Trade protection and tax evasion: Evidence from Kenya, Mauritius and Nigeria

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Abstract

We examine the effect of trade protection rates on evasion in three African countries Kenya, Mauritius and Nigeria. In capturing the effect of trade protection on tariff evasion, we use a much improved measure of trade protection from MacMAP 2001 and 2004. For two of these countries, the MacMAP dataset allows the novelty of using variation in trade protection across product, time and trading partners leading to significantly refined estimates of evasion elasticity relative to existing studies on tariff evasion. We find a robust evidence for positive elasticity of evasion with respect to tariffs in Kenya and Nigeria with relatively weaker evidence for Mauritius. Our results match the rankings of countries in institutional quality (in terms of the Corruption Perception Index). Greater responsiveness of evasion to the level of tariffs is established in Nigeria (comparatively weak institutional quality) vis-à-vis Kenya, and in Kenya vis-à-vis Mauritius (comparatively good institutional quality). This pattern is preserved even when focusing on same set of trading partners and same set of imported products for the three countries. This result is robust to controlling for protection on related products (that creates incentives/ opportunities for evasion) and also for degree of differentiation of the product and some other characteristics that could determine the ease of detection of evasion).

JEL Classifications: F13; H26; K42

Keywords: Evasion; tariffs; enforcement

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"The new tariff has low rate of duty that would encourage payment of duty and discourage smuggling activities"- Customs Comptroller-General of Nigeria, Alhaji Hamman-Bello Ahmed on the new tariff regime introduced in Nigeria (Vanguard, News Report, October 2008).

1. Introduction

The effect of trade protection on tax evasion is of considerable policy interest in low income countries as an overwhelming share of total government revenues comprises tariff revenues. Between 2001 and 2003, the trade tax revenues comprised 22% of total government revenues in low income countries while in the OECD countries it was just 1% (Fukasaku, 2003). For Kenya and Mauritius respectively, in 2005, the share of taxes on international trade in central government revenues was 11% and 20% (World Development Indicators, 2007). This figure is lower for Nigeria and estimated to be around 5-6% (OECD 2008).[1]

Even though the shares of tariff revenue have gone down over time in these countries, they continue to be significant in government's budget.[2] Thus, fear of a loss of a major source of revenue is widely perceived to be a deterrent to trade liberalization (see for example Ng'eno et al 2003). In Nigeria also even though contribution of tariffs to government revenue is smaller, fears of a loss of tariff revenue have been prominent in discussions relating to trade liberalization and also to participation in several regional arrangements such as the Economic Community of West African States (ECOWAS), the Common Market for Eastern and Southern Africa (COMESA) and in Economic Partnership Agreement (EPA) with Europe.[3] However, if the level of trade protection is positively correlated with evasion, then the expectation of loss of trade revenue need not be valid. Further, the level of trade itself could rise with lowering of tariffs and also loss in revenue collection could be made up through increases in collection efficiency (See Aizenman and Jinjarak 2005).[4]

The effect of the level of tax rate on tax evasion has been highly contentious in the literature owing to the theoretical ambiguity about the direction of the impact as well as the problems of measurement of evasion. In a pioneering work, Allingham and Sandmo (1972) showed that the sign of the elasticity of tax

[1] In Nigeria oil contributes very significantly to revenues (some estimates put it nearly 80%). This is mainly in the form of production and export taxes. However even in oil tax revenues there have been reports of corruption (see the recent work by Nigerian Extractive Industries Transparency Initiative (NEITI) that looked at payments from the oil companies to the government between 1999 and 2004). On the import side dependence on import tax revenues could be lower but the same forces that would lead to evasion in import taxes could apply to evasion in export/production taxes. The evasion in production or export taxes we do not address in this paper. Yet to the extent that import tax evasion establishes the level of institutional quality in Nigeria this is likely to have a bearing also on evasion in other taxes most importantly in case of Nigeria in the oil sector.

[2] In Kenya the average share of trade taxes in government revenues between 1999-2001 was 14.59%. It came down to 8.98% for 2002-2005. The corresponding numbers for Mauritius are 27.14 and 20.13 percent respectively. In Nigeria, the latest budget for 2009 envisages to raise the share of trade taxes in government revenue and reduce the dependence on oil taxes mainly in light of the falling oil prices.

[3] See for example Zouhon-Bi and Nielsen (2007) for potential impact of EPA on Nigeria's revenue (estimated to be around 1% of GDP).

[4] It could also be made up by increase in collection from other sources such as Value Added taxes (VAT).

evasion with respect to tax rates is ambiguous, depending on taxpayers' risk aversion and the punishment for evasion. Though the theoretical ambiguity remains for tax rates' relationship with evasion, Bhagwati (1964) suggested that the discrepancies between a country' s reported imports and the corresponding exports reported by its trading partners may be explained by the undervaluation or misclassification of imports at the border in order to reduce the tariff burden. More recently, Fisman and Wei (2004) argued that trade flows in fact offer a good opportunity to analyze the relationship between tax rate and evasion with the measurement of evasion suggested by Bhagwati (1964) and quantify this effect for trade between mainland China and Hong Kong. Following these authors, several studies have explored the correlation between trade taxes and evasion using the reporting gap between exporting and importing country agencies. These include Levin and Widell (2007) for Kenya and Tanzania, Mishra et al (2008) for India, Javorcik and Narciso (2008) for East European countries and Dunem and Arndt (2006) for Mozambique.

In this paper, we study the tariff evasion for Kenya, Mauritius and Nigeria. We employ a much improved trade protection data (MacMAP 2001 and 2004) relative to the existing studies on tariff evasion. This dataset provides extended measures of protection. The MAcMAP (2001 and 2004) database on trade protection includes ad valorem equivalent (AVE) of specific tariffs, AVE of tariff rate quotas and AVE of anti dumping duties apart from ad valorem tariffs. Further, the dataset also captures country specific trade protection by accounting for all regional agreements and preferential schemes. Hence, the analysis captures evasion with respect to a more comprehensive set of trade protection variables relative to the existing measures (that focus mostly on ad valorem tariffs or Most Favored Nation (MFN) tariffs.[5] The choice of the three African countries is dictated by the fact that at least two of them are highly dependent on tariffs as a source of revenue and that their institutional qualities appear different according to international rankings such as the one from Transparency International.

In relation to the now established literature on relationship between tariff rates and evasion, this paper makes the following contributions. First, the paper implements a rigorous analysis of this relationship for countries in the most protectionist continent, i.e. Africa, selecting three countries that differ in their perceived institutional quality. As the discussion in the paper would show there exist some studies on Africa but most of them are based on extremely small sample and/or have employed very simple methodologies.

Second and more importantly, the paper uses a dataset that can account for potentially important errors in measures of protection. These errors emanate from narrow focus on ad valorem tariffs. Neglecting other measures like specific tariffs and tariff rate quotas is far from trivial and for the three countries the measured cross-elasticity of evasion varies with the breadth of the measure of protection. Though like in three previous studies, i.e. Fisman and Wei (2004), Mishra et al (2008) and Javorcik and Narciso (2008), we are also unable to account for quantitative barriers but there is partial accounting for it in our dataset through tariff rate quotas.

Third, since evasion is postulated to be a function of level of *applied* tariffs, the variation in tariffs by trading partners implies that incentives to evade vary across exporters. The construction of the MacMAP dataset allows us to account for this with applied tariffs varying across trading partners. Variation across trading partners is particularly important owing to the role of some unobserved factors determining evasion. For example, the customs enforcement is likely to vary depending upon the origin of imports. Reputation effects imply that custom officials are more circumspect when the same product is shipped from particular countries. Also the mode of shipment could differ across trading partners affecting the ease of evasion. Another trading partner characteristic that could be extremely important for determining evasion is the

[5] Though not the central focus of this paper, we find that the breadth of the measure of protection is important as estimated evasion elasticity varies with it.

system of pre-shipment inspection (Anson et al (2006)).[6] Additionally, evidence for the exporter country characteristics to be important comes from differences in match between export and import country data. In the cases studied here as well as in Mishra et al (2008) match rates tend to go up with developed country exporters i.e. with countries that presumably have better institutional quality.

Controlling for product, time and trading partner fixed effects implies that our estimates are likely to be quite refined. In effect, we exploit variation across three dimensions, across product (as in Fisman and Wei 2004, Levin and Widell (2007) and Dunem and Arndt (2006)), across time (product and time variation hence as in Mishra et al (2008) and Javorcik and Narciso (2008) and across trading partners.

Our results indicate that in these three African countries, the evasion elasticity is significant with weaker evidence in case of Mauritius (i.e. in two specifications among several, insignificant effect is obtained). Moreover, the evasion elasticity is much higher in Nigeria, followed by Kenya and then Mauritius. The difference between the three cases is preserved when comparing the same set of products and trading partners. In this case the evasion elasticity differences are likely to be a function of enforcement quality. This relative ordering of the estimated evasion elasticity matches the ordering in different indices of perceived institutional quality (for example as provided by Transparency International). While most indices of institutional quality are based on perception surveys and are subject to enumerator and respondent bias, the estimated evasion elasticity particularly with same partners and in same products could provide an objective basis for comparison of institutional quality across countries. The implicit metric for measuring institutional quality in this case is the quality of enforcement of customs regulation.

In our econometric specification, we also account for characteristics that could be correlated with enforcement such as degree of product differentiation (which is expected to make evasion more likely). Even after accounting for degree of product differentiation, the evasion elasticity continues to be higher for Nigeria relative to Kenya and higher for Kenya relative to Mauritius. The supportive evidence for enforcement being the factor determining evasion follows the Mishra et al (2008) and Javorcik and Narciso (2008) criteria of ease of detection. The authors argue that evasion is simpler with greater degree of product differentiation. .

The paper is organized as follows. Section 2 describes the three countries in terms of trade policy and institutional quality. Section 3 outlines the definition of the evasion measures and the methodology. Section 4 describes the data and provides summary statistics of the variables used in the paper. Section 5 presents the results of the regression analysis. Section 6 checks for robustness of some of the results obtained earlier. Section 7 concludes.

2. Trade and institutional characteristics of Kenya, Mauritius and Nigeria

Kenya, Mauritius and Nigeria are all members of the World Trade Organization. The three countries' tariff profiles are very similar: for Kenya, Mauritius and Nigeria respectively, only 14.6%, 17.8% and 19.2% of tariff lines are bound with simple average bound tariffs equal to 95.7%, 93.7% and 118.3% respectively (WTO Tariff profiles 2006). To put the level of tariff protection in these countries in context, Table 1 gives estimates of protectionism in the African continent in 2004 with reference to world, other continents and income-level groups of countries.[7] The African continent is clearly highly protectionist and

[6] The empirical results for different countries in Anson et al (2006) are mixed with regard to the effect of PSI on import tariff evasion.

[7] Comparisons between averages from WTO's Tarif Profiles and the MacMAP-HS6 database reveal substantial differences: it can be explained by differences of computational methods (simple average vs. reference group's trade-weighted averages; MFN applied duties vs. applied duties and different periods of reference).

the three countries studied here are amongst the most protectionist countries with average duty on imports at 16.3%, 17.8% and 26.5% respectively.

