WTO Accession and Tariff Evasion

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Abstract This study focuses on displacement of illicit activities in the context of institutional reforms mandated by the WTO accession process. We argue that implementation of Article VII of the GATT resulted in limiting discretion of customs officials in terms of assessing unit values of goods. While prior to the WTO accession, officials were free to use minimum or reference prices, after their country joined the WTO they were mandated to accept the invoice issued by the exporter. This limited the scope for negotiation between importers and customs officials and the ability to misrepresent import prices. This institutional reform has thus effectively shut down one channel of import duty evasion. Dishonest importers have responded by more heavily relying on alternative evasion channels, such as undercounting quantities and product misclassification. We formally test these hypotheses using data on 15 countries which joined the WTO between 1996 and 2008. We calculate the discrepancy in the unit values of imports as reported by the exporter and the importer and find that there is a positive relationship between the tariff rate and misrepresentation of import prices prior to the accession. This relationship disappears after the country joins the WTO. However, at the same time we find that removing the opportunity to underreport unit values has induced importers to underreport quantities. We find that in the post-accession period there is a positive and statistically significant relationship between underreporting of import quantities and the tariff rate. Further, we find that the relationship between the tariff on similar products and underreporting quantities becomes stronger after the accession, which is suggestive of product misclassification becoming more widespread.

1.   Introduction

This paper studies the response of tax evasion to an institutional reform which shuts down one of the channels through which evasion takes place. While the evidence suggests virtual elimination of tax evasion through the affected channel, it also indicates greater evasion through alternative channels. Thus the evidence is consistent with strong displacement of an illicit activity, which contrasts with the earlier literature suggesting that displacement of illegal activities tends to be small in magnitude.[1]

The analysis focuses on membership in the World Trade Organization (WTO), and in particular on the WTO Customs Valuation Agreement (Agreement on Implementation of Article VII of the GATT) which countries joining the organization are expected to implement. Article VII sets the international rules on the methodology that countries must use to value imported goods in order to collect duty. Customs value should be based on "actual value", which is the price of the imported merchandise, or like merchandise, in sales in the ordinary course of trade under fully competitive conditions. Customs value should not be based on value of merchandise of national origin, or arbitrary or fictitious values. Countries joining the WTO are under pressure to comply with the agreement as failure to do so may result in being brought to the WTO Dispute Settlement Mechanism. [2,3]

By essentially mandating the use of invoices issued by the exporter as the basis for import valuation, Article VII limits the discretion of customs officials. The intended purpose of Article VII is to prevent member countries from evading tariff concessions made to other WTO members by *overvaluing* import flows.[4] However, many developing countries are concerned about implementing the valuation methods set out in Article VII because they fear that importers may use fake invoices to evade duties by *undervaluing* import flows.[5]

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[1] See, for instance, Chaiken, Lawless, and Stevenson (1974), McPheters, Mann, and Schlagenhauf (1984), Ayres and Levitt (1998), Levitt (1998), and Di Tella and Schargrodsky (2004), as well as a literature review by Hesseling's (1994). A notable exception is Yang (2008).

[2] The *Report of the Working Party on the Accession of China to the WTO* (1 October 2001, emphasis added) reads: "Some members of the Working Party expressed concern regarding the methods used by China to determine the customs value of goods, in particular regarding the practice of using minimum or reference prices for certain goods, which would be inconsistent with the Agreement on Implementation of Article VII of the GATT 1994 ("Customs Valuation Agreement")." In response, "The representative of China confirmed that, upon accession, China would apply fully the Customs Valuation Agreement (. . .)".

[3] In January 2008 the European Community (EC) requested consultations with Thailand with respect to the way the Thai customs authorities value alcoholic beverages and other products from the EC. The EC disputed the application by the Thai customs authorities of an "assessed value", which is considered to be arbitrary. In February 2008, the Philippines and the US requested to join the consultations.
Source: http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds370_e.htm

[4] For example, if the tariff rate on widgets is 10 percent, then a firm importing $100 worth of widgets should pay $10 in import duties. If, however, customs officials at the border valued the shipment at $200, the resulting duty payment would increase to $20 which would be equivalent to a 20% tariff rate.

[5] Though there are provisions for situations when customs administrations have reason to doubt the accuracy of the declared value of imported goods.

Our study builds on the literature started by Fisman and Wei (2004) who find that the extent of tariff evasion is positively correlated with the tariff rate. This literature shows that the missing trade, defined as the discrepancy in the product-specific trade flow reported by the exporting country and the figures reported by the importer is positively correlated with the tariff rate.[6]

We focus on misrepresentation of the import price and its sensitivity to the tariff rate before and after the WTO accession. To capture the misrepresentation of the import price, we follow Javorcik and Narciso (2008) and calculate the difference between the unit value of exports reported by the exporting country and the unit value of imports recorded by the importer (hereafter referred to as the unit value gap). Unit values are measured at the 6-digit level of the Harmonized System (HS) classification. We focus on differentiated products, as defined by Rauch (1999). It is more difficult for honest customs officials to accurately assess the true price of differentiated products due to their intrinsic features and different qualities, which may give corrupt customs officers a plausible explanation for why they did not detect the problem with the invoice.[7] We focus on four major exporting countries, all of which are developed and relatively uncorrupt economies: Germany, US, Japan and France.[8] We consider 15 importing countries which joined the WTO between 1996 and 2008. We use trade figures from the UN COMTRADE database and tariff data from the World Bank's WITS database.

