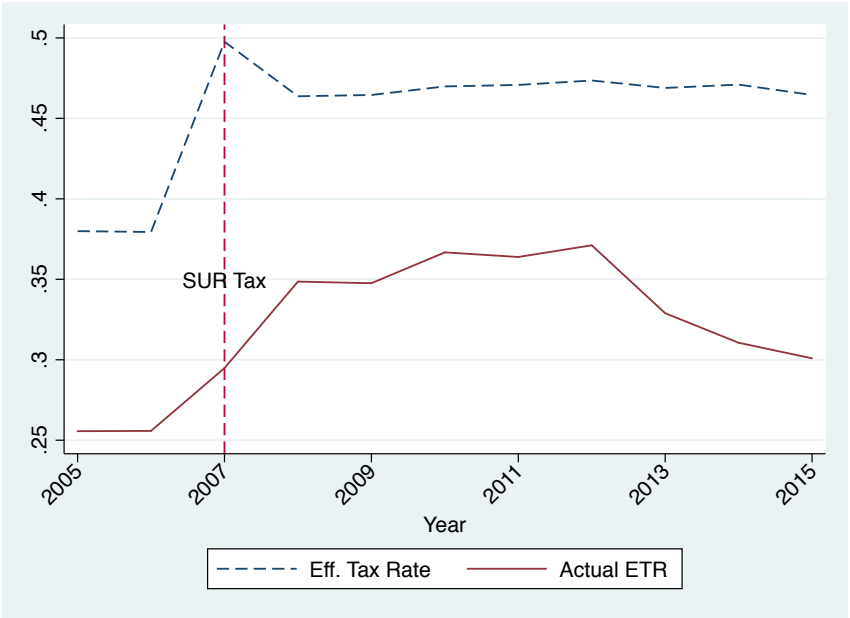
Source: Own computation based on data from ERCA.

Table 2.5 Number of products and averages of main variables by source country (2015)

Source Ctry	#HS6 Prod	Statu. ETR	Act. ETR	Log Trade Cost	Val Gap	Vol Gap	Pr Gap
Australia	138	0.38	0.24	6.73	-0.58	-0.56	1.16
Belgium	1034	0.43	0.32	6.57	-0.28	-0.20	-0.05
Canada	293	0.41	0.11	7.39	-0.53	-0.21	-0.08
France	664	0.43	0.30	6.38	-0.70	-1.06	0.32
Germany	2129	0.44	0.31	7.03	-0.34	-0.75	0.52
Japan	1083	0.48	0.32	7.05	-0.69	-0.90	0.24
Netherlands	1477	0.44	0.27	7.42	0.13	-0.71	0.72
Switzerland	575	0.44	0.39	8.43	-0.75	-1.66	0.87
UK	1223	0.44	0.26	6.28	-0.79	-0.76	0.44
USA	1292	0.44	0.22	8.31	-0.37	-0.12	-0.27

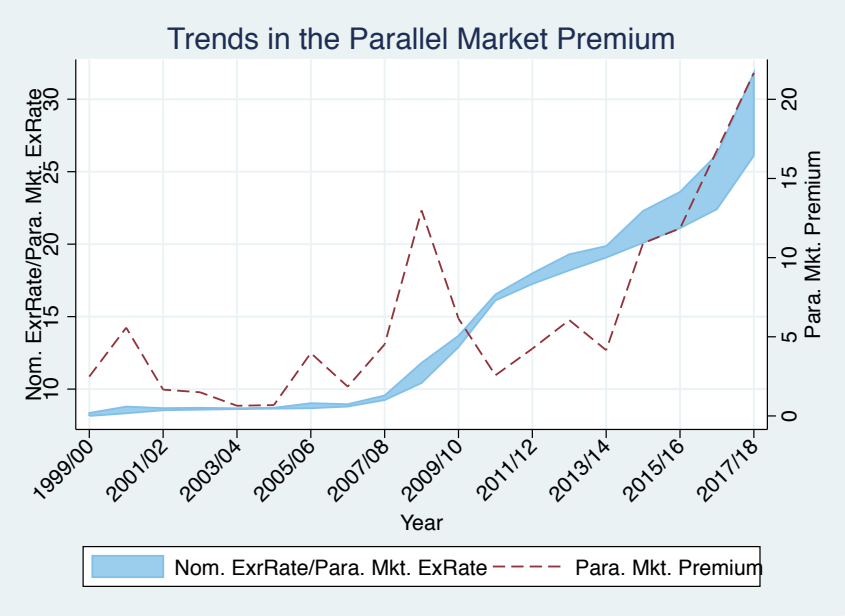
Source: Own computation based on data from ERCA.