Table 1: Protection applied on imports in 2004

Country	*Global*	*Agriculture*	*Industry*	*Primary*
Madagascar	3.7%	4.5%	3.6%	0.1%
Swaziland	5.2%	16.3%	4.6%	0.2%
Namibia	5.2%	16.3%	4.6%	0.2%
Lesotho	5.2%	16.4%	4.6%	0.2%
Eritrea	6.0%	8.3%	5.6%	3.1%
Rwanda	6.8%	11.6%	6.5%	4.8%
South africa	7.0%	16.8%	6.1%	0.6%
Botswana	7.1%	17.9%	6.1%	0.6%
Uganda	7.4%	10.5%	6.3%	13.0%
Côte d ivoire	8.2%	12.6%	8.5%	1.3%
Mayotte	8.3%	7.0%	9.1%	0.5%
Senegal	8.3%	13.0%	8.6%	1.3%
Togo	8.3%	13.0%	8.6%	1.3%
Mauritania	8.7%	10.0%	8.9%	5.1%
Angola	8.8%	9.1%	7.2%	28.6%
Burkina faso	9.5%	11.8%	9.2%	1.8%
Mozambique	9.5%	13.2%	8.9%	3.8%
Niger	9.5%	11.9%	9.2%	1.8%
Mali	9.5%	11.8%	9.2%	1.8%
Benin	9.6%	11.8%	9.2%	1.8%
Guinea bissau	9.7%	11.8%	9.4%	1.8%
Zambia	10.5%	14.1%	9.9%	5.7%
Congo democratic republ	10.6%	12.1%	10.4%	6.3%
Tanzania united rep. of	10.7%	18.2%	9.4%	1.6%
Malawi	11.0%	12.5%	10.9%	1.2%
Ethiopia	12.9%	17.8%	12.1%	5.7%
Algeria	13.1%	17.5%	13.2%	7.3%
Gabon	13.8%	20.2%	13.5%	10.0%
Equatorial guinea	13.8%	20.2%	13.5%	10.0%
Zimbabwe	14.3%	23.1%	13.5%	12.9%
Egypt	14.4%	64.7%	10.7%	3.7%
Central african republic	15.0%	23.3%	14.6%	10.0%
Cameroon	15.0%	23.3%	14.6%	10.0%
Chad	15.1%	21.1%	13.9%	10.0%
Congo	15.1%	21.1%	13.9%	10.0%
Kenya	16.3%	29.4%	13.9%	4.2%
Ghana	17.2%	19.6%	18.7%	2.7%
Mauritius	17.8%	24.1%	17.8%	2.3%
Sudan	18.5%	25.8%	17.2%	7.5%
Morocco	19.2%	44.7%	17.3%	13.7%
Tunisia	19.6%	54.8%	17.3%	9.0%
Burundi	20.4%	27.4%	19.1%	13.3%
Libyan arab jamahiriya	21.0%	13.7%	18.3%	60.5%
Nigeria	26.5%	41.8%	23.6%	14.9%
Seychelles	28.6%	44.0%	26.9%	28.0%
Djibouti	30.5%	14.9%	32.1%	32.4%
World	**4.4%**	**15.5%**	**3.6%**	**1.5%**
Africa	14.3%	27.6%	12.9%	9.9%
Asia - Oceania	6.9%	22.5%	5.8%	2.4%
Europe	2.3%	13.2%	1.5%	0.2%
North America	3.2%	7.9%	2.9%	1.7%
South America	8.2%	12.4%	8.1%	3.8%
OECD	2.8%	13.9%	2.0%	0.5%
MIC	8.4%	19.6%	7.7%	3.9%
LDC	12.2%	15.3%	11.5%	14.4%

(Source: MacMAP-HS6 2004)

Our hypothesis is that the elasticity of fiscal evasion depends on the institutional quality of the importing country. The countries selected here follow an ordered ranking in terms of perceived institutional quality across different indices. To rank institutional quality, an index often used is the Corruption Perception Index (CPI) constructed by Transparency International.[8] The CPI ranks 180 countries by their perceived levels of corruption. These perceived levels are determined by expert assessments and opinion surveys. Table 2 provides the three countries' ranks and scores in 2001 and 2004.

Table 2: Corruption Perception Index (2001 and 2004) - Ranking and Score

	2001		2004	
I	**Country Rank**	**Country Score**	**Country Rank**	**Country Score**
Kenya	84/91	2.0/10	129/145	**2.1/10**
Mauritius	40/91	4.5/10	54/145	**4.1/10**
Nigeria	**90/91**	**1.0/10**	**144/145**	**1.6/10**

(source: Transparency International)

Amongst African countries, Mauritius is clearly one of the less corrupted countries (as perceived by experts, business leaders and external and internal stakeholders). Nigeria on the other hand is frequently pointed out as one of the countries in Africa with worst perceived institutional quality and in the world in terms of corruption. Compared to Africa, Kenya gets an intermediate rank.[9]

In Kenya and Nigeria in particular corruption in the customs department has been documented quite extensively. In March 2008, the Kenya Revenue Authority for example suspended 183 customs clearing agents, including some who were being investigated for tax evasion. News reports indicated that in some cases, KRA employees colluded with the agents to falsify the paperwork so as to evade paying tax worth millions of shillings (AllAfrica.com, March 5, 2008). Kenya Ethics Department in its 2004 report stated that there are serious corruption issues at the Mombasa port including large scale incidence of underreporting of imports. In its 2008 report by Transparency International, among the surveyed clients of Kenya Port Authority, 58% of the respondents reported encountering a bribery incidence.

In case of Mauritius even though the perceived institutional quality is among the highest in Africa, issues relating to customs corruption have been prominent there. The Mauritian government had actually

[8] http://www.transparency.org/policy_research/surveys_indices/cpi.

[9] It is noteworthy that according to the last survey conducted by Transparency International in 2007, scores of Mauritius and Nigeria have improved significantly compared to 2004 (4.7 and 2.2 respectively while Kenya's score has been stable at 2.1). Consequently, Nigeria has outranked Kenya in 2007, but the difference in score is not significant. This study focuses on 2001 and 2004 when the relevant indices for the three countries still had Mauritius with best ranking and Nigeria with worst ranking.

hired a foreigner to clean up the customs department by bringing in more transparency and reducing corruption.[10]

3. Methodology

Basic Specification

We follow Fisman and Wei (2004) and Mishra et al (2008) in defining the measures of evasion. The first definition of evasion in value is identical to Fisman and Wei (2004) and is defined as:

$$EvValue1_{ptc} = \log(XValue_{ptc}) - \log(MValue_{ptc}) \quad (1)$$

Where $EvValue1_{ptc}$ refers to evasion in value of product p (at the harmonized schedule 6 digit level) at time t (2001 and 2004) with trading partner c (all the trading partner countries). $XValue_{ptc}$ refers to the export value reported in year t by the country c from which the good p is exported to Kenya, Mauritius or Nigeria, and $MValue_{ptc}$ is the value of imports reported by Kenyan, Mauritian or Nigerian authorities. Note that this measure of evasion, named definition 1, exists only when both imports as well as exports at the 6 digit level appear in the data. However, there exist a sizable number of cases where corresponding to the entries in the export data, there does not exist an entry in the import data.

For these cases we follow the second measure of evasion $EvValue2_{ptc}$ as in Mishra et al (2008) which is based on the extreme assumption of complete smuggling in such cases. Thus, if an export transaction is recorded by the partner country but not by the Kenyan/Mauritian/Nigerian authorities, these exports are assumed smuggled into the country, and import value is coded as zero. Thus, the second measure of evasion is defined as follows:

$$EvValue2_{ptc} = \log(1 + XValue_{ptc}) - \log(1 + MValue_{ptc}) \quad (2)$$

Unlike Mishra et al (2008) we do not find (for the pooled data for 2001 and 2004) that trade protection measures for those exports for which there are no corresponding imports are significantly higher on an average thus creating greater incentives to evade taxes. In Nigeria however such an ordering is observed where the average applied tariff is 33.6% in this case while it is 25.0% otherwise. For all three countries, we employ specifications with the assumption of complete smuggling as test for robustness and also to tally with existing measures of evasion as referred to by Fisman and Wei (2004) and implemented by

[10] The following quote summarizes the state of affairs in Mauritius regarding customs corruption. "Imagine living in paradise: a tropical island, filled with white-sand beaches, coral reefs, turquoise lagoons and palm trees. This is how Bert Cunningham (a Canadian national), describes the island of Mauritius, his home since being appointed as the head of Customs and Excise for Mauritius in October 2002. But something was rotten in paradise. Cunningham, nicknamed "The Cleaner", came to Mauritius with the dubious task of cleaning up decades of corruption in the area of customs and revenue. His hard work is paying off: following three difficult years of cleaning, Cunningham was recently named Mauritian of the Year. The latest report of Transparency International has revealed that Mauritius has gone up in the index concerning the perception of corruption. Mauritius is now at the 41st place against 53rd in 2007.

In Mauritius, the report underlines that reforms of the Mauritius Revenue Authority were carried out over the past two years with the aim of ensuring greater transparency and integrity in customs, which was previously considered to be one of the three most corrupt sectors in the country (along with law enforcement and the National Transport Authority).

Mishra et al (2008). In cross-sectional estimation on 2001, 2004 and pooled sample data with the measures of evasion as defined in equations 1 and 2, our basic specification is:

$$i = 1,2\ EvValueiptc = \propto + \beta * Tariff\ ptc + \rho * Tariffrelptc + \gamma * d + \theta^{*}(Tariffptc * d) + \varepsilon_{ptc} \quad (3)$$

where the right hand side is specified for both measures of evasion. The main coefficient of interest is β: it measures the (semi) elasticity of evasion with respect to $Tariff\ ptc$, the tariff imposed by Kenya, Mauritius or Nigeria on product p coming from partner c at time t. Following Fisman and Wei (2004), in addition to under-reporting of the value of imports, evasion may take the form of misclassification i.e. reporting a higher taxed product as a lower tax one. To investigate this type of evasion we add the tariff on related products as an additional regressor. The variable $Tariffrelptc$ is defined as the tax on related products (i.e. the average tariff on other products in the same HS-4 category, weighted by their value of exports from their source countries). [11]

d is the dummy that equals 1 if products are differentiated based on Rauch classification. Degree of differentiation is one of the intrinsic characteristics of products that may affect the ease of enforcement. The Rauch classification (Rauch, 1999) distinguishes goods by whether they are homogenous goods (whose prices are widely known or quoted in exchanges) or differentiated goods (whose prices are less well known and determined more by specific transactions). Following Mishra et al (2008) and Javorcik and Narciso (2008), the fact that prices are widely known and quoted in exchanges make it easier for compliance as under-reporting or misclassification can be more easily spotted from available information. We thus interact tariffs with the differentiated dummy to capture the effect of this product characteristic on evasion.