Our empirical analysis proceeds in several steps. First, we show that there exists a positive and statistically significant relationship between the unit value gap and the tariff rate. When estimating this relationship we control for country pair, 6-digit HS product and year fixed effects. Our results are consistent with the underreporting of import prices being greater when the tariff rate is higher. This finding is intuitive as importers wanting to evade paying import duties will have a greater incentive to underreport the price of the imported product if the tariff rate is higher.[9]

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[6] While the finding of Fisman and Wei is based on trade flows between Hong Kong and China, subsequent studies have documented similar patterns in ten transition economies (Javorcik and Narciso 2008), India (Mishra, Topalova and Subramanian 2008), Chinese imports from multiple exporters (Rotunno and Vézina 2011) and Cameroon (Raballand et al. 2013).

[7] Javorcik and Narciso (2008) find no evidence of price misrepresentation (i.e., reporting unit values of imports as being lower than what they really are) being responsive to the tariff rate in general. However, they do find evidence suggesting that price misrepresentation is positively correlated with the tariff rate in the case of differentiated products. Their results suggest that a one-percentage-point increase in the tariff rate is associated with a 0.9 to 1.2% increase in the unit value gap of differentiated products in Eastern European transition countries.
Our results also hold for non-differentiated products as discussed later in the paper.

[8] All four countries are in the top quantile of the least corrupt countries in the world according to the Transparency International Corruption Perception Index.

[9] An anthropological study of the Cameroonian customs administration concludes that the recorded details of an import transaction are a result of negotiations between customs officials (who need to meet their revenue targets) and importers (who would like to limit their duty payments).

  "With 'large undertakings', often subsidiaries of international groups, officers do not negotiate; they apply the 'transactional value', the value shown on the invoice. . . .Negotiation is used for 'informals', 'central market traders'. It is even strongly recommended and organized for agreement on three points: quantity per unit of

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Then, we examine whether the relationship between the unit value gap and the tariff rate changes after the WTO accession. This appears to be the case. Our results suggest that the positive link between misrepresentation of the import price and the tariff level disappears after the importing country joins the WTO. A 10 percentage point increase in the tariff rate is associated with a 6.3% larger unit value gap prior to the WTO membership and less than a quarter of a percent decline in the post accession period. Our findings are consistent with the WTO Customs Valuation Agreement limiting the discretion of customs officials in terms of assessing the price of imported goods, which makes it much more difficult for corrupt officials to cooperate dishonest importers to evade duty payments. Thus fears of developing countries that underpricing would increase after implementation of Article VII appear to be unfounded.

In a series of robustness checks, we show that our results hold when we control for the average tariff level in the importing country, unobservable importer-year or importer-exporter-year heterogeneity, or include non-WTO members in the control group. We also demonstrate that our results hold for many individual accession countries.

So far our analysis suggests that the institutional change resulted in shutting down one of the tariff evasion channels. Therefore, next we examine whether changes to customs valuation procedures induce importers to seek alternative ways of tariff evasion. We do so by focusing on underreporting of quantities. We find a positive and statistically significant relationship between underreporting of quantities and the tariff rate in the post-accession period. The magnitude of the estimated effect is quite large as it suggests that a 10 percentage point increase in the tariff rate is associated with an 11–20 percent larger quantity gap. We find evidence of this phenomenon in regressions for individual countries. In 11 of 15 cases, we find a positive coefficient on the interaction term between the WTO membership and the tariff rate. The coefficient is positive and statistically significant in 5 countries. Interestingly, China appears to be a country where the WTO accession both weakens underreporting of prices and strengthens underreporting of quantities.

We also explore tariff evasion through misclassification of imports. We do so by controlling for tariffs on similar products. More specifically, we include in our regression the average weighted tariff in the same 4-digit HS category. We find a negative and statistically significant coefficient on the new variable, which suggest that lower tariffs on similar products are associated with a higher quantity gap. This is in line with the argument that lower tariffs on similar products make misclassification of products more attractive. More interestingly, the relationship between the tariff on similar products and the

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measurement (bundle, container), value of that unit of measurement and tax category (generally the highest of three or four categories). . . . Customs officers apply, or indeed set, 'administrative values', 'approved values' or 'reference values'. These differ from the invoice value, which is considered to be incorrect." Cantens (2012, p. 5)

quantity gap becomes stronger after the WTO accession. Again, this is suggestive of the importers switching to an alternative channel of tariff evasion.

Our study has documented two opposing effects of WTO accession. We have argued that on the one hand taking away discretion of customs officials with respect to assessing prices of imported goods has resulted in lesser underreporting of prices (or more precisely, a lower semi-elasticity of the unit value gap with respect to the tariff rate). On the other hand, we have found evidence consistent with greater evasion of import duties through underreporting quantities and product misclassification following entry into the WTO.[10]

To examine this question, the third part of our analysis focuses on the trade value gap, or discrepancy in total value of trade (i.e, price x quantity) as reported by the exporting country and the importing country. The results suggest worsening of tariff evasion in the aftermath of the WTO accession. The magnitude of the effect is economically meaningful. Before the WTO accession, a 10 percentage point increase in the tariff rate is associated with a 4.9 percent increase in the trade gap. After the accession, the response of the trade gap increases to 8.1 percent. The results on individual countries suggest an increase in the semi-elasticity of the missing trade with respect to the tariff rate in 8 of 15 countries, with the coefficient of interest being statistically significant in 5 cases.

Overall, our results suggest that the institutional reform mandated by WTO accession resulted in shutting down one channel of tariff evasion, but at the same time has lead to greater evasion through alternative channels. Thus our evidence is consistent with strong displacement of an illicit activity.[11]

Our study is related to several strands of the literature. The first strand is the literature on tax evasion [REVIEW TO BE ADDED].