Figure 2.1 All countries: based on statutory rates



Source: Own computation based on data from ERCA

Figure 2.2 Trends in the parallel market premium



Source: Own computation based on data from NBE

3 Results and discussion

3.1 Baseline results: statutory and effective tax rates

In this subsection we discuss the basic relationship between tax rate and tax evasion. Table 3.1 provides the results from the baseline regression. While results presented in columns 1 and 3 are based on the statutory tax rate, those in columns 2 and 4 are based on the actual effective tax rate. As indicated above, the statutory tax rates are based on tax rates importers are expected to pay for each type of good. The effective tax rate, on the other hand, is based on the actual amount of taxes importers pay for each HS8 product. Unlike the statutory rate, the effective tax rate takes into account the presence of exemptions. In the Ethiopian tax system, similar goods may be fully taxed or exempted based on the characteristics of the importing firm. Generally, manufacturing and/or exporting firms enjoy a host of trade tax exemptions. As shown in Figure 2.1, there is a stark difference between the statutory and effective tax rate. Unlike elsewhere in the literature, with the exception of Chalendard (2017) , we are able to generate the effective tax rate using administrative data containing information on the tax actually paid for each item imported to the country.

The first column of Table 3.1 shows that statutory tax rate and evasion are negatively related. However, this relationship disappears once we control for time fixed effect, as shown in column 3. We have shown above that the statutory tax rate remains stable while effective tax rate declines over time. The decline in effective tax rate that resulted in reduced evasion is not captured by the relatively stable time trend of the statutory tax rate. That explains the radical shift in the relationship once we control for time fixed effects.

On the other hand, we find a large statistically significant positive relationship between the tax rate and evasion when we use the effective tax rate. The coefficients on evasion provided in

columns 2 and 4 show that the relationship between effective tax rate and evasion is robust to inclusion of time fixed effect. This indicates the importance of dealing with the issue of exemptions prevalent in the Ethiopian tax system. In terms of magnitude, the results indicate that a percentage point increase in the effective tax rate is associated with a 1.1 per cent increase in the evasion gap, which is measured as the difference between log exports and log imports.

Table 3.1 Tax rate and tax evasion

	Statu. ETR	Actu. ETR	Statu. ETR	Actu. ETR
Statutory ETR	-0.677		0.129	
	(0.250)***		(0.380)	
Actual ETR		1.136		1.144
		(0.082)***		(0.083)***
Constant	0.284	-0.364	0.168	-0.059
	(0.111)**	(0.025)***	(0.139)	(0.046)
Year FE	No	No	Yes	Yes
No. of Obs.	35167	35175	35167	35175
Number of Groups	9286	9287	9286	9287

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

3.2 Role of product differentiation using ETRs

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 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 there is a standard price and less variation in the nature of imported products. As shown in the literature (see (Javorcik and Narciso 2008)), 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 (Rauch 1999) to identify these two types of goods in the case of Ethiopia, in order to test for the presence of such heterogeneity and/or investigate which types of products are more responsible for the observed relationship between evasion and tax rate.

In the Ethiopian context, however, there does not seem a substantial difference in evasion across homogeneous and differentiated products. Although the estimated impact of the effective tax rate on 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 3.2. Columns 1 and 2 of Table 3.2 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 effective tax rate 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 effective tax rate is different for homogeneous and differentiated goods.

As pointed out in the customs valuation section of this paper, prices in Ethiopia are preset by

customs officials; invoice prices that do not align with the pre-specified prices of these commodities are not accepted for tax purposes. That may partly explain why we do not find a significant difference in evasion between homogenous and differentiated commodities.