The counterpart of equation (3) in quantity is specified as:

$$\forall\ i = 1,2\quad EvQtyi_{ptc} = \propto + \beta * \text{Tariff}\, ptc + \rho * Tariffrelptc + \theta * (Tariffptc * d) + \gamma * d + \varepsilon_{ptc} \quad (4)$$

where $EvQty1_{ptc} = log(XVolume_{ptc}) - log(MVolume_{ptc})$ and $EvQty2_{ptc} = log(1 + XVolume_{ptc}) - log(1 + MVolume_{ptc})$; $XVolume_{ptc}$ and $MVolume_{ptc}$ refer to trade in volume (exports and imports respectively). Thus, the equation is specified for both the measures of evasion. For a check of robustness both equations (3) and (4) are estimated for all set of trading partners, top 20 and top 5 trading partners respectively

Fixed effects estimation

As discussed above, since trade protection data (for Mauritius and Kenya) based on MacMAP (2001) and MacMAP (2004) allows variation over time, products and trading partners, we employ the following rich specification.

$$EvValueiptc_{ptc} = \propto + \beta * Tariffptc + Dp + Dt + Dc + \gamma * Tariffrelptc + \delta * (Tariffptc * d) + \in_{ptc} \quad (5)$$

[11] Note that tariffs weighted by own exports are generally lower than simple averages owing to negative relationship between level of tariffs and level of exports.

The dependent variable in equation 5 is evasion as described earlier which is measured at product, time and trading partner level (to match with the trade protection data). D's are vectors of product, year and trading partner fixed effects. It is important to note that given the fixed effects, our identification will rely on within-product (at the 6-digit level) and partner over-time variation and will not be affected by product or partner country characteristics. We cluster the standard errors at the 4-digit product level, to account for potential serial correlation of evasion for a particular product. A counterpart of equation 5 is also estimated for evasion in terms of quantity that is specified in equation (6) below.

$$EvQtyi_{ptc} = \propto + \beta * Tariffptc + Dp + Dt + Dc + \gamma * Tariffrelptc + \delta * (Tariffptc * d) + \in_{ptc} \quad (6)$$

The generality of the specification in equations (5) and (6) implies that endogeneity issue is much less of a concern for the coefficient on tariffs. If tariffs at the product and trading partner level were changed between 2001 and 2004 taking into account the evasion at the product and partner level then it will be a concern. The identification of the coefficient of evasion elasticity relies on within product trading partner variation over time. Such a minute basis for policy making is highly unlikely. Hence, the richness of the specification makes the possibility of bias in coefficients to be minimal leading to very refined estimate of the evasion (semi) elasticity. Moreover, as Fisman and Wei (2004) have pointed out that if the government tries to protect tax revenue by setting tax rates systematically in inverse proportion to importer's ability to evade them, then the estimated elasticity will be an underestimate implying a favorable direction of bias.

4. Data

Our main sources of data are twofold. The data on imports by Kenya, Mauritius and Nigeria as recorded by their respective authorities and exports as recorded by authorities in countries that export to Kenya, Mauritius and Nigeria comes from UN COMTRADE data. These data are available as a time series at the HS-6 digit level for about 4,700 products for our case. We use the data for 2001 and 2004 to match the data for trade protection from MacMAP.

We term the missing imports definition-match rate as the proportion of cases for any particular year for which the data on exports at HS-6 digit level has a counterpart entry at the import end. The corresponding extreme smuggling-definition match rate is defined as the proportion of cases for any particular year for which the data on exports at HS-6 digit level has a counterpart entry at the import end, plus the cases for which data on exports has no counterpart entry at the import end.

Appendix Table 1 provides summary indicators of match rates for the three countries. These rates vary by partner, country and year. Overall the missing definition-match rate for the pooled sample is 35% for Kenya, 38% for Mauritius and 30% for Nigeria. The extreme smuggling-definition match rates are much bigger. In general, match rates are higher for the more advanced trading partners. In the empirical analysis, we do the analysis with all trading partners but also include the analysis restricting the sample to top 20 trading partners and top 5 trading partners. The top 20 trading partners account for more than 90% of trade for Kenya and Mauritius and more than 88% for Nigeria. The extreme smuggling-definition match rate here is greater than 80%. The match rate changes marginally with the top 5 trading partners vis-a-vis the top 20 trading partners.

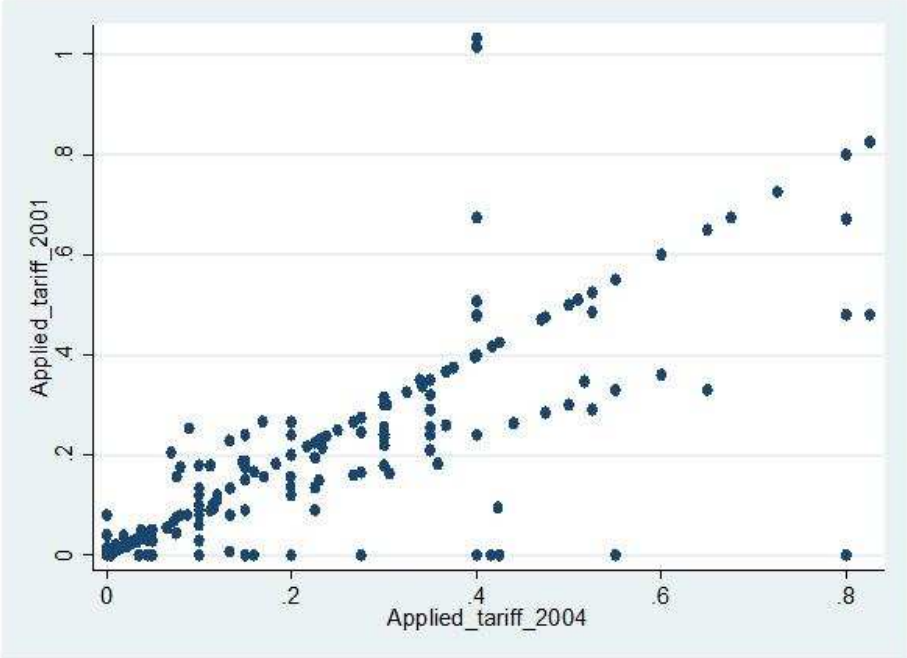
Unlike earlier studies, our measure of evasion is not averaged across partner countries since the variable of interest, Kenyan, Mauritian and Nigerian tariffs (Nigerian tariffs do not vary with time in our data), varies not only by product and time but also with partner countries. The sample that makes the

extreme smuggling assumption has more than 56,000 observations for Kenya and Nigeria and more than 51,000 observations for Mauritius. In the specification without the extreme smuggling assumption, the sample size reduces to about 24,000, 23,000 and 26,000 observations for Kenya, Mauritius and Nigeria respectively. Note that this size of sample is for the case where we include all the trading partners.

Data on trade protection comes from MacMAP 2001 and MacMAP 2004. As discussed above, the import duty from the MAcMap database includes all preferential schemes and regional agreements prevailing in 2001 and 2004 and other measures of bilateral protection (specific tariffs, tariff rate quotas and anti-dumping duties). The MAcMap database is a three-dimensional database that gives for all vectors (importer/exporter/product) ad valorem equivalent tariffs from information on either bound Most Favored Nation (MFN) regime, or Applied Most Favored Nation regime, or preferential regime granted by the importer to the exporter on this product.[12] Tariff information is available at the HS6 level, for 163 importing countries, 208 exporting countries and 5,111 products.

Figures 1, 2 and 3 show the scatter plot of the applied tariffs for Mauritius, Kenya and Nigeria (at the product and trading partner level) for 2001 and 2004 data. At the product, trading partner level there is significantly greater variation between two time periods for Mauritius that we exploit in the estimations of equations 5 and 6. The corresponding variation for Kenya is smaller while there is almost no change in the Nigerian tariff between 2001 and 2004.

Figure 1: Applied tariffs in Mauritius (2001 and 2004)



[12] We do implement the specifications in equations 3-6 with alternate measures of protection such as specific tariffs and MFN tariffs. The results are qualitatively similar and are not reported here. Importantly, however the estimated elasticities are significantly different.

Figure 2: Applied tariffs in Kenya (2001 and 2004)

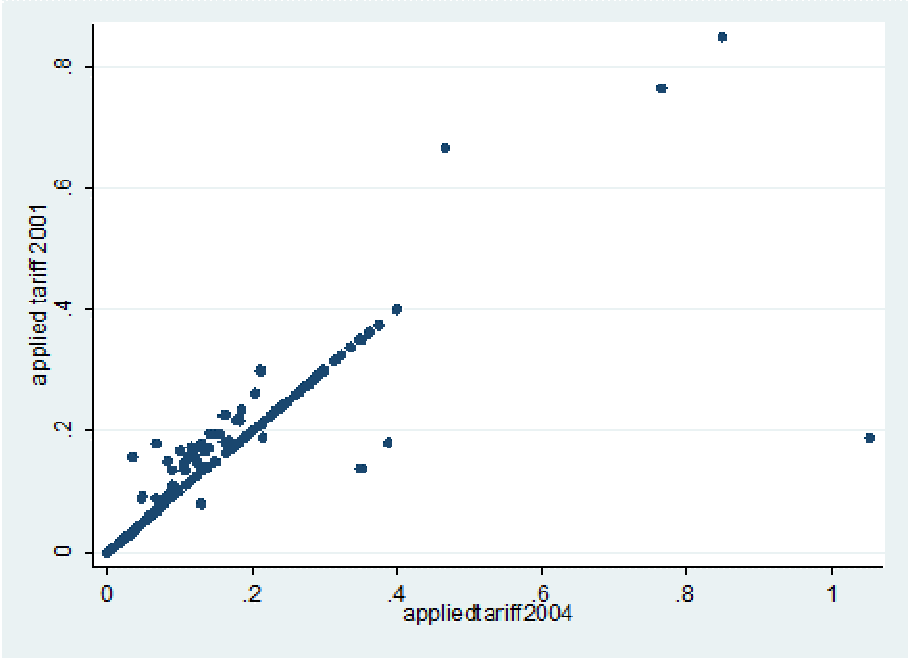


Figure 3: Applied tariffs in Nigeria (2001 and 2004)

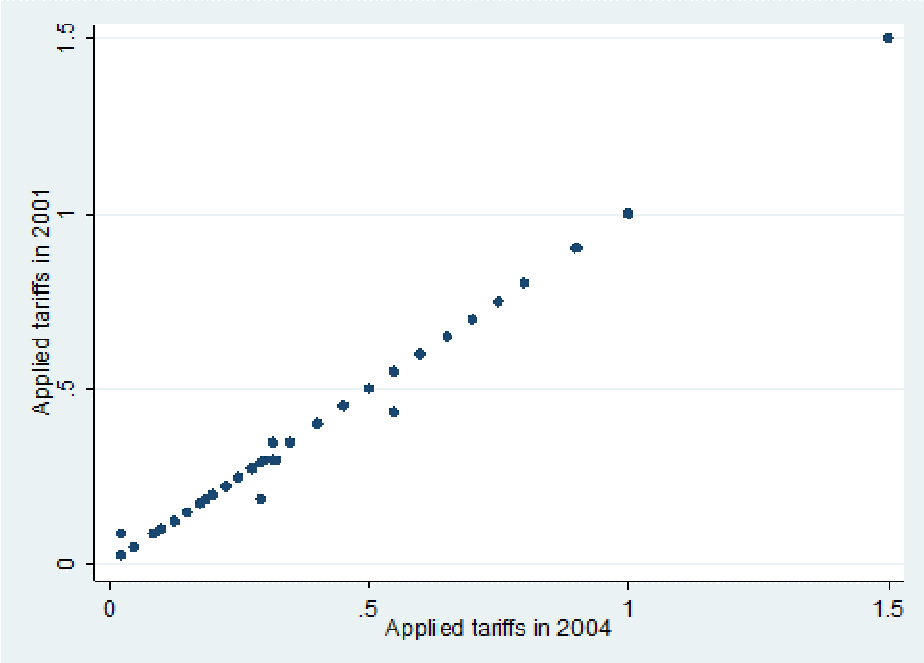


Table 3 provides summary statistics for some of the variables based on MacMap and COMTRADE dataset for Kenya, Mauritius and Nigeria (for the pooled sample of 2001 and 2004). The values for first definition of evasion are summarized in greater detail in table 4.