The second strand of the related literature assesses the implications of WTO membership. Increased trade as the potential gain from the membership has received the most attention in the literature. Yet, at best the trade-promoting effects of the WTO membership seem to be quite uncertain. In a widely cited study, Rose (2004) failed to find a statistically significant relationship between the GATT/WTO membership status of a pair of countries and their bilateral trade. This finding was partially reversed by

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[10] One can speculate that reforming one aspect of functioning of the customs administration was so effective precisely because officers retained discretion in other areas. Cantens (2012, p. 10) argues that officers are very well aware of politician's objectives:

"All Customs officers are familiar with the *Doing Business* reports*,* the *Logistics Performance Index* and the *Transparency International* classifications. Some Customs officers even know where their country is ranked directly from the cross-border trade indicator, one of the indicators summarized for the general classification in *Doing Business*. They describe what the minister wants following those classifications and the relative pressure that results."

[11] The observed pattern is consistent with the finding of Yang (2008) who found that introduction of pre-shipment inspections in the Philippines led to increased usage of alternative methods of duty avoidance. Alternative methods included splitting shipments into smaller shipments with values below the threshold where pre-shipment inspection was required, as well as routing shipments through duty-exempt export-processing zones.

Tomz, Goldstein and Rivers (2007) who updated Rose's data to include both de jure and de facto WTO membership and then found a positive effect of the WTO. Subramanian and Wei (2007) allowed for a differential effect on different country groupings and showed that a positive WTO trade effects exists for industrialized but not for developing nations. Eicher and Henn (2011) focused on improvements to the estimation technique and found that once they control for three sources of omitted variable bias: multilateral resistance, unobserved bilateral heterogeneity and trade effects of preferential trade agreements, there was no evidence of a positive WTO trade effect. This contrasts with the most recent results of Chang and Lee (2011) who used nonparametric methods and showed large GATT/WTO trade-promoting effects. Possible worsening of tariff evasion in the post-accession period, documented in our study, may have made it more difficult to detect an increase in trade resulting from the WTO membership.

Another strand of related literature suggests that the WTO eliminates the terms-of-trade-driven restrictions in trade that arise when policies are set unilaterally (Broda et al. 2008, Bagwell and Staiger 2011) or can be used by governments as a commiment device vis-à-vis domestic lobbies (Maggi and Rodriguez-Clare 1998 and 2007). There is also evidence consistent with WTO accession raising income, but only for those countries that were subject to rigorous accession procedures (Tang and Wei 2009).[12]

Our study is structured as follows. The next section describes the data. Section 3 explores the relationship between underreporting of prices and the WTO membership. Section 4 focuses on underreporting quantities and product misclassification, while Section 5 examines the effect on the overall trade value. The last section presents the conclusions.

2.   Data

Our main data source is the World Bank's World Integrated Trade Solution (WITS) database that contains information on most favored nation (MFN) and preferential tariff rates specific to pairs of countries and years, derived from the UNCTAD's Trade Analysis and Information System (TRAINS). The information is available at the 6-digit level in the HS classification. We consider 15 importing countries which joined the WTO between 1996 and 2008. These are: Albania, Armenia, China, Cape Verde, Ecuador, Georgia, Lithuania, Latvia, Moldova, Macedonia, Nepal, Oman, Saudi Arabia, Ukraine and Vietnam. Table 1 lists their accession dates. Due to data constraints, we exclude from the sample six WTO members that joined the organization during the same period.[13] In our analysis, we consider the

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[12] Article XXVI 5(c)-eligible countries were able to join the GATT by 1994 without making extensive reform commitments. These were former colonies whose former colonizers were GATT members by the time of their colonies' independence.
[13] Table 2 lists their names and the reasons why they have been excluded.

actual year of accession if the country became a WTO member between January and June, and the following year if the accession happened between July and December. We consider four exporters: Germany, US, Japan and France. We chose these particular exporters to cover the major source of exports in all regions of the world. We also decided to focus on developed and relatively uncorrupt countries in order to avoid confounding the effects of corruption in the exporting nation with the effects of corruption in the importing country.

Our second data source is the United Nations' COMTRADE database which contains information on trade flows, also at the 6-digit HS level. The data on tariffs and trade flows are available for the period 1992-2009, though the coverage differs by country.

We consider only differentiated products because as argued by Javorcik and Narciso (2008) it may be easier to conceal the true value of such products, thus creating more opportunities for tariff evasion. We use Rauch's (1999) definition of differentiated products. He classified goods into three categories: (i) homogeneous which are products whose price is set on organized exchanges; (ii) reference priced, which are goods not traded on organized exchanges, but which possess a benchmark price; and (iii) differentiated which are products whose price is not set on organized exchanges and which lack a reference price because of their intrinsic features. Rauch suggested two definitions, a conservative and a liberal one, in order to account for the ambiguities arising in the classification. The conservative definition minimizes the number of commodities that are classified as homogeneous goods, while the liberal definition maximizes this number. We employ the conservative classification, but our results are robust to using the liberal definition.

3.   Implementation of the WTO Customs Valuation Agreement

Summary statistics

Our variable of interest is the unit value gap defined as the difference in unit values of exports of product *p* at time *t* reported by the exporter *k* and the importer *c*:

$$Unit\ value\ gap_{kcpt} = \ln\left(\frac{Export\ value_{kcpt}}{Export\ quantity_{kcpt}}\right) - \ln\left(\frac{Import\ value_{kcpt}}{Import\ quantity_{kcpt}}\right) \tag{1}$$

The gap is calculated at the level of 6-digit HS product for each exporter-importer combination and each year.[14] A discrepancy between the value of exports recorded by the exporting country and the value of imports recorded by the importer is to be expected. The first reason is that export prices are expressed in f.o.b. terms while imports are recorded including the cost of insurance and freight (c.i.f.). The second reason is that countries tend to monitor imports more carefully than exports. In the absence of tariff evasion one would expect the discrepancy to be negative. Yet, as illustrated in Table 3 presenting the summary statistics, both the average and the median gap in our sample are positive reaching 18% and 10%, respectively.[15]

More interestingly from the perspective of our study, there is a sharp decline in the value of the gap from the average value of 34% before the WTO accession to 2% after the accession. The difference between the two figures is statistically significant (see Table 4).