Table 3.2 Tax rate and tax evasion: role of product differentiation

	Differentiated		Homogenous		Difference	
	M1	M2	M3	M4	M5	M6
Actual ETR	1.065	1.196	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	-0.084	-0.072	0.012	-0.198	-0.064
	(0.036)***	(0.054)	(0.072)	(0.127)	(0.032)***	(0.050)
Year FE	No	Yes	No	Yes	No	Yes
No. of Obs.	18005	18005	3704	3704	21709	21709
Number of Groups	5738	5738	1478	1478	7216	7216

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

3.3 Role of foreign currency rationing

As indicated in Section 1, whenever there is a shortage of foreign currency (excess demand for foreign currency) in Ethiopia, the government rations foreign exchange. This rationing takes place both by limiting the amount an importer can receive at any one time, and by increasing the waiting period to get access to foreign currency or a Letter of Credit (LC). Both limits, however, fluctuate across time based on the degree of foreign currency shortage the country faces. One mechanism traders employ, as a work-around, is to declare the price or quantity of a good to be lower than its actual value for letter of credit purposes, and fill in the rest by purchasing their remaining foreign currency needs from the parallel market.

This may have two counteracting effects on the extent of evasion and its response to the tax rate. On the one hand, the need to declare a lower amount means that importers who were not intending to evade taxes may end up evading, and this may raise total evasion in Ethiopia.[17] If this practice is uniform across all products, it will not be related to tax rates or tax evasion. However, since the rationing takes into account the characteristics of the goods (luxury goods, which are highly taxed, are also given less priority in foreign currency rationing), it may also increase the response of evasion to the tax rate. The impact of the tax rate on evasion may depend on the level of foreign currency shortage, as proxied by the parallel market premium.

On the other hand, receiving foreign currency, at times of a foreign currency shortage in the country, increases the profitability of the importer, because receiving a foreign currency permit (a letter of credit) will give the importer a temporary monopoly on the good, apart from the benefit of getting foreign currency at a subsidised rate. The cost of getting caught while evading taxes becomes higher as the parallel market premium increases. One potential effect of this scenario is for the 'lucky' traders to behave more honestly than usual.

Table 3.3 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

[17] For this to work there needs to be a lack of coordination between ERCA and NBE. Up until recently this has been the case, and it is only recently, as per directive FXD/52/2017 and amended in directive FXD/53/2018, that the NBE requires importers' LCs to be the same as their invoices.

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.[18]

Table 3.3 Tax rate and tax evasion: using ETR based on actual taxes paid, role of exchange rate rationing (parallel market premium)

	Without Year FE	With Year FE
Actual ETR	1.142 (0.116)***	1.232 (0.120)***
Para. Mkt. Premium	-0.034 (0.005)***	
ETR × PM Premium	0.000 (0.000)	-0.000 (0.000)
Constant	-0.160 (0.041)***	-0.074 (0.048)
Year FE	No	Yes
No. of Obs.	35175	35175
Number of Groups	9287	9287

Robust SEs clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

[18] Capital flight may be another plausible explanation. A shortage of foreign currency may tempt traders to over-price their imports in a bid to keep some of the proceeds abroad. Another plausible explanation may be that the parallel market premium has trended upwards in recent times, while the effective tax rate has decreased. The decline in the effective tax rate has contributed to a narrowing of the trade gap. The decline in trade gap (evasion) and the increase in parallel market premium coincided time-wise. As a result, the estimated coefficient may be indicative of a spurious relationship between evasion and parallel market premium.

4 Taking trade costs into account

4.1 Measuring trade costs

Before proceeding to a discussion on the importance of taking into account trade costs in the next subsection, we provide below a brief discussion on how our trade cost measure is generated. We access administrative data that captures all import transactions in the country for the period 2005-2017. Our data contains information on freight, insurance and other trade costs for each import transaction in Ethiopia (i.e. at firm, product, source country and date level). We use this data to generate two alternative ways to measure the trade gap that do not include trade costs.

In the first measure, we use the export value from COMTRADE to measure the FOB export value to Ethiopia for each HS6 commodity for each year. To generate the import value in FOB terms, we aggregate the FOB value of the transaction-level data from ERCA to HS6-level equivalent annually. This helps us compare both export and import values in FOB terms. One issue with this measure is that COMTRADE and the Revenue Authority in Ethiopia may classify commodities differently, or there may be a difference in the comprehensiveness of the data coverage.

To test the robustness of our trade gap measure discussed in the preceding paragraph, we generate another trade gap using both export and import values from COMTRADE. 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 (see Equation 5). Third, we generate the trade cost for each HS6 commodity by multiplying the CIF import value of the commodity for that year by the ratio generated in step 2 (see Equation 6) . Finally, the adjusted value gap is generated by subtracting the trade cost from the import value expressed in CIF terms (see Equation 7)

Our result shows that we get similar coefficients when we use either of the trade gap measures that account for trade costs.

$$tradecost\ cif\ ratio_{cpt} = \sum_{i}(weight_{cpti} \times trade\ cost_{cpti}/Import\ Value_{cpti}) \tag{5}$$

$$tradecost_{cpt} = tradecost\ cif\ ratio_{cpt} \times Import\ value_{cpt} \tag{6}$$

$$ValueGapAdj_{cpt} = log(Export\ Value_{cpt}) - log(Import\ Value_{cpt} - Trade\ Cost_{cpt}) \tag{7}$$

c is source country, p is the HS 6 code commodity, t is year and i is transaction.