Table 3: Summary statistics of the sample

	Kenya			Mauritius			Nigeria		
II.	Mean	Std dev.	No. of observations	Mean	Std dev.	No. of observations	Mean	Std dev.	No. of observations
Log value of exports	9.42	2.15	24926	9.19	2.11	38158	10.94	2.31	23075
Log value of imports	9.25	1.92	24926	9.11	1.88	38158	10.73	2.16	23075
Log quantity of exports	7.14	3.29	22766	6.99	3.05	35810	8.39	3.78	23075
Log quantity of imports	6.99	3.33	22766	6.55	3.05	35810	9.68	2.65	23075
Log value of exports – complete smuggling	9.42	2.15	41658	9.19	2.2	46902	9.93	2.54	53430
Log value of imports – complete smuggling	9.25	1.92	41658	9.29	1.90	46902	10.23	2.12	51394
Evasion in value – complete smuggling	0.23	6.80	41658	0.22	6.58	46902	1.85	7.55	67727
Log quantity of exports – complete smuggling	4.91	4.27	38840	6.99	3.01	45830	7.49	3.70	49848
Log quantity of imports- complete smuggling	5.13	4.15	38840	6.70	3.10	45830	9.23	2.62	51158
Evasion in quantity – complete smuggling	0.06	5.70	38840	0.22	5.21	45830	0.15	6.89	67727

Table 3 shows that trade gap is generally higher with the definition of complete smuggling which is expected. Moreover, the variance is higher with the latter definition. The average evasion gap in value for the three countries is higher for differentiated products relative to non-differentiated products based on Rauch (1999) classification, (0.48, 0.36 and 0.27 respectively for differentiated products; 0.19, 0.16 and 0.20 respectively for non-differentiated products in Kenya, Mauritius and Nigeria). In quantity, it holds only for Kenya and Mauritius.

In absence of evasion, trade gap is expected to be negative since imports are reported in cost insurance freight (cif) terms and exports are reported in free on board terms (fob). Table 4 shows that for both Kenya and Nigeria the average trade gap is positive. The biggest positive value for the trade gap is in case of Nigeria where the median trade gap is also positive. This provides some indication about evasion being more likely and significant in Nigeria vis-à-vis Kenya and Mauritius.

Table 4: Trade gap (in value) and applied tariffs in Kenya, Mauritius and Nigeria

Kenya							
Applied tariffs				*Evasion*			
Mean	Median	Standard Deviation	Observations	Mean	Median	Standard Deviation	Observations
0.18	0.15	0.12	19,426	0.03	-0.04	1.83	19,426
Mauritius							
Applied tariffs				*Evasion*			
0.23	0.15	0.27	18,211	-0.13	-0.11	1.80	18,211
Nigeria							
Applied tariffs				*Evasion*			
0.24	0.2	0.20	11,586	0.23	0.29	2.24	11,586

5. Results

Results from cross-sectional analysis

Tables 5, 6 and 7 present the results from cross-sectional regression based on the first definition of evasion for Kenya, Mauritius and Nigeria (for evasion in value). Tables A.2 presents the results from the evasion in value regression for Kenya, Mauritius and Nigeria using the second definition of evasion gap. In table A.3, the regression results for evasion in quantity are presented.

Table 5: Cross-sectional results for evasion in value (Kenya) - All trading partners

COEFFICIENT	2001	2004	Pooled	Pooled	Pooled
Applied tariff	0.815*** (0.12)	1.036*** (0.17)	0.927*** (0.10)	1.360*** (0.24)	1.315** (0.255)
Tariff on related products				-0.421* (0.25)	-0.4122 (0.25)
Differentiated dummy X tariff					-0.160*** (0.58)
Differentiated dummy					0.14 (0.29)
Constant	-0.175*** (0.027)	-0.0712* (0.036)	-0.134*** (0.022)	-0.136*** (0.025)	-0.130*** (0.025)
Observations	11204	8222	19426	16603	16603
R-squared	0.001	0.001	0.001	0.001	0.01

Table 6: Cross-sectional regression for evasion in value (Mauritius) – All trading partners

COEFFICIENT	2001	2004	Pooled sample	Pooled sample	Pooled sample
Applied tariff	0.231*** (0.064)	0.173** (0.076)	0.193*** (0.049)	0.515*** (0.12)	0.517*** (0.123)
Tariff on related products				-0.416*** (0.13)	-0.406*** (0.123)
Differentiated X tariff interaction					-0.076 (0.055)
Differentiated dummy					0.027 (0.131)
Constant	-0.0810*** (0.022)	-0.304*** (0.028)	-0.179*** (0.018)	-0.152*** (0.020)	-0.152*** (0.020)
Observations	10004	8207	18211	15764	15764
R-squared	0.001	0.003	0.004	0.005	0.005

Table 7: Cross-sectional regression for evasion in value (Nigeria) – All trading partners

COEFFICIENT	2001	2004	Pooled	Pooled	Pooled
Applied tariff	1.219*** (0.148)	1.587*** (0.148)	1.404*** (0.105)	1.614*** (0.421)	1.766*** (0.424)
Tariff on related products				-0.144 (0.432)	-0.101 (0.427)
Differentiated dummy X tariff					-0.639 (0.243)
Differentiated dummy					0.167** (0.081)
Constant	0.046 (0.046)	-0.272*** (0.045)	-0.120*** (0.032)	-0.117*** (0.036)	-0.12 (0.037)
Observations	5428	6158	11586	9797	9797
R-squared	0.013	0.020	0.016	0.018	0.018

In tables 4,5 and 6, differentiated dummy in the regression equals 1 if the product is differentiated based on Rauch classification and equals 0 if the product is homogenous. Tariff on related products is the average tariff on products at the hs-4 digit level. Table 8, 9 and 10 present the same results for Kenya, Mauritius and Nigeria for the top 5 trading partners.[13] Note that these regressions need not involve the same set of products and/or trading partners. Based on the average of the two years 2001 and 2004, the top 5 trading partners for Mauritius are China, France, Germany, India, and South Africa. In case of Kenya, the top 5 trading partners are China, India, South Africa, UK, and USA. In case of Nigeria these are China, Germany, Italy, UK, and USA. So the only country common among the top 5 trading partners for Kenya, Mauritius and Nigeria is China.

Following the literature, we also run the specification with evasion in quantities Resulted reported in the appendix table A.3, like Javorcik and Narciso (2008) show that there is no consistent evidence for evasion in quantity being the channel for evasion for either of the three countries.

[13] Similar analysis has been done for the top 20 partners. Results are qualitatively similar and are not reported here.

Table 8: Cross-sectional regression for evasion in value (Kenya) - Top 5 trading partners

COEFFICIENT	2001	2004	Pooled sample	Pooled sample	Pooled sample
Applied tariff	0.672*** (0.18)	0.878*** (0.22)	0.779*** (0.14)	0.981*** (0.31)	0.927*** (0.31)
Tariff on related products				-0.237 (0.33)	-0.239 (0.34)
Differentiated X tariff interaction					0.287 (0.422)
Differentiated dummy					-0.170 (0.091)
Constant	-0.209*** (0.041)	-0.106** (0.049)	-0.160*** (0.032)	-0.158*** (0.035)	-0.155*** (0.035)
Observations	5282	5021	10303	9310	9310
R-squared	0.001	0.001	0.001	0.001	0.001

Table 9: Cross-sectional regression for evasion in value (Mauritius)-Top 5 trading partners

COEFFICIENT	2001	2004	Pooled sample	Pooled sample	Pooled sample
Applied tariff	0.222** (0.089)	0.403*** (0.11)	0.285*** (0.069)	0.546*** (0.17)	0.585*** (0.17)
Tariff on related products				-0.342* (0.18)	-0.351** (0.72)
Differentiated X tariff interaction					-0.151 (0.83)
Differentiated dummy					0.036 (0.075)
Constant	-0.157*** (0.030)	-0.524*** (0.040)	-0.313*** (0.025)	-0.297*** (0.027)	-0.297*** (0.027)
Observations	5273	4118	9391	8507	8507
R-squared	0.001	0.002	0.001	0.002	0.002

Table 10: Cross-sectional regression for evasion in value (Nigeria)-Top 5 trading partners

COEFFICIENT	2001	2004	Pooled sample	Pooled sample	Pooled sample
Applied tariff	1.182*** (0.252)	2.1*** (0.251)	1.664*** (0.179)	2.495*** (0.642)	2.749*** (0.687)
Tariff on related products				-0.79 (0.658)	-0.718 (0.695)
Differentiated X tariff interaction					-1.135*** (0.390)
Differentiated dummy					0.373*** (0.132)
Constant	0.099 (0.079)	-0.499*** (0.074)	-0.224*** (0.054)	-0.214*** (0.058)	-0.217*** (0.059)
Observations	2035	2490	3981	4113	4113
R-squared	0.115	0.032	0.042	0.023	0.023

The columns in the tables 4-9 thus present results with increasing level of generality by adding controls. Moving across the columns, added controls are for effective incentives to evade taxes in terms of tariffs on related products and interaction of tariffs with dummies for differentiation, the variables which are expected to capture the incentive to misclassify and evade and the ease of evasion respectively.

The results in tables 4-9 suggest that in Kenya, Mauritius, and Nigeria there is evidence for positive and significant elasticity of tariff evasion. The positive sign of the coefficient (and if it is significant) suggests that greater is the tariff on related products, greater is the (semi) elasticity of tariff evasion. If misclassification by listing the product as some other similar products is the channel to evade taxes then incentives to evade taxes is lower with higher tariffs on those similar or related products. Unlike the literature we do not find robust evidence for differentiated goods to exhibit greater trade gap. One conjecture for this result is the measure of protection used. If for example more differentiated products have lower unaccounted for protection in other studies then the correlation between tariffs and evasion could be inflated for these products.

Also, if differentiated products are traded more with certain partners and if trading partner characteristics matter then one could find negative or insignificant effect of differentiation if more trade of differentiated products occurs with partners with better institutional quality. The central theme of Javorcik and Narciso (2008) that differentiated products have greater evasion could thus be context specific. The fact that Javorcik and Narciso (2008) consider trade only with one partner i.e. Germany is thus potentially important for their results. Mishra et al (2008) also find evidence for higher evasion in differentiated products. Both these studies however use ad valorem tariffs only and thus use a restricted measure of protection that is narrow in breadth and also does not vary across trading partners.