The existence of the unit value gap is suggestive of corruption in customs, but it does not constitute conclusive evidence. A systematic relationship between the tariff level and the gap would be much stronger evidence of improper customs practices. Thus in Table 5, we check whether there is a difference in the average unit value gap for the high and low tariff levels. Looking at the pre-accession period, we find a much higher gap for the above median tariffs than for the below median tariffs (47% vs 28%).[16] The difference between the two is statistically significant. In contrast, in the post-accession period, the average gaps are much lower (about 2%), almost identical, and the difference between them is not statistically significant. This pattern is in line with our hypothesis that the WTO accession is associated with limiting discretion of customs officials in terms of assessing the price of imported goods.

Econometric specification

To formally test the relationship between WTO accession and tariff evasion, we will examine whether the elasticity of the unit value gap with respect to the tariff rate changes around the accession time. More specifically, we will estimate the following model:

$$unit\_value\_gap_{kcpt} = \beta_0 + \beta_1 tariff_{kcpt} + \beta_2 WTO_{ct} * tariff_{kcpt} + \beta_3 WTO_{ct} + \alpha_{kc}(+\alpha_k + \alpha_c)(+\alpha_p) + \alpha_t + \varepsilon_{kcpt}$$

(2)

where the unit value gap is defined as above, tariff is the applied tariff on imports of product p from country k to country c at time t, WTO is the dummy variable taking on the value of 1 if country c was a member of the organization at time t, and zero otherwise. The full specification of the model also includes

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[14] We drop from the sample the top and bottom 1% of observations for each country to avoid including possible coding mistakes in the data set.

[15] Exp(.163) − 1 =.177

[16] The median tariff is calculated by the importing country and year.

importer and exporter fixed effects (or importer-exporter pair fixed effects), product fixed effects and time fixed effects. We do, however, show the results with various combinations of fixed effects. In all specifications, we allow for heteroskedasticity-robust standard errors.

Following the literature outlined earlier, we will interpret a positive semi-elasticity of the unit value gap with respect to the tariff rate ($\beta_1 > 0$) as evidence of tariff evasion. The question of interest is whether this semi-elasticity changes after the WTO accession. If the WTO membership improves functioning of the customs service, we would expect to observe a negative coefficient on the interaction term ($\beta_2 < 0$).

Before we proceed to testing the question of interest, we check for evidence of tariff evasion in our sample regardless of the WTO membership. In other words, we drop the terms involving the WTO from the estimation and show the results in the top panel of Table 6. We present four specifications with different combinations of fixed effects: (i) importer, exporter and year fixed effects; (ii) country-pair and year fixed effects; (iii) importer, exporter, product and year fixed effects; and (iv) country-pair, product and year fixed effects. In all four specifications, we find a positive and statistically significant (at the 1% level) relationship between the tariff rate and the unit value gap. In the first specification, a 10 percentage point increase in the tariff rate is associated with a 7% larger unit value gap. In other words, if the tariff rate is 10 percentage points, on average the importing country reports a 7% lower unit price than the exporter. In the most stringent specification (column 4), the magnitude of the effect declines to 5.4% but the coefficient remains statistically significant at the 1% level.

Baseline results

The results from our baseline specification, outlined in equation 2, support our hypothesis that institutional reforms mandated by the WTO accession affect tariff evasion through underreporting of prices. As evident from the bottom panel of Table 6, we find a positive and statistically significant semi-elasticity of the unit value gap with respect to the tariff rate in the pre-accession period. In the post-accession period, this semi-elasticity becomes either much smaller in magnitude (changing from 0.0084 to 0.0016 in column 1) or even negative.[17] Looking at column 1, a 10 percentage point increase in the tariff rate is associated with an 8% larger unit value gap prior to the WTO membership and a 1.6% larger gap in the post-accession period. The corresponding figures for column 4 are a 6.3% increase pre-accession and less than a quarter of a percent decline in the post accession period. These results are

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[17] A negative semi-elasticity is consistent with customs service performing more vigorous checks on imports of high tariff products, thus leading to lower evasion at higher tariff levels. This argument has found some empirical support in the context of pre-shipment inspection examined by Anson et al. (2006).

consistent with the WTO Customs Valuation Agreement limiting the discretion of customs officials and thus the scope for underreporting of unit values of imports.

Robustness checks

WTO accession is often associated with changes in trade policy. To make sure that our results are driven by changes in tariff evasion rather than other trade policy changes, we perform two checks. First, it could be the case that incentives to evade tariffs decline as the average tariff decreases. To take this into account we augment our baseline specification with the weighted applied tariff averaged over all imports of country c from the partner country k in year t. We also allow the elasticity of missing trade with respect to tariff to vary depending on the average tariff by interacting the product-specific tariff with the average tariff. We find a positive relationship between the average tariff and the unit value gap, and a negative elasticity of missing trade with respect to the interaction term, though the magnitude of the effect does not seem to be economically meaningful. More importantly, we find that our main results are robust to this change (see Table 7).

Second, we change our baseline specification to include different sets of fixed effects. In the left panel of Table 8, we control for all importer-specific changes taking place in each year by including importer-year fixed effects in addition to exporter and product fixed effects This change does not affect our conclusions. As before we find a positive and statistically significant sign on the import tariff and a negative and statistically significant coefficient on the interaction between the tariff rate and the WTO membership.[18] In the right panel of Table 8, we include importer-exporter-year fixed effects in addition to product fixed effects. In this way, we account for shocks specific to a pair of trading partners in a particular year. Again, our results remain unaffected by this change. All the coefficients of interest follow the expected sign pattern and are statistically significant. As anticipated, the results suggest that the relationship between underreporting of prices and the tariff level pretty much disappears after a WTO accession.