4.2 Trade costs and their implication for evasion

The standard practice in the literature is to generate the trade gap measure by comparing the FOB value of exports to the CIF value of imports, and relate this with tax rate to detect evasion. Although part of this gap is clearly due to trade costs, the literature normally assumes that tax

rates and trade costs (insurance, fright and other similar costs) are not correlated and hence failing to take into account trade costs does not matter for the estimated relationship between evasion and tax rate. Some, on the other hand, argue that since trade costs are product-specific and change over time in the same fashion, they can be captured by including year and product fixed effects (Javorcik and Narciso 2008).

However, correlation between tax rates and trade costs would cause a bias in the estimated coefficient of ETR. As shown in Appendix Figure C.1, there is heterogeneity across goods in terms of the proportion of trade costs relative to the value of the goods' FOB (CIF) values. In addition, Appendix Table C.1 and Appendix Figure C.2 show that there is a clear negative correlation between trade costs and effective tax rates. In this case, failing to take into account trade costs will most probably cause an upward bias in the estimate of the tax evasion parameter. In panel data regressions, however, it is possible to mitigate this endogeneity problem by including product and year fixed effects in the evasion regressions, as long as the trade cost is not systematically changing over time. In this case the correlation between ETR and trade costs will not cause a bias in the coefficient of the ETR (see also Javorcik and Narciso 2008).

However, as shown in Appendix Table C.2, the negative relationship between trade costs and tax rates observed in a cross-sectional setting (see Appendix Table C.1 and Appendix Figure C.2) persists even after taking into account product and time fixed effects. This implies that estimating tariff evasion using a fixed effects panel data model does not completely address the bias, and it is important to explicitly take into account trade costs in the estimation of the relationship between evasion and tax rates. The literature so far has largely ignored this, as it is difficult to measure trade costs directly. The only exception to this is Javorcik and Narciso (2008), who have checked for the robustness of the evasion results to the violation of the above assumption - of no correlation between trade costs and ETR - by including an index of transport cost variable in the estimated equation. Unlike these authors' measure of trade costs that does not vary across products, we have used a unique administrative-level data to generate a measure of trade costs that is specific to each product-source country-year.

When we employ the same technique and control for log trade costs, we observe that it exacerbates the downward bias in the coefficient of the ETR variable (see Table 4.1 columns 3 and 6). The result shows that the evasion parameter, although still statistically significant, decreases by (0.7 percentage points - from 1.144 to 0.438). However, there are several reasons why this may not be proper way of addressing the endogeneity problem due to trade costs. First, since the import value is correlated with trade costs, by holding trade costs constant we are keeping the part of the variation in trade gap that is correlated with trade costs constant and hence underestimating the coefficient of ETR. Second, controlling for trade costs in this regression is tantamount to adjusting the trade gap (the dependent) variable by deducting log trade costs - generating the dependent variable using the formula $AdjGap1 = log(ExpVal) - log(ImpVal) - log(tradec)$. Given the non-linear nature of the log transformation/function, this is not a correct adjustment.

In order to be able to address the issue properly, we use our measure of trade costs to measure our dependent variable (trade gap) in a more precise way, as the log difference in the FOB export values and FOB import values - we have made the adjustment to the trade gap variable as AdjGap2=log(ExpVal)-log(ImpVal - tradec). Table 4.1 presents results based on the adjusted measure of trade gap variable. As shown in columns 2 and 5 of Table 4.1 the adjustment that we have made on the calculation of the trade gap variable changes the coefficient of the ETR - confirming the fact that not taking trade costs into account will lead to a downward bias in the estimation of the evasion parameter. Specifically, the elasticity of evasion is 1.144 when the trade gap variable is not adjusted, whereas it increases to 1.158 when trade costs are taken out of the trade gap measure.