We also find that the results evasion elasticity is sensitive to the exact measure of protection. Results reported in the appendix (Table A.4) show that the estimates are different if the only ad valorem tariffs are used compared to a case where applied tariffs are used. Similarly, it matters whether or not ad valorem equivalent of specific tariffs are included in the measure. Thus we believe that the breadth of trade protection measure used is an important consideration as existing estimates from several studies (based only on ad valorem tariffs) are potentially based on inadequately measured protection.

Comparing the estimates for Kenya, Mauritius and Nigeria, the (semi) elasticity of evasion is higher for Nigeria relative to Kenya, and higher for Kenya relative to Mauritius. This is true in almost all specifications, including the regressions restricted to the sample with top 5 trading partners. We will see later

that this ordering of the estimated (semi) elasticity holds in most cases even when focusing on the same set of products and identical set of trading partners for Kenya, Mauritius and Nigeria.

Among the three countries, a study on tariff evasion exists only in case of Kenya which however is constrained by the use of a very small sample (the study by Levin and Widell (2007). Even though Kenya ranks low in the index of institutional quality, Levin and Widell (2007) argue that between 2001 and 2004, the overall bribery index declined in Kenya. The Kenyan tax authority was in fact ranked as one of the most improved organizations within the country in 2004. A simple test for the improvement in institutional quality during this time period would be a decline in tariff evasion after controlling for characteristics that determine enforceability. Our results indicate that this is hardly true and after controlling for incentives for evasion and potential for evasion in terms of differentiation in products or focusing on same set of products for the two time periods, the evasion elasticity in 2004 continues to be significant for Kenya and is as high (if not higher) as in 2001.

Levin and Widell (2007) who assess the evasion elasticity for Kenya (in values) for imports coming in from Tanzania do not find significant evasion elasticity for Kenya after adding controls for tariffs on related products. The specification where Levin and Widell (2007) do find significant evasion elasticity, the estimate for 2004 is 1.8. Comparing to our estimates for 2004, the estimated elasticity is lower in our case. With the addition of controls, the highest estimate of elasticity is 1.4, still 0.4 points below the estimate in Levin and Windell (2007). However, like Levin and Widell (2007) we do find that evasion elasticity in Kenya has risen over time (but it continues to be as high). Looking at the restricted sample of Tanzania as exporter as Levin and Widell (2007) but using the MacMAP dataset for trade protection, we also find insignificant estimates of evasion elasticity (though still lower than Levin and Widell (2007). As in Levin and Windell (2007), the sample size is extremely small (only 72 data points).

Levin and Widell (2007) also analyze evasion with respect to trade only with UK. To compare with Levin and Windell (2007), the estimated evasion elasticity for trade with UK is positive and insignificant (as in Levin and Widell 2007). Our evidence however is based on much larger sample and using a broader measure of protection from MacMAP (2001 and 2004). The results for the data on top 5 trading partners (table 5) however shows positive and significant elasticity of evasion in a sample that includes UK as well.

The difference in our estimates with the existing estimate (for Kenya) can be explained based on several factors. First, our estimated elasticity comes from use of data for all trading partners or top 5 trading partners and not one country (Tanzania or UK) as in Levin and Widell (2007). The sample in Levin and Widell is extremely small with a maximum of 160 observations. Hence their estimates are likely to be highly imprecise. In this paper, the estimated elasticity for Kenya is the average across all trading partners. Secondly, our trade protection measure is different from the ones used in Levin and Widell (2007). Most importantly, the estimated elasticity of evasion is obtained from a large sample (over 16,000 data points in the pooled sample).

Further, there exist point estimates for different countries based on cross-sectional regressions starting with the pioneering work by Fisman and Wei (2004). The point estimates for Tanzania in Levin and Widell (2007) are much higher at 3.8. Dunem and Arndt (2006) apply the cross-sectional methodology of Fisman and Wei (2004) to the imports of Mozambique from South Africa in year 2003. The estimated coefficient in their case is 1.4. Focusing on estimates for 2004 for Kenya in this paper, these estimates of elasticity for evasion in value for other African countries are generally higher except for Mozambique which is nearly identical. Similar point estimates exist for non-African countries, China and India from Fisman and Wei (2004) and Mishra et al (2008) respectively. Without adding any controls the point estimates are 2.7 and 0.9 respectively in the two studies. In Javorcik and Narciso (2008), the estimate of evasion elasticity is for the sample pooling all countries. Hence country specific elasticities are not available.

Interestingly, all these countries are ranked higher than Kenya and Nigeria and lower than Mauritius in the Corruption Perception Index of the Transparency International. However, the caveat is that de facto institutional quality might require evasion elasticity to be estimated using datasets for same trading partners,

products and also time periods. Without focusing on same set of products and trading partners, the comparison shows that the link between perceived institutional quality and observed tax evasion could be weak and not necessarily monotonic.

The estimation of the (semi) elasticity of evasion (in this paper) above exploits only one source of variation to identify the effects of tariffs on evasion i.e. across products. However, exploiting variation only across products has some limitations. As Mishra et al (2008) have argued if tariffs are systematically correlated with some other aspect of the product (say ease of enforcement) that also affects evasion, then including the time variation can control for such product-specific characteristics. This can better isolate the impact of tariffs on evasion. Mishra et al (2008) motivate their analysis by exploiting the variation in tariffs within 6-digit products over time for India and deem it a very general and demanding specification. Similar identification strategy not contain is across trading partners. In the next section we run specification that captures the variation across all three dimensions (for Kenya and Mauritius).

Results from fixed effects regression

Table 10 presents the results from regression on pooled sample for 2001 and 2004 respectively where for Kenya, trading partner and product fixed effects are added one by one in columns 2 and 3 respectively. The column 4 adds all the fixed effects. Columns 5 onwards repeat the same exercise for Mauritius and Nigeria. Table A.5 provides the same results for evasion in quantity using the two definitions.

Table 11: Fixed effects regression for evasion value in Kenya, Mauritius and Nigeria (All trading partners – first definition)

COEFFICIENT	Kenya				Mauritius				Nigeria
Applied tariff	1.199*** [1.025]	1.688* (0.853)	2.689** (1.090)		0.527*** [0.198]	0.712** (0.277)	0.790* (0.403)		1.760*** (0.549)
Tariff on related products	-0.525 [0.321]		-0.870 [0.858]		-0.394** [0.20]	-0.870 (0.858)	-0.163 (0.344)		-0.125 (0.545)
Differentiated dummy	-0.205** (0.805)				-0.081 (0.065)				0.149 (0.116)
Differentiated dummy X tariff	-0.355** [0.391]	-0.805 (1.186)			0.043 [0.183]				-0.587 (0.349)
Product fixed effect		Y	Y			Y	Y		
Trading partner fixed effect	Y	Y	Y		Y	Y	Y		Y
Time fixed effect		Y	Y			Y	Y		
Observations	16604	19426		16603	15764	15764		15764	9797
R-squared	0.27	0.27	0.29	0.29	0.28	0.31	0.32	0.32	0.041

Table 12: Fixed effects regression for evasion value in Kenya, Mauritius and Nigeria (All trading partners – second definition)

COEFFICIENT	Kenya			Mauritius			Nigeria
Applied tariff	2.467*** (0.511)	2.600* [1.508]	5.173** (2.432)	0.382* (0.211)	0.371 (0.533)	0.006 (0.837)	5.217*** [0.508]
Tariff on related products			-0.563 [1.950]			0.290 (0.629)	
Differentiated dummy							
Differentiated dummy X tariff		0.009 (1.381)			0.294 (1.088)		
Product fixed effect		Y	Y		Y	Y	
Trading partner fixed effect	Y	Y	Y	Y	Y	Y	Y
Time fixed effect		**Y**	**Y**		**Y**	**Y**	
Observations	42463	42463	32678	38768	38768	30725	27768
R-squared	0.21	0.43	0.44	0.17	0.44	0.44	0.17

Results in tables 11 and 12 show the importance of adding trading partner and product fixed effects. This can be gauged from the comparison with the cross-sectional regression. For example just adding the trading partner fixed effect changes the evasion elasticity in Kenya to move from 0.92 to 1.19, in Mauritius from 0.19 to 0.52 and in Nigeria from 1.40 to 1.76. There are several ways in which for the same products and at the same time, evasion could be related to who the trading partner is. For example, it could be correlated with mode of transport. Mishra et al (2008) for example find that evasion differs based on mode of entry (by air or by sea). Else, evasion technology which is largely unknown can be conjectured to require inputs from both exporter and importer. For example, exporters and importers could collude with an implicit or explicit side payment to foster evasion. Similarly, historical reputation of trade with some particular trading partners often determines the bias of inspectors and could ease or tighten enforcement. All these possibilities are likely to be correlated with characteristics of the trading partner, for example unobserved institutional quality.

The results from the fixed effects estimation provide strong evidence for evasion elasticity to be significant in these countries. In case of Mauritius, the evasion elasticity is significantly lower and after controlling for product and trading partner unobserved characteristics, the evasion elasticity is no longer significant but in case of second definition. Comparing with the addition of only the trading partner fixed effects, the evasion elasticity for Nigeria is greater compared to Kenya and Mauritius.

Similarly addition of product fixed effects also changes the coefficient significantly in all three cases. In Kenya, just addition of product fixed effects nearly doubles the estimate from pooled sample cross-sectional regression for both evasion in value and evasion in quantity (in case of first definition). This contrasts with Mishra et al (2008) where addition of the product fixed effects actually reduces the coefficient of elasticity of evasion. Nevertheless point remains that as the magnitude of the coefficient changes significantly, there is a systematic correlation between our trade protection measures and product characteristics relevant for evasion. One of the characteristics i.e. whether or not good is differentiated, we control for in the specifications above. However, several other product characteristics, observed and unobserved could correlate with product specific amenability to evasion and therefore bias the results.

Hence, the estimation of evasion elasticity that exploits only the product level variation as in several studies discussed above potentially leads to inconsistent estimates.

6. Common set of products and trading partners

The comparison between Kenya, Mauritius and Nigeria as discussed above does not put any restriction on the set of trading partners or imported products. The analysis above shows that both the products on which as well as the trading partners with which evasion is considered matters. Hence, a more meaningful comparison of tariff evasion between Kenya, Mauritius and Nigeria would be by restricting the sample to same set of traded products and trading partners. There are three ways in which we restrict samples for comparison. First we restrict the sample for all three countries to include the same set of traded products. Next we restrict it to contain the same set of trading partners. Finally, the samples are restricted to contain the same set of trading partners as well as products i.e. the sample includes same products traded with the same partner for the three countries. Below we conduct the same analysis as above but imposing these restrictions.

Table 13 presents the results from cross-sectional regression with the last of these restrictions. The ordering of results is identical in case of common products and common partners and has not been reported below. In case of regression on a sample with perfectly matched trade but using the second definition, the coefficients or Kenya and Nigeria are significant at 1% level and estimated to be 3.14 and 6.023 respectively. The coefficient on Mauritius is insignificant and estimated to equal 0.15. (these estimates compare to the ones in columns J,K and L in table 13 below that is for first definition).