In Appendix A Table A1, we present another robustness check. Rather than comparing tariff evasion in the pre- and post-accession period in WTO members alone, we also include non-member countries in our control group. The non-members include: Algeria, Azerbaijan, Belarus, Bhutan, Bosnia Herzegovina, Kazakhstan, Lebanon, Russian Federation, Serbia, Syria and Yemen. Changing the comparison group does not affect our findings.

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[18] The negative sum of these two coefficients suggests that underreporting of prices is less likely if the tariff rate is high, which would be consistent with more stringent enforcement of customs checks at higher tariff levels.

In Table 9, we present the results for individual countries. We find the expected sign pattern in 10 of 15 countries. In five countries, both coefficients of interest follow the expect sign pattern and are statistically significant.

Three countries Cape Verde, Nepal and Ecuador committed to implementation of Article VII only after a transition period. In the case of Cape Verde, a country that asked for a transition period post accession in order to implement customs valuation obligations, we do not find the expected sign pattern. Both coefficients of interest are positive but neither is statistically significant. In the case of Nepal, we only have two years of data and 233 observations which probably explains why we do not find any statistically significant patterns.[19] Ecuador is interesting case. The country joined the WTO in January 1996 and asked for a 5-year transition period for implementing the Customs Valuations Agreement. To take the transition period into account we estimate an augmented model for Ecuador, in which we allow for a different coefficient on the tariff rate in the 1996-2000 period (i.e., the time when Ecuador was already member of the WTO but was not obliged to implement Article VII) and in the 2001-2009 period (when Ecuador was a member obliged to have implemented Article VII). The results, presented in Appendix A Table A2 show a positive and significant coefficient on the tariff rate. As we would expect, the interaction term between the tariff rate and the 1996-2000 period dummy is not statistically significant, while the interaction with the 2001-2009 period is negative and statistically significant. In other words, we find a positive relationship between underpricing of imports and the tariff rate in years prior to 2001. This relationship disappears in 2001, the year when Ecuador was expected to implement the Customs Valuation Agreement.

Data for Ukraine suggest evasion of import duties through misreporting of unit values. There is no evidence of the situation changing after the WTO accession, which is consistent with the US State Department report documenting pervasive corruption in the Ukrainian customs service.[20]

Finally, we show in Appendix A Table A5 (top panel) that our conclusions hold for non-differentiated products. We argued before that it is harder to misrepresent the price of homogenous goods and goods possessing a reference price. This view is confirmed by the lower sensitivity of price underreporting to the tariff rate observed for non-differentiated goods.

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[19] Nepal also asked for a transition period. Our data include one year prior to the WTO accession and one after the expiration of the transition period.

[20] "Companies have identified improper customs valuation procedures -- i.e. Customs officers valuing goods well above their true value, thereby raising the customs duties and value added tax owed -- as a major obstacle to doing business in Ukraine." Source: US Department of State *2012 Investment Climate Statement – Ukraine* http://www.state.gov/e/eb/rls/othr/ics/2012/191257.htm

4. Is there evidence of displacement?

Closing one avenue of tariff evasion may lead to importers exploring alternative means of duty evasion. To explore this possibility we examine the patterns of underreporting quantities pre- and post-WTO accession. We define quantity gap as difference between quantities of exports of product p reported at time t by the exporting country k and quantities of imports reported by the importing country c:

$$Quantity \quad gap_{\ kcpt} \ = \ \ln(\ Export \quad quantity_{\ \ kcpt}\ )\ ^{-}\ \ln(\ \text{Im} \, port \quad quantity_{\ \ kcpt}\ ) \qquad (3)$$

Unlike the unit value gap, the quantity gap will not be affected by exports being reported on f.o.b. basis and imports including the costs of insurance and freight. However, a mismatch is statistics may arise due to transit time (e.g., exporting country may report goods as being shipped in December of year t, while goods may arrive at their destination only in January of year t+1) or to countries recording their imports more carefully than their exports. As indicated by the summary statistics, presented in Table 10, the average quantity gap prior to the WTO accession was equal to -23 percent (i.e., on average importing countries reported larger quantities of goods arriving relative to the exporting countries' records). This sign pattern reversed after the WTO accession with the average quantity gap reaching positive 8 percent, which is consistent with underreporting of quantities by importing countries. The difference between the two means is statistically significant.

Table 11 breaks down these averages by the tariff level. After the WTO accession, a positive quantity gap is observed in products with the above median tariff rate and there is virtually no quantity gap in products where tariffs are below the median. The difference between the two figures is statistically significant. Before the WTO accession, the gap in both categories is negative, but, as expected, it is smaller in high tariff products. The summary statistics presented so far are quite suggestive of tariff evasion through underreporting of quantities (or outright smuggling) taking place after the WTO accession.

Next we turn to econometric evidence. We estimate a specification analogous to equation (2) with the quantity gap as the dependent variable and present results in Table 12. We do not find a consistent message on the relationship between the quantity gap and the tariff rate in the pre-WTO period. If product fixed effects are not included, we find either no statistically significant relationship or weak positive relationship. Focusing on the second column of Table 12, we find that a 10 percentage point increase in the tariff rate is associated with a 1% larger quantity gap (recall than in Table 6, the same change in the tariff rate led to an 8% larger unit value gap). When product fixed effects are included, the sign of the coefficients reverses suggesting a negative relationship between undercounting quantities and tariff rates. One possible explanation is more stringent checks being placed on imports of high tariff goods. Another

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likely possibility is that tariff rates tend to be higher on the same type of goods in various countries and product fixed effects pick up this pattern.