A couple of points should be noted from this exercise. First, the assumption that ignoring trade costs does not alter the relationship between tax rate and evasion is valid as long as product and year fixed effects are used to properly account for the potential endogeneity problem. Second, controlling for trade costs in the regression in a linear fashion may lead to wrong conclusions, by exacerbating the downward bias in the estimated evasion parameter.

Table 4.1 Tax rate and tax evasion: adjusting value gap using information on trade costs

	Without Year FE			With Year FE		
	Baseline	Adj for TC	Control for TC	Baseline	Adj for TC	Control for TC
Actual ETR	1.136	1.161	0.422	1.144	1.158	0.438
	(0.082)***	(0.083)***	(0.070)***	(0.083)***	(0.084)***	(0.071)***
Log Trade Cost			-0.550			-0.548
			(0.008)***			(0.009)***
Constant	-0.364	-0.290	3.600	-0.059	0.009	3.649
	(0.025)***	(0.025)***	(0.064)***	(0.046)	(0.047)	(0.073)***
Year FE	No	No	No	Yes	Yes	Yes
No. of Obs.	35175	35001	35175	35175	35001	35175
No. of Groups	9287	9267	9287	9287	9267	9287

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5 Understanding the mechanisms for evasion

So far we have analysed how evasion through under-reporting of import values relates to the effective tax rate applied on imports. Evasion of international trade taxes can, however, take place through under-invoicing (price), under-reporting of import quantities, as well as misclassification of products. Evasion through each of these mechanisms is reflected as evasion through under-reporting of import values, and in this section we attempt to understand the evasion mechanisms in the Ethiopian case.

5.1 Evasion through import prices vs. quantities

Since we do not have data on actual prices, we have used import unit values as proxy for prices. As such, we can think of the price vs. quantity evasion as a decomposition of the evasion in import value discussed in preceding sections. As anticipated in the background section, we find that under-invoicing is not a significant part of the evasion mechanism. As shown in columns 1 and 4 of Table 5.1, we do not find a statistically significant relationship between the price gap and the tariff rate. In other words, almost all the evasion in international trade in Ethiopia takes place through the quantity channel. As can be seen in columns 2 and 5, we find a large, positive and statistically significant relationship between the quantity (volume) gap and the tax rate. Another confirmation of the significance of the quantity channel as the dominant mechanism of evasion is that the coefficients of the quantity gap are similar in magnitude to the coefficients of the value gap.

Table 5.1 Tax rate and tax evasion: evasion through price vs. quantity

	Price	Volume	Value	Price	Volume	Value
Actual ETR	0.076	1.002	1.077	0.004	1.082	1.086
	(0.048)	(0.088)***	(0.081)***	(0.050)	(0.092)***	(0.083)***
Constant	0.376	-0.738	-0.362	0.247	-0.354	-0.107
	(0.015)***	(0.027)***	(0.025)***	(0.028)***	(0.051)***	(0.045)**
Year FE	No	No	No	Yes	Yes	Yes
No. of Obs.	33076	33076	33076	33076	33076	33076
Number of Groups	8853	8853	8853	8853	8853	8853

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2 Evasion through mislabelling

Another avenue through which evasion can take place is by declaring goods as belonging to a group that is very similar, but whose tax rate is lower. Such product mislabelling is feasible if there are similar items with lower tax rates. In this context, for each HS4 products we generate the average and median tax rates of all other HS4 category products that fall under the same HS6 product category. Table 5.2 shows that, although the coefficients are of the right sign, indicating 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 fixed effects. In other words, most of the evasion in the Ethiopian context takes place through under-reporting of imported quantities.

Table 5.2 Tax rate and tax evasion: role of mislabelling

	M1	M2	M3	M4
Actual ETR	1.204	1.199	1.162	1.156
	(0.084)***	(0.085)***	(0.084)***	(0.084)***
Med ETR Paid Sim pro.	-0.005		-0.002	
	(0.002)***		(0.002)	
Avg ETR Paid Sim pro.		-0.007		-0.002
		(0.002)***		(0.003)
Constant	-0.173	-0.168	0.003	-0.012
	(0.059)***	(0.073)**	(0.066)	(0.081)
Year FE	No	No	Yes	Yes
No. of Obs.	35175	35175	35175	35175
Number of Groups	9287	9287	9287	9287

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

It is well documented in the literature that developing countries raise less tax revenue as a share of their GDP than their developed counterparts. Part of this gap can be explained by the relatively higher tax evasion in the former. In view of this, understanding the relationship between tax rates and tax evasion in developing countries like Ethiopia is relevant from the point of view of tax policy and administration. Theory does not give us a clear prediction on the relationship between tax rates and tax evasion. Moreover, empirically investigating the issue is a challenge, as tax evasion, by its very nature, is unobservable and hence difficult to measure. In the case of the international trade tax system, however, this is to some extent possible due to the availability of records of imports and exports from both trading partners – mirror trade data. This paper uses similar data for Ethiopia, and estimates the relationship between evasion and import tax (including tariff, excise, VAT and surtaxes). To this end we use highly disaggregated product-level data on taxes and trade costs from administrative sources, as well as data on imports and exports from international sources.