Table 13: Cross-sectional regression Kenya, Mauritius and Nigeria (Perfectly matched trade) – First definition of evasion (Same product, same trading partner)

	A	B	C	D	E	F	G	H	I	J	K	L
	Kenya	Mauritius	Nigeria	Kenya	Mauritius	Nigeria	Kenya	Mauritius	Nigeria	Kenya	Mauritius	Nigeria
Applied tariff	**1.044*** ** [0.225]	**0.344*** ** [0.103]	**1.948*** ** [0.179]	**0.992** ** [0.467]	**0.961*** ** [0.226]	1.860*** **[0.607]**	0.891*** [0.246]	0.380*** [0.121]	1.989*** **[0.205]**	0.667** [0.336]	0.250* [0.131]	1.922*** [0.278]
Tariff on related products				0.124 [0.479]	**-0.709*** ** [0.236]	0.162 **[0.628]**						
Differentiated dummy x tariff							0.718 [0.557]	-0.019 [0.237]	-0.148 [0.383]			
Differentiated dummy							-0.213* [0.127]	-0.078 [0.104]	0.049 [0.131]			
Trading Partner fixed effects	N	N	N	N	N	N	N	N	N	Y	Y	Y
Observations	3942	3942	3942	3581	3590	3600	3942	3942	3942	3942	3942	3942
R-squared	**0.005**	**0.001**	**0.017**	**0.006**	**0.002**	**0.018**	**0.006**	**0.002**	**0.018**	**0.041**	**0.040**	**0.042**

These results show that even after restricting ourselves to sample that is directly comparable across the three countries, we find consistent evidence for the evasion elasticity to be significantly higher in Nigeria vis-à-vis Kenya, and in Kenya vis-à-vis Mauritius. In such a restricted sample that imposes the restriction of matched trade, comparison is most meaningful as difference in estimates is not driven by differences in product or trading partner characteristics but by countries' levels of trade protection and their efficiency in enforcement.

7. Robustness Checks and Limitations

7.1 Robustness checks

The analysis above provides consistent evidence of evasion in value being positively and significantly correlated with level of tariffs in Kenya, Mauritius and Nigeria (particularly for first definition of evasion). We however do not find similar consistent evidence on the relationship between evasion in quantity and level of tariffs. Though there is some evidence for evasion in quantity also being positively and significantly correlated with level of tariffs, such a relationship holds for Nigeria with robustness while in case of Kenya and Mauritius it holds only in some specifications. Where there is lack of evidence on correlation between evasion in quantity and the level of tariffs it suggests that undercounting of quantities is less likely to be the channel of evasion.

In this section we present results of several robustness checks for the two results mentioned above. First, we want to check the robustness of evidence for semi elasticity of tariff evasion being positive and statistically significant in the three countries. Second we want to test for robustness of ranking of evasion vis-à-vis the order of perceived institutional quality.

There are potential biases possible in the results obtained in this paper. The first relates to the issue of endogeneity. Is it possible that tariffs are set minutely enough (at the trading partner and product level at a given point in time) in response to evasion in that particular category that could lead to endogeneity. This question is likely to be less pertinent for case of Kenya and Mauritius where identification in the most general specification comes from within product and trading partner changes over time (discussed above). In case of Nigeria since the only fixed effect we are able to control for is trading partner fixed effect,

endogeneity is more of a concern. Below we present results from two regressions using the instrumental variable strategy to control for potential endogeniety bias. Given the limited data we have the instrumental variable regressions are not very useful for assessing the direction of the bias (in relation to the uninstrumented regressions above). This is because in case of both instrumental variable regressions, the data is essentially different from the regressions implemented above without instrumenting.

7.1.1 Results from instrumental variable regressions.

We implemented two instrumental variable regressions. In the first case we used the cross-sectional data for 2004 for Kenya and Mauritius and in the regression used lagged tariff i.e. tariff for 2001 as an instrument. Same instrumental variable (i.e. lagged tariffs) has been used by Javorcik and Narciso (2008). Note that given our data set such an instrumenting cannot work for Nigeria where the tariffs in 2001 and 2004 are nearly similar. Table 14 presents the results for regression on 2004 data using tariffs in 2001 as instrument for the case of Kenya and Mauritius (using the first definition).

Table 14: Instrumental variable regression of evasion in value on tariffs (lagged tariff as instrument)

VARIABLES	Evasion in value 2004 (Kenya)	First stage – applied tariff in 2004 (Kenya)	Evasion in value 2004 (Mauritius)	First stage -applied tariff in 2004 (Mauritius)
Applied tariff in 2001	0.748*** (0.132)	0.924*** (0.003)	0.145** (0.062)	0.938*** (0.003)
Constant	-0.165*** (0.0285)	0.0174*** (0.0008)	-0.0597*** (0.022)	0.0119*** (0.001)
Number of observations	9927	9651	9821	9751
R-squared	0.003	0.70	0.001	0.78

We implemented another instrumental variable regression where applied tariffs was instrumented with bound tariffs. The drawback for this instrument is that it is available for very few commodities (in developing countries – please see the discussion above for the number of tariff lines that are bound) and even though it has high correlation with applied tariffs it is most closely related with MFN tariffs. Given the scarcity of data we implemented the regression for the case using second definition of evasion. The results are presented in table 15 below.

Table 15: Instrumental variable regression for evasion in value (second definition) on tariffs (Bound tariffs as instrument)

	Kenya	Mauritius	Nigeria
Applied tariff	3.932* (2.069)	3.296* (1.795)	6.045*** (1.400)
Constant	2.680*** (0.442)	2.423*** (0.384)	0.898 (0.740)
Observations	1456	1814	640
R-squared	0.018	0.015	0.027

7.1.2 Further accounting for product types

There are two types of distinction amongst product that could make them more or less amenable to evasion. First, there could be distinction across capital and consumer goods that is likely to result in different evasion possibilities. This could be owing to several reasons such as mode of transport or the simple difference in bulkiness. To the extent that the level of differentiation varies across the two sets of products, it is accounted for in the specifications considered above. Secondly, the nature and extent of protection could differ across consumer and capital goods. It is common that countries tend to protect their consumer goods sector more especially during initial periods of liberalization vis-à-vis the capital goods sector. Hence, particularly when comparing across countries, the nature of products traded could be important. The classification into basic, capital and intermediate good and consumer good (durables and non-durables)comes from Nouroz (2001). The results are presented in table 15 below. For Kenya and Mauritius the specification includes time, product and trading partner fixed effects along with interaction of tariffs with consumer good dummy that equals 1 if it is consumer durable or consumer non-durable. The ordering of the magnitudes is as before with Mauritius having the least elasticity followed by Kenya (in the specification that is comparable).

Similarly, it is worthwhile to distinguish between agricultural and non-agricultural imports. The former is prone to be subjected to different types of non-tariff barriers and are more homogenous relative to non-agricultural goods (Javorcik and Narciso 2008). Table 16 below presents results of regressions on a sample that does not contain agricultural goods.

Table 16: Effect of applied tariffs on evasion – Accounting for consumer good and capital/basic/intermediate good distinction

	Kenya	Mauritius	Nigeria
Applied tariff	0.671*** [0.151]	-0.053 [0.088]	1.685*** [0.223]
Consumer good dummy	0.064 [0.052]	-0.014 [0.039]	0.317*** [0.078]
consumer good dummy x applied tariffs	0.395* [0.228]	0.294*** [0.114]	-0.405 [0.270]
N	16682	15353	10064
R squared	0.01	0.001	0.02

Table 17 shows that restricting to non-agricultural imports also the evasion (semi) elasticity is highest in Nigeria followed by Kenya.

Table 17: Effect of applied tariffs on evasion: Limiting to non-agricultural goods

VARIABLES	evasion_val non-agriculture (Kenya c1)	evasion_val non-agriculture (Mauritius c1)	evasion_val (non agriculture Nigeria c1)
Applied tariff	0.963*** (0.105)	0.174*** (0.0507)	1.586*** (0.110)
Constant	-0.134*** (0.0232)	-0.168*** (0.0187)	-0.134*** (0.0338)
Observations	18638	16453	10724
R-squared	0.005	0.001	0.017

7.1.3 Testing for equality of coefficient in a pooled regression (across three countries)

Our interest in this paper is on relative ordering of evasion elasticity across the three countries. One simple test whether the countries have similar elasticity of evasion with respect to tariffs (in a statistical sense) is by implementing the model under two different assumptions (i) Allowing coefficients to differ across the three countries and (ii) Restricting the coefficients to be the same across the three countries. In an augmented regression as expressed in equation 7, simple t tests on some coefficients could provide evidence whether or not the coefficients are statistically different from each other.

$$EvValuei_{ptc} = \propto + \beta * Tariffptc + D_N + D_M + \gamma * Tariff * D_M + \delta * Tariff * D_N + \in_{ptc} \quad (7)$$

In equation 7, D_N and D_M are dummies that equal 1 if country is Nigeria and Mauritius respectively. The excluded category in the country dummy is Kenya. The t tests on coefficients γ and δ determine whether the tariff coefficients in each of the two countries are individually different from the excluded category i.e. Kenya. The regression results are presented in table 18 below. Results show that as the interaction term of tariffs with both Nigeria and Mauritius dummy is highly significant (at 1% level), the null hypothesis that the coefficients are equal across the three countries is rejected. Also the hypotheses that $\gamma < 0$ and $\delta > 0$ is not rejected at least at 5% level of significance. Together these provide some evidence of evasion elasticity to vary across these countries with Mauritius having the least elasticity of evasion with respect to applied tariffs.

Table 18: Regression on pooled sample: Testing for equality of coefficients

	Coefficient (standard error)
Applied tariff	0.92***(0.10)
Applied tariff *Nigeria dummy	0.47***(0.14)
Applied tariff * Mauritius dummy	-0.73***(0.11)
Mauritius dummy	-0.04(0.02)
Nigeria dummy	0.01(0.03)
Constant	-0.133***(0.02)
R squared	0.01
Number of observations	49223

7.1.4 Non-parametric and semi-parametric regression to allow for non-linearity in the effect of applied tariffs on evasion

Until now we have allowed applied tariffs to affect evasion linearly. In general we obtained significant effects of applied tariffs on evasion in value for the three countries (the exception being Mauritius in some specifications i.e. with second definition). In this section we allow for tariffs to enter non-linearly in evasion equation. In particular we implement a fully non-parametric regression and a semi-parametric version of equation (3) where applied tariff is made to enter non-parametrically. The semi parametric specification is specified as in equation 8 below.

$$i = 1,2 \; EvValueptc = \propto + f(Tariff\ ptc) + \rho * Tariffrelptc + \theta * d + \varepsilon_{ptc} \quad (8)$$

In equation (8) above, in technical terms it is assumed that the conditional mean of evasion in value has a linear parametric component (depending on the tariffs on similar products and differentiated dummy) and a non-parametric component (i.e. the applied tariffs). The requirements on function f are standard as in non-parametric regressions i.e. it is smooth, single valued and has a bounded first derivative. We estimate the partial linear model in equation 8 by Robinson (1998) method.