The most intriguing is, however, the finding of a positive and statistically significant relationship between underreporting of quantities and the tariff rate in the post-accession period. The magnitude of the estimated effect is quite large as it suggests that a 10 percentage point increase in the tariff rate is associated with an 11—20% larger quantity gap.[21]

We find evidence of this phenomenon in regressions for individual countries (Table 13). In 11 of 15 cases, we find a positive coefficient on the interaction term between the WTO membership and the tariff rate. The coefficient is positive and statistically significant in 5 countries. Interestingly, China appears to be a country where the WTO accession both weakens underreporting of prices and strengthens underreporting of quantities.

Next, we look for evidence of evasion through misclassification of goods. We do so by adding an additional variable, tariff on similar products, to our model. More specifically, we control for the average weighted tariff in the same 4-digit HS category. The rationale for this exercise is that lower tariffs on similar products make it more attractive for dishonest importers to misclassify their products into a lower tariff category. We allow for the effect of the new variable to vary with the WTO accession. As can be seen in Table 14, we find the expected sign on the variable of interest. The estimated coefficient is statistically significant in 3 of 4 regressions in the pre-accession period and in all cases in the post-accession period. Strikingly, the magnitude of the effect more than quadruples with the WTO accession.[22]

The results presented in this section are consistent with tariff evasion through underreporting of quantities (or outright smuggling) and product misclassification worsening after the WTO accession. A possible explanation is that abolishing quantitative restrictions mandated by the accession to the WTO made this type of evasion easier. If goods are subject to quantitative restrictions, importers need to obtain import licenses from a relevant ministry and such goods tend to be more strictly monitored.[23] The alternative (or perhaps a complementary) explanation is that some dishonest customs officials who see

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[21] Our conclusion with respect to the increase in evasion through underreporting of quantities in the aftermath of WTO accession is not sensitive to the unit of measurement. As illustrated in Appendix Table A3, this conclusion holds for goods whose quantities are measured in kilograms (99% of observations) and for those whose quantities are reported as the number of items (19% of observations). The elasticity of the quantity gap with respect to the tariff rate is larger for the latter group, presumably because it is easier to verify the shipment weight than the number of items shipped. Similarly, our results for the unit value gap are not sensitive to the measurement units (see Appendix Table A4). Finally, as illustrated in Appendix C the pattern we document cannot be explained by computerization of the customs procedures.

[22] Examining misclassification in the context of the overall trade value leads to the same conclusions (see Appendix A Table A6).

[23] In Appendix B, we present evidence supporting this view.

their discretion taken away in one area (decisions about import prices) decide to find alternative means for corrupt activities.

A simple model following Yang (2008), presented in Appendix D, illustrates than an increase in the costs of evasion through one method may induce importers to switch to another method of evasion. Whether or not this happens depends on the relative costs of the two methods. If the relative costs vary by country, it may explain why country-specific patterns are not the same.

5.   The overall effect

So far our study has documented two opposing effects of WTO accession. We have argued that on the one hand taking away discretion of customs officials with respect to assessing prices of imported goods has resulted in lesser underreporting of prices.   On the other hand, we have found evidence consistent with greater evasion of import duties following entry into the WTO through underreporting of quantities (or outright smuggling) and product misclassification. But what is the overall effect?

To examine this question, we focus on the trade value gap, or discrepancy in total value of trade (i.e, price x quantity), as reported by the exporting country c and the importing country k pertaining to product p at time t. In other words, we ask whether "more trade goes missing" in higher tariff categories in the aftermath of the WTO accession. The summary statistics presented in Tables 15 and 16 suggest that this is the case. Table 15 indicates that the percentage of trade going missing is higher in the aftermath of the WTO accession (the gap increases from 3 to 10 percent). Table 16 shows a large and statistically significant difference between the amount of trade going missing in the high versus the low tariff products. More trade goes missing in the high tariff products both before and after the WTO accession.

Next we estimate our baseline specification from equation 2, but we replace the dependent variable with the trade value gap. The results, presented in Table 17, suggest worsening of tariff evasion in the aftermath of the WTO accession. Both coefficients of interest are positive and statistically significant at the one percent level. Their magnitudes are economically meaningful. Before the WTO accession, a ten percentage point increase in the tariff rate is associated with a 4.9 percent increase in the trade gap. After the accession, the response of the trade gap increases to 8.1 percent.

The results on individual countries in Table 18 suggest an increase in the semi-elasticity of the missing trade with respect to the tariff rate in 8 of 15 countries, with the coefficient of interest being statistically significant in 5 cases. Only in two countries, Ecuador and Latvia, we observe a positive and statistically significant semi-elasticity before the WTO entry, which decreases in magnitude after the WTO accession.

6. Conclusions

Our study focuses on displacement of illicit activities in the context of institutional reforms mandated by the WTO accession process. We argue that implementation of Article VII resulted in limiting discretion of customs officials in terms of assessing unit values of goods. While prior to the WTO accession, they were free to use minimum or reference prices, after their country joined the WTO they were mandated to accept the invoice issued by the exporter. This limited the scope for negotiation between importers and customs officials and the ability to misrepresent import prices. This institutional reform has thus effectively shut down one channel of import duty evasion. Dishonest importers have responded by more heavily relying on alternative evasion channels, such as undercounting quantities and product misclassification.

To formally test our hypotheses we use data on 15 countries which joined the WTO between 1996 and 2008. We calculate the discrepancy in the unit values of imports as reported by the exporter and the importer and find that there is a positive relationship between the tariff rate and misrepresentation of import prices prior to the accession. This relationship disappears after the country joins the WTO. However, at the same time we find that removing the opportunity to underreport prices has induced importers to underreport quantities. More specifically, we find that in the post-accession period there is a positive and statistically significant relationship between underreporting of import quantities and the tariff rates. Further, we find that the relationship between tariff on similar products and underreporting quantities becomes stronger after the accession. Thus our evidence is consistent with closing one avenue for tariff evasion leading importers to find alternative ways of avoiding duty payments.