Following standard practice in the literature, we have measured tax evasion by relating tax rates with trade gap - given as the difference between exports to Ethiopia as reported by some of its selected trading partners, and imports of the same products from these countries as reported by Ethiopia. Obviously not all of the observed trade gap can be taken as a measure of evasion, as part of it can be attributed to measurement errors as well as trade costs. In this regard the literature in the area makes a crucial assumption that tax rates are unrelated to trade costs and measurement errors. In this paper we have used local transaction-level administrative data to generate a measure of trade costs for each HS6 product by year and source country, in order to check the validity of the aforementioned assumption, and test if failing to take trade costs into account matters for the results – its potential bias in the estimated impact of tax rates on evasion. We have used the transaction-level data on the actual tariffs that importers pay on each of their imported products to generate a measure of an effective tariff rate that is applicable on imports of each HS6 product by year and source country. Unlike the statutory tax rate that is commonly used in literature, we believe that the 'actual effective tax rate' used in this paper is better suited in terms of capturing the presence of several exemptions in the Ethiopian foreign trade tax system.

When we use the statutory tax rate, which is higher than the effective tax rate by more than 10 percentage points and also does not take into account the presence of exemptions, we do not find any evidence that links evasion with tax rate. On the other hand, when we use the effective tax rate that importers actually face on their imports, we find a large, positive and statistically significant relationship between evasion and the effective tax rate. Specifically, we find that a 1 percentage point increase in the effective tax rate is associated with a 1.14 per cent up to 1.16 per cent increase in evasion as measured by the log difference in imports and exports. Such elasticity estimates are important in terms of understanding the impact of trade reforms that may result in a reduction in tariff rates. This result indicates that a cut in tariff rates does not necessarily result in a proportional reduction in tariff revenue, as part of it will be compensated for by a reduction in evasion. This result is found to be robust to estimation of the relationship using a first difference model that mainly uses the variation (increase) in the effective tax rate due to the introduction of a 10 per cent surtax in 2007. In terms of magnitude, our estimated coefficients are at the higher end of studies that employ panel data reporting semi-elasticity estimates in the range of 0.3 per cent and 0.9 per cent, and below the estimates reported in cross-sectional studies that find evasion parameters that range between 1.4 per cent and 2.5 per cent.

Under-reporting of imports can be done in three ways: under-reporting the price of the commodity, under-reporting the quantity of the commodity, or mislabelling the commodity as some similar but lower-taxed product. Our result shows that price under-reporting does not play a role in the evasion of trade taxes in Ethiopia. This is consistent with the customs valuation system in the country, described in Section 2.1, which makes price under-invoicing difficult. Although our results in relation to evidence of evasion through mislabelling of products tend to support what is reported in the literature, the magnitude is very small and not robust to the inclusion of year fixed effects. In other words, almost all the evasion in the country takes place through under-reporting of the volume (quantity) of imports.

The above results are based on the standard assumption made in the literature that trade costs and tax rates are uncorrelated, or that trade costs are product-specific and change over time in a similar fashion, and can therefore be taken into account using product and year fixed effects. This assumption implicitly suggests that failing to take trade costs into account does not matter for the estimated relationship between evasion and tax rates. In this paper we test for the validity of this assumption, and check the robustness of our results for taking into account trade costs.

First, we find a statistically significant negative correlation between trade costs and import tax rates that survives even after controlling for product and year fixed effects, and thus challenges the aforementioned crucial assumption in the literature. Second, our results show that taking trade costs into account, by adjusting the gap in FOB values of exports and CIF values of imports by the level of trade costs, increases the estimated relationship between evasion and tax rates. Failing to take trade costs into account underestimates the impact of tax rates on evasion, although the magnitude of the bias is small (about 0.02 percentage points). We also show that the manner in which trade costs are taken into account significantly matters for the results - for example, controlling for trade costs in the estimated regression equation, as done in Javorcik and Narciso (2008), will exacerbate the downward bias that results from ignoring trade costs.