Figures A.1, A.2 and A.3 (in the appendix) show the non-parametric local polynomial smoothing based mean regression with their confidence bands (the rule of thumb bandwidths have been used) for Kenya, Mauritius and Nigeria respectively. The plots show some evidence for non-linearity but in most ranges an upward sloping relationship. Further, the confidence bands show that the relationship is tighter for Kenya and Nigeria vis-à-vis Mauritius.

The linear regressions are a special case of this non-parametric regression where a sufficiently high bandwidth will result in a linear relationship. In the tails as the density is low the confidence bands are wider. The marginal effects from simple non-parametric regressions have not been presented which are similar to the ones from semi parametric regressions that are plotted below. The results for semi parametric regressions are presented in table 19 below.

Table 19: Results of semi-parametric regression of evasion in value (first definition) on applied tariffs

	Kenya			Mauritius			Nigeria		
Kenya	Coefficient	Value of test statistic	P value	Coefficient	Value of test statistic	P value	Coefficient	Value of test statistic	P value
Differentiated dummy	-0.11	-1.03	0.30	0.01	0.06	0.95	-0.25	-0.69	0.48
Average tariff on similar products	0.10	0.06	0.95	-2.63***	-3.48	0.00	-4.99**	-2.42	0.01
Significance test on applied tariff :		13.256***	0.00		13.12***	0.00		10.60***	0.00
Number of observations	16602			15627			9796		

Results show that allowing for non-linear specification of applied tariff, the significance test of the applied tariffs (ut_uv) that enters the specification non-linearly indicates that applied tariffs is highly significant for evasion in all three countries (P-value of 0.000).

In comparing the effect of level of tariffs on evasion we computed the marginal effects of the tariffs on evasion at different levels of tariffs and constructed confidence intervals (95%) around each marginal effect. With non-parametric regression, the effect of tariffs on evasion varies locally. The marginal effects for the non-linear part can be calculated as: $ME = \frac{\partial y}{\partial x}$ where ∂y is the change in the dependent variable

from one observation in the sample to the next, and ∂x is the change in value of the nonlinear function. The marginal effect of a particular level of tariff is averaged across products and trading partners. Comprising several local regressions, the marginal effects vary from one point to the other. The test of significance is then implemented at different points along the curve where the standard errors are obtained from bootstrapping.

Figures 4, 5 and 6 plot the significant marginal effects against tariffs in the case of three countries from the semi parametric regression in equation (8). As marginal effects vary across level of tariffs and the number of points for which statistical significance is obtained also vary in the three countries it is difficult to compare the strength of effect of tariffs on evasion per se. However, suggestive evidence can be obtained from the distribution of marginal effects; if skewed towards higher numbers suggest a greater effect of tariffs on evasion. As figures 4,5 and 6 show that where the marginal effects are positive the values in Nigeria are the highest (the highest being nearly 7 in Nigeria). Relatively smaller positive values of marginal effects are in case of Kenya and smallest in case of Mauritius.

Figure 4: Marginal effect of tariffs on evasion – Kenya

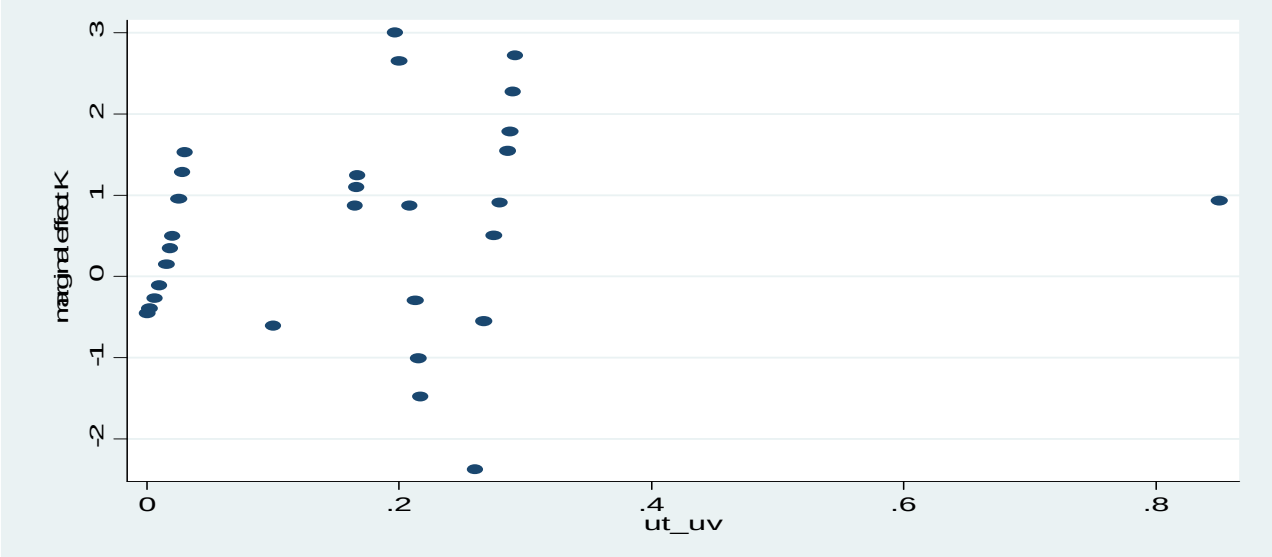


Figure 5: Marginal effect of tariffs on evasion (Mauritius)

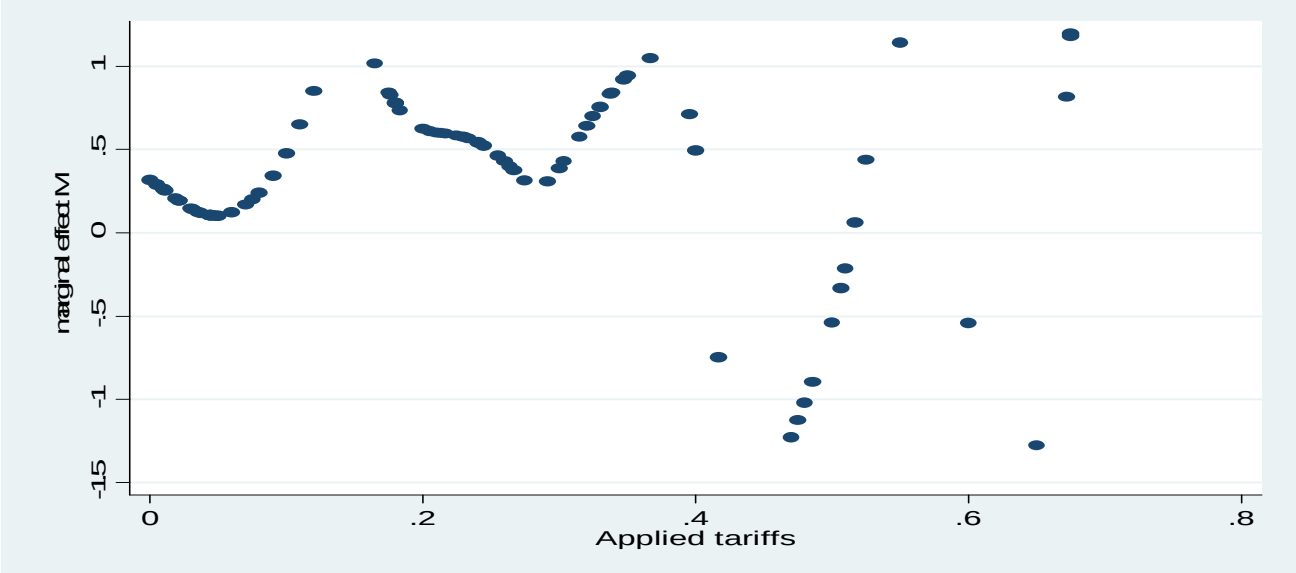
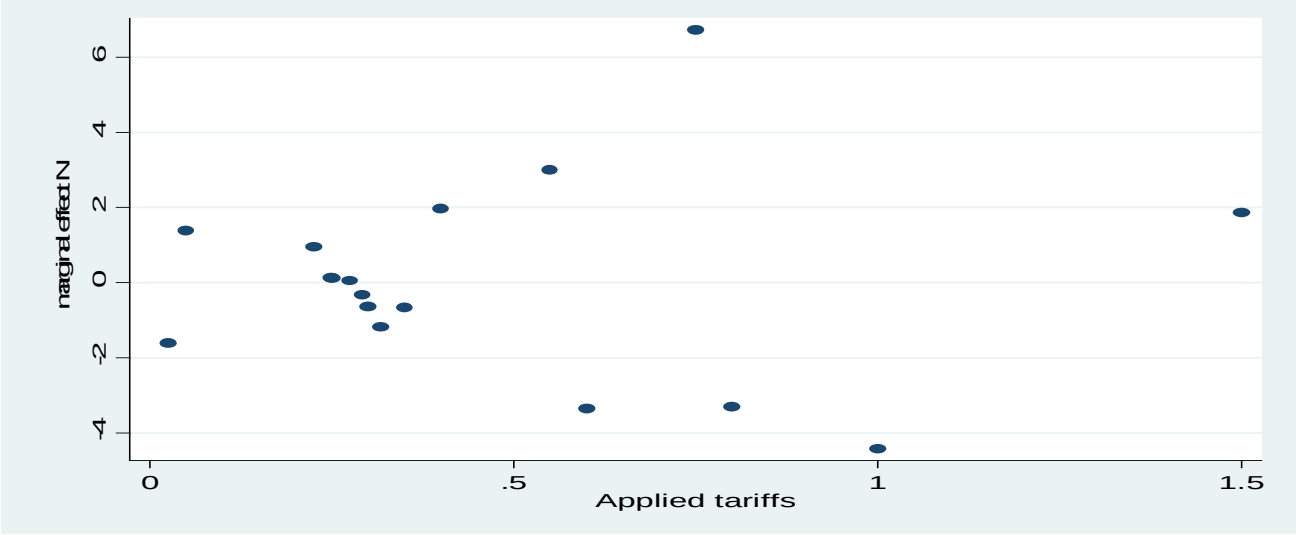


Figure 6: Marginal effect of tariffs on evasion –(Nigeria)



7.2 Limitations of the study

The most important strength of the data set used in this paper is that it offers the most comprehensive measure of protection (from MacMAP) vis-à-vis the ones used in all other papers on tariff evasion. However, this dataset is available for only two years which depending on the case does or does not have over time variation. This constrains the methods used for estimating evasion (semi) elasticity as in case of Nigeria. Also, the analysis focusing on two years though provides strong evidence of an objective measure of specific institutional quality viz. the customs authority, it needs to be updated with more long term data as institutions do evolve slowly over time. Similarly, to conclude about a general relationship between tariff evasion and institutional quality, a comprehensive list of countries should be tested for such an ordered relationship. The evidence here is only indicative based on a small set of countries (3 countries).