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Table 1. Recent WTO members included in the analysis

Accession countries	Date of WTO accession
Albania	8 September 2000
Armenia	5 February 2003
China	11 December 2001
Cape Verde	23 July 2008
Ecuador	21 January 1996
Georgia	14 June 2000
Lithuania	31 May 2001
Latvia	10 February 1999
Moldova	26 July 2001
Macedonia	4 April 2003
Nepal	23 April 2004
Oman	9 November 2000
Saudi Arabia	11 December 2005
Ukraine	16 May 2008
Vietnam	11 January 2007

Table 2. List of recent WTO members not included in the analysis

Countries not included	Year of WTO accession	Trade data availability (comments)
Croatia	2000	2001-2009 (no trade figures available prior to accession)
Jordan	2000	2000-2007 (no trade figures available prior to accession)
Panama	1997	1997-2008 (no trade figures available prior to accession)
Estonia	1999	Uniform tariff (no variation in tariff rates)
Cambodia	2004	No tariff data
Kyrgyz Republic	1998	Large gaps in tariff data

Table 3: Summary statistics

	Mean	Median	Min	Max	No. observations
Tariff	10.676	10	0	220	293,512
Unit Value Gap	0.163	0.099	-5.021	4.860	293,512
Quantity Gap	-0.100	-0.101	-12.902	12.207	293,512
Trade Gap	0.063	-0.028	-10.307	13.203	293,512
WTO	0.477	0	0	1	293,512

Table 4: Summary statistics by WTO accession. Unit value gap

Sample	Before WTO accession (1)	After WTO accession (2)	Difference (1)-(2)
	Mean Unit Value Gap		
All importers	0.295 (153,534 obs.)	0.019 (139,978 obs.)	**0.276***

Table 5: Summary statistics by tariff rate and WTO accession. Unit value gap

Sample	Tariff above the median (1)	Tariff below the median (2)	Difference (1)-(2)
	Mean Unit Value Gap		
Before WTO accession	0.386 (50,455 obs.)	0.250 (103,079 obs.)	**0.136***
After WTO accession	0.017 (48,035 obs.)	0.020 (91,943 obs.)	-0.003

Table 6. Unit value gap in WTO accession countries

	(1)	(2)	(3)	(4)
	Unit value gap during the whole period			
Tariff	**0.0071*****	**0.0069*****	**0.0054*****	**0.0054*****
	[0.000]	[0.000]	[0.000]	[0.000]
Observations	293512	293512	293512	293512
Adjusted R-squared	0.044	0.047	0.117	0.120
	Unit value gap pre and post WTO accession			
Tariff	**0.0084*****	**0.0083*****	**0.0064*****	**0.0063*****
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**-0.0068*****	**-0.0073*****	**-0.0084*****	**-0.0088*****
	[0.000]	[0.000]	[0.000]	[0.000]
WTO	-0.0237***	-0.0177**	-0.0152*	-0.0104
	[0.009]	[0.009]	[0.008]	[0.008]
Observations	293512	293512	293512	293512
Adjusted R-squared	0.045	0.048	0.118	0.121
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. The specifications in the top panel mirror the bottom panel in terms of fixed effects. Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively

Table 7. Unit value gap pre- and post-WTO accession. Controlling for the effect of the average tariff

	(1)	(2)	(3)	(4)
Tariff	**0.0086*****	**0.0089*****	**0.0048*****	**0.0051*****
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**-0.0065*****	**-0.0071*****	**-0.0080*****	**-0.0085*****
	[0.001]	[0.001]	[0.001]	[0.001]
Average weighted tariff	0.0173***	0.0170***	0.0190***	0.0192***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x Avg weighted tariff	-0.0001***	-0.0001***	-0.0001***	-0.0001***
	[0.000]	[0.000]	[0.000]	[0.000]
WTO	-0.0073	-0.0014	0.0017	0.0064
	[0.009]	[0.009]	[0.009]	[0.009]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	293512	293512	293512	293512
Adjusted R-squared	0.047	0.050	0.120	0.123

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 8. Unit value gap pre- and post-WTO accession. Further robustness checks

	Controlling for			
	importer-year fixed effects		country-pair-year fixed effects	
	(1)	(2)	(3)	(4)
Tariff	**0.0050*****	**0.0026*****	**0.0092*****	**0.0080*****
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**-0.0013****	**-0.0046*****	**-0.0076*****	**-0.0090*****
	[0.001]	[0.001]	[0.000]	[0.000]
WTO			-0.1028***	-0.1032***
			[0.007]	[0.007]
6-digit HS product fixed effect	no	yes	no	yes
Exporter fixed effects	yes	yes	no	no
Observations	293512	293512	293512	293512
Adjusted R-squared	0.058	0.131	0.046	0.118

Notes: The dependent variable is the unit value gap as defined in equation 1 in the text. Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 9. Unit value gap pre- and post-WTO accession. Regressions on individual countries

	ALB	ARM	CHN	CPV	ECU	GEO	LTU	LVA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff	0.0049	**0.0138***	**0.0037***	0.0025	**0.0203***	**0.0694***	**0.0025****	**0.0057***
	[0.006]	[0.007]	[0.000]	[0.003]	[0.003]	[0.026]	[0.001]	[0.002]
Tariff x WTO	-0.0023	**-0.0230***	**-0.0032***	0.0050	**-0.0164***	**-0.0728***	-0.0130	0.0005
	[0.007]	[0.008]	[0.001]	[0.006]	[0.003]	[0.026]	[0.008]	[0.002]
Exporter FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5252	4795	86948	1160	30522	7427	16864	10947
Adjusted R-squared	0.027	0.006	0.072	0.078	0.022	0.005	0.034	0.036