Appendices

Appendix A: Restricting the sample period to 2005-2009

Table A.1 Tax rate and tax evasion: based on data for 2005-2006 and 2008-2009

	Statu. ETR	Actu. ETR	Statu. ETR	Actu. ETR
Statutory ETR	0.327		0.092	
	(0.360)		(0.670)	
Actual ETR		1.023		1.081
		(0.165)***		(0.175)***
Constant	0.031	-0.133	0.175	-0.054
	(0.145)	(0.048)***	(0.236)	(0.055)
Year FE	No	No	Yes	Yes
No. of Obs.	10818	10818	10818	10818
Number of Groups	5385	5385	5385	5385

Robust standard errors clustered on at HS6 level given in parentheses.
All regressions include Source country-Product Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix B: First difference model: based on 2006 and 2008

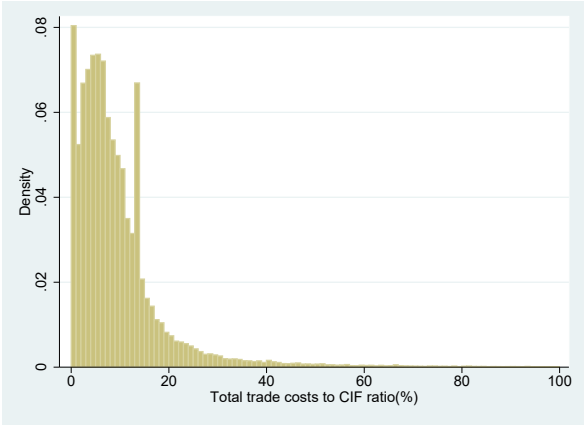
Table B.1 Tax rate and tax evasion: based on a first difference model, data for 2006 (before surtax) and 2008 (after surtax)

	Baseline		Mislabelling			
	M1	M2	M3	M4	M5	M6
Δ ETR Actual	1.194	1.742	1.254	1.658	1.230	1.727
	(0.223)***	(0.626)***	(0.239)***	(0.628)***	(0.241)***	(0.637)***
Δ ETR $\times$ PM Premium		-0.080		-0.062		-0.077
		(0.080)		(0.082)		(0.085)
Δ Med. ETR Sim Prods.			-0.004	-0.003		
			(0.004)	(0.004)		
Δ Avg. ETR Sim Prods.					-0.004	-0.001
					(0.007)	(0.007)
Constant	0.360	0.446	0.402	0.454	0.393	0.449
	(0.056)***	(0.098)***	(0.071)***	(0.101)***	(0.084)***	(0.105)***
Number of Obs.	2125	2125	2125	2125	2125	2125
Adj. R2	0.047	0.047	0.047	0.047	0.046	0.046

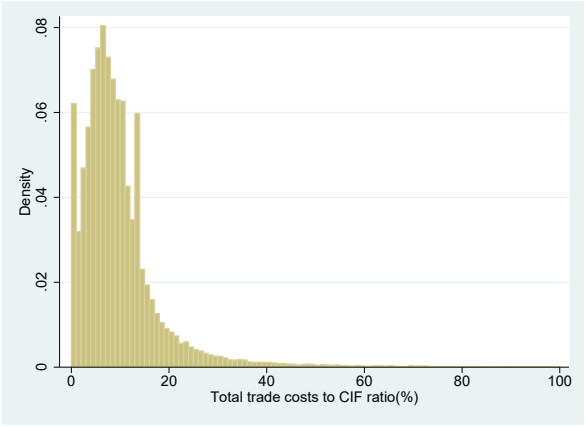
Robust SEs clustered at 4 digit HS and Source Country level are given in parentheses.
All aregressions include Source country Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix C: Dealing with trade costs