In the analysis above, there is one reason to believe that our estimate of the evasion elasticity might be biased downward. Recall that the policy measure that we use is applied tariffs. Though the measure of applied tariffs (from MacMAP) is extensive and incorporates several instruments of trade protection, yet one important measure that could be missing in the analysis is the quantitative restriction. It is not clear how extensive are these measures and there do not exist good product level measures of quantitative measures of such restrictions. Note that the three countries are members of WTO and therefore several quantitative restrictions would have been reduced over time.

Another limitation of the study could come from our inability to account for transport costs at the disaggregated level of products. As discussed above since imports are reported as cif and exports as fob transport cost differences could affect the size of trade gap across countries. This concern is mitigated to some extent by the fact that none of these countries are landlocked. Further in terms of average distance from its trading partners, Mauritius is the farthest among the three countries (computed for top 20 partners). Indeed issues relating to infrastructure and input costs (oil price in case of Nigeria) also remain and can result in different cif values for a given fob value of exports.

8. Conclusions

In this paper, we use the case of Kenya, Mauritius and Nigeria to examine the effect of tariff policies on evasion. The analysis was motivated by the relative ordering of these three African countries in terms of their perceived institutional quality and the fact that in these countries tariff revenues constitute a very important component of the government budget. The methodological contribution of the paper has been to better identify the effect of tariffs on evasion using the variations in trade protection measures across three dimensions (time, product and trading partner). We also find evidence for effect of enforcement-related factors on evasion elasticity mainly in terms of level of protection on similar products being important. Numerous robustness checks have been carried out and support our main conclusions.

Our main findings are as follows. First, we find a significant and robust impact of tariffs on evasion (semi-elasticity) in values for Kenya and Nigeria in different specifications. The result on Mauritius provides weaker evidence for the relationship between evasion and trade protection. The evidence is weaker as in an alternate measure of evasion we do not find statistically significant effect of tariffs on evasion in Mauritius. For all the three countries there is no robust evidence for evasion in quantity being significantly related to level of tariffs. The data supports the hypothesis of significant evasion (semi) elasticity in quantities for Kenya and Nigeria only in case of complete smuggling assumption for missing trade.

Further, the ranking of estimated evasion elasticity (for value) actually matches the ranking of these countries in terms of institutional quality. Given our emphasis on trading partner and product characteristics it is particularly important that this ordering is preserved in case of perfectly matched trade. Yet, one needs to be cautious in pre-supposing a monotonic relationship between evasion and institutional quality. The aggregative nature of the institutional quality indices implies that this mapping may be far from perfect. Hence, the Kenya bribery index seems to have improved over time but the estimate of evasion elasticity also seems to have risen between 2001 and 2004.

What the results here suggest that evasion gap is positively correlated with trade protection measure especially in case of Kenya and Nigeria. Thus, evasion gap can potentially be reduced through trade reform. Importantly, it is possible that trade reform can lead to higher and not necessarily lower tax revenues. This is all the more important as this element has been and is still used as a main deterrent to important tariff and trade reforms.

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Appendix:

Table A.1: Match rates for Kenya, Mauritius and Nigeria for the pooled 2001 and 2004 sample

Coverage	Assumption about missing imports	Kenya	Mauritius	Nigeria
Full sample	Missing	33%	38%	30%
Top 20 trading partners	Missing	43%	42%	39%
Top 5 Trading Partners	Missing	50%	52%	48%
Full sample	Extreme smuggling	80%	83%	83%
Top 20 trading partners	Extreme smuggling	83%	84%	84%
Top 5 Trading Partners	Extreme smuggling	84%	85%	85%

Table A.2: Cross-sectional results on evasion in value using the second definition of evasion gap

COEFFICIENT	Kenya (Pooled sample)	Mauritius (Pooled sample)	Nigeria (Pooled Sample)
Applied tariff	3.118*** (0.64)	0.411 (0.255)	7.52*** (0.91)
Tariff on related products	-0.077 (0.649)	-1.171*** [0.270]	-0.276 (1.181)
Differentiated dummy	-0.520*** [0.161]	-0.055 [0.112]	-0.770** [0.382]
Differentiated dummy **X tariff interaction**	-0.507 (0758)	-1.018*** [0.255]	-2.393** (0.957)
R-squared	0.01	0.001	0.05
Observations	32678	30601	20829

Table A.3: Cross-sectional results on evasion in quantity

	Kenya (Pooled sample)		Mauritius (Pooled sample)		Nigeria (Pooled sample)	
COEFFICIENT	First definition of evasion gap	Second definition of evasion gap	First definition of evasion gap	Second definition of evasion gap	First definition of evasion gap	Second definition of evasion gap
Applied tariff	0.281 (0.37)	2.298*** (0.559)	0.320* (0.17)	0.411 (0.23)	1.001 (0.717)	7.444*** [1.12]
Tariff on related products	-0.949** (0.38)	-0.567 (0.61)	-0.914*** (0.17)	-1.031*** (0.23)	2.139*** [0.725]	-0.276 [1.181]
Differentiated dummy	0.160 [0.102]	-0.387*** (0.140)	0.249*** [0.077]	-0.055 (0.112)	-0.895*** [0.139]	-0.770** [0.382]
Differentiated dummy **X tariff**	0.125 (0.484)	-0.062 (661)	-0.452** (0.182)	-1.246*** 0.17)	0.141 (0.414)	-2.393** [0.957]
Observations	15053	32563	14675	30601	9000	20829
R-squared	0.01	0.002	0.01	0.003	0.03	0.08

Table A.4: Evasion with respect to MFN tariffs and applied tariffs in Kenya and Mauritius

COEFFICIENT	evasion_val (Kenya)	evasion_val (Kenya)	evasion_val (Mauritius)	evasion_val (Mauritius)
applied tariff	0.927***		0.193***	
	(0.10)		(0.049)	
mfn tariff		0.787***		0.150***
		(0.12)		(0.047)
Constant	-0.134***	-0.171***	-0.179***	-0.172***
	(0.022)	(0.027)	(0.018)	(0.018)
Observations	19426	11204	18211	18211
R-squared	0.001	0.001	0.001	0.001

Table A.5: Fixed effects regression for evasion in quantity in Kenya, Mauritius and Nigeria (All trading partners – first definition – first three columns, second definition –last three columns)

COEFFICIENT	Kenya	Mauritius	Nigeria	Kenya	Mauritius	Nigeria
Applied tariff	0.306 [0.506]	0.334 [0.245]	1.008 [0.972]	2.144*** [0.822]	0.404 [0.342]	7.273*** (1.215)
Tariff on related products	**-0.846 [0.515]**	**-0.845*** [0.252]**	**1.825* [0.939]**	-0.741 [0.868]	--0.982*** [0.345]	-1.026 (1.192)
Differentiated dummy	0.086 [0.299]	0.227 [0.169]	-0.858* [0.456]	-0.2 (0.368)	0.017 [0.191]	-0.084 [0.342]
Differentiated dummy X tariff	0.370 [1.086]	-0.446 [0.371]	0.178 [0.920]	-0.627 (1.258)	-1.265*** [0.445]	-2.920*** [0.981]
Trading partner fixed effect	Y	Y	Y	Y	Y	Y
Observations	15054	14675	9000	32563	30602	20829
R-squared	0.04	0.04	0.11	0.19	0.12	0.164

Figure A.1: Local Polynomial smoothed regression – Kenya (c1)

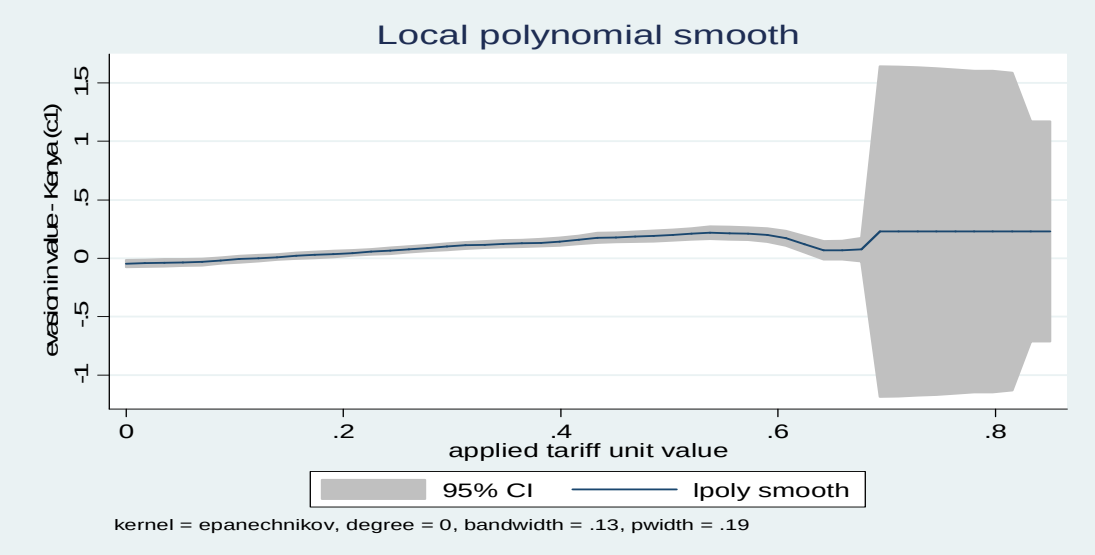

Figure A.2: Local polynomial regression – Mauritius(c1)

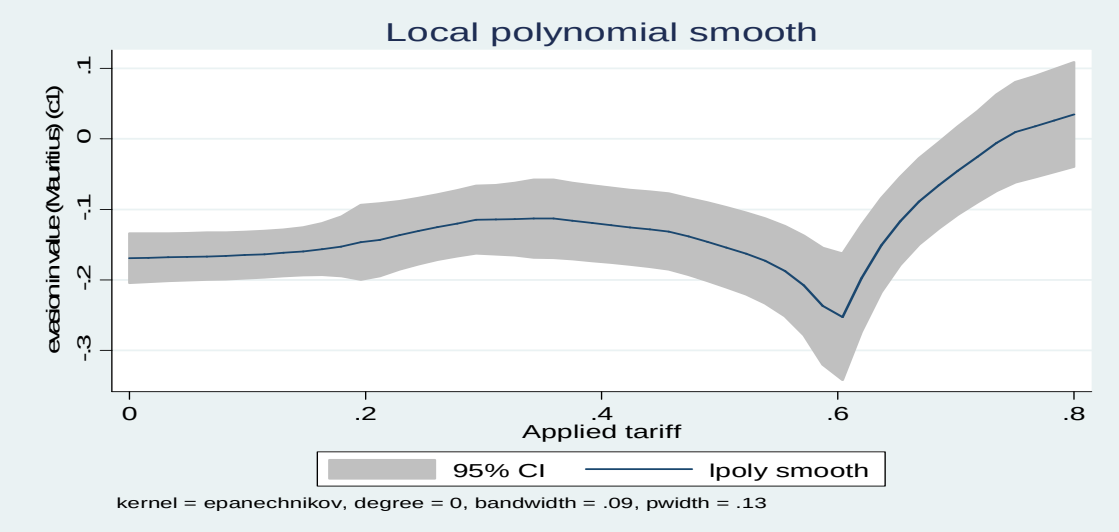

Figure A.3: Local polynomial regression: Nigeria (c1)