Figure C.1 Ratio of trade cost (freight, insurance and other costs) to CIF value



(a) Developed countries



(b) Developing countries

Figure C.2 Relationship between trade cost and effective tax rate

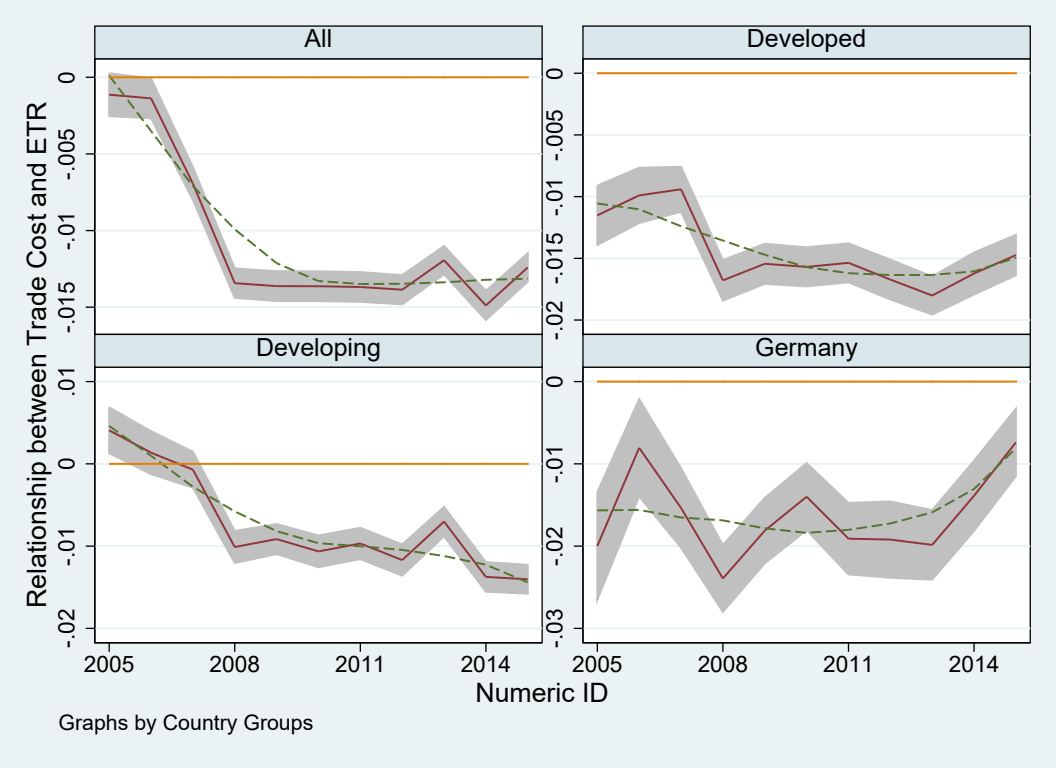


Table C.1 Relationship between trade cost (freight, insurance and other costs) and ETR

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
etr	-1.15***	-0.99***	-0.94***	-1.68***	-1.54***	-1.57***	-1.54***	-1.67***	-1.80***	-1.62***	-1.47***
	[0.15]	[0.14]	[0.11]	[0.10]	[0.10]	[0.10]	[0.10]	[0.10]	[0.09]	[0.10]	[0.10]
Number of observations	11065	12032	12141	10597	10215	10977	11315	11867	11885	12306	12124
Adjusted R^2	.0063	.005	.0066	.032	.027	.028	.026	.03	.035	.027	.022

Standard errors in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
etr	0.41*	0.14	-0.07	-1.01***	-0.91***	-1.06***	-0.97***	-1.17***	-0.70***	-1.37***	-1.40***
	[0.17]	[0.16]	[0.13]	[0.12]	[0.11]	[0.12]	[0.12]	[0.12]	[0.11]	[0.11]	[0.11]
Number of observations	7459	8182	8740	8049	8128	8303	8735	9152	9519	10394	10348
Adjusted R^2	.00086	.000097	.000036	.0095	.0083	.011	.0087	.012	.0046	.017	.018

Standard errors in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
etr	-0.11	-0.14	-0.69***	-1.34***	-1.36***	-1.36***	-1.37***	-1.39***	-1.19***	-1.49***	-1.24***
	[0.09]	[0.08]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]	[0.06]
Number of observations	30157	32845	33541	29267	28689	30143	31532	32973	33114	35722	35806
Adjusted R^2	.000064	.000099	.0037	.02	.02	.02	.019	.019	.014	.022	.015

Standard errors in brackets
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C.2 Relationship between trade cost and ETR: controlling for product and time fixed effects

	Dep. Var: Trade Cost
ETRActual	-0.295
	(0.065)***
Constant	7.606
	(0.026)***
Year FE	Yes
No. of Obs.	353789
Number of Groups	5857

Robust SEs clustered at HS8 level given in parentheses.
All regressions include product and Year Fixed Effects.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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