	MDA	MKD	NPL	OMN	SAU	UKR	VNM
	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Tariff	**0.0148***	**0.0185****	-0.0030	0.0232	**-0.0150***	**0.0224***	**0.0058***
	[0.003]	[0.008]	[0.004]	[0.017]	[0.002]	[0.001]	[0.000]
Tariff x WTO	-0.0030	**-0.0142***	-0.0008	-0.0259	0.0120	-0.0014	-0.0004
	[0.004]	[0.008]	[0.006]	[0.018]	[0.017]	[0.004]	[0.001]
Exporter FE	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes
Observations	8129	11549	233	13862	46220	30973	18631
Adjusted R-squared	0.234	0.015	0.002	0.014	0.023	0.041	0.028

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 10: Summary statistics by WTO accession. Quantity gap

Sample	Before WTO accession	After WTO accession	Difference
	(1)	(2)	(1)-(2)
		Mean Quantity Gap	
All importers	-0.265	0.080	**-0.346***
	(153,534 obs.)	(139,978 obs.)	

Table 11: Summary statistics by tariff rate and WTO accession. Quantity gap

Sample	Tariff above the median	Tariff below the median	Difference
	(1)	(2)	(1)-(2)
		Mean Quantity Gap	
Before WTO accession	-0.148	-0.323	**0.175***
	(50,455 obs.)	(103,079 obs.)	
After WTO accession	0.229	0.003	**0.226***
	(48,035 obs.)	(91,943 obs.)	

Table 12. Quantity gap pre- and post-WTO accession

	(1)	(2)	(3)	(4)
Tariff	0.0007	**0.0011****	**-0.0019*****	**-0.0015*****
	[0.000]	[0.000]	[0.001]	[0.001]
Tariff x WTO	**0.0187*****	**0.0194*****	**0.0112*****	**0.0118*****
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.1096***	-0.1366***	-0.0624***	-0.0897***
	[0.016]	[0.016]	[0.016]	[0.016]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	293,512	293,512	293,512	293,512
Adjusted R-squared	0.030	0.035	0.109	0.114

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 13. Quantity gap pre- and post-WTO accession. Regressions on individual countries

	ALB	ARM	CHN	CPV	ECU	GEO	LTU	LVA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff	-0.0083	**0.0265***	**0.0050****	**-0.0124****	0.0002	-0.0383	**0.0125****	**0.0165****
	[0.011]	[0.014]	[0.001]	[0.004]	[0.005]	[0.040]	[0.002]	[0.003]
Tariff x WTO	**0.0228***	0.0265	**0.0280****	0.0070	0.0056	0.0419	**0.0711****	**-0.0121***
	[0.012]	[0.016]	[0.002]	[0.011]	[0.006]	[0.040]	[0.023]	[0.005]
Exporter FE	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Observations	5,252	4,795	86,948	1,160	30,522	7,427	16,864	10,947
Adjusted R-squared	0.026	0.020	0.067	0.015	0.011	0.029	0.038	0.019

	MDA	MKD	NPL	OMN	SAU	UKR	VNM	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Tariff	0.0050	**0.0381****	0.0016	-0.0233	**0.0155****	**0.0293****	**0.0053****	
	[0.006]	[0.013]	[0.006]	[0.042]	[0.004]	[0.002]	[0.001]	
Tariff x WTO	**0.0206****	-0.0055	0.0100	0.0006	**-0.0700***	**0.0273****	-0.0025	
	[0.007]	[0.014]	[0.014]	[0.043]	[0.034]	[0.008]	[0.003]	
Exporter FE	yes	yes	yes	yes	yes	yes	yes	
Year FE	yes	yes	yes	yes	yes	yes	yes	
Observations	8,129	11,549	233	13,862	46,220	30,973	18,631	
Adjusted R-squared	0.101	0.020	-0.014	0.012	0.008	0.053	0.022	

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 14: Misclassification and underreporting of quantities

	(1)	(2)	(3)	(4)
Tariff	**0.0043****	**0.0037****	**0.0033***	**0.0029***
	[0.002]	[0.002]	[0.002]	[0.002]
Tariff x WTO	**0.0286*****	**0.0290*****	**0.0279*****	**0.0284*****
	[0.003]	[0.003]	[0.003]	[0.003]
Tariff on similar products	**-0.0040****	**-0.0028**	**-0.0060*****	**-0.0051*****
	[0.002]	[0.002]	[0.002]	[0.002]
Tariff x Tariff on similar products	**-0.0114*****	**-0.0111*****	**-0.0194*****	**-0.0191*****
	[0.003]	[0.003]	[0.003]	[0.003]
WTO	-0.0996***	-0.1271***	-0.0453***	-0.0728***
	[0.016]	[0.016]	[0.016]	[0.016]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	293,512	293,512	293,512	293,512
Adjusted R-squared	0.030	0.035	0.109	0.115

Notes: The dependent variable is the quantity gap. Tariff on similar products is defined as the weighted average tariff on all products within the same 4-digit HS code. Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 15: Summary statistics by WTO accession. Trade gap

Sample	Before WTO accession	After WTO accession	Difference
	(1)	(2)	(1)-(2)
		Mean Trade Gap	
All importers	0.029	0.099	**0.070*****
	(153,534 obs.)	(139,978 obs.)	

Table 16: Summary statistics by tariff rate and WTO accession. Trade gap

Sample	Tariff above the median	Tariff below the median	Difference
	(1)	(2)	(1)-(2)
		Mean Trade Gap	
Before WTO accession	0.238	-0.073	**0.311*****
	(50,455 obs.)	(103,079 obs.)	
After WTO accession	0.246	0.023	**0.224*****
	(48,035 obs.)	(91,943 obs.)	

Table 17. Trade gap pre- and post-WTO accession

	(1)	(2)	(3)	(4)
Tariff	**0.0090*****	**0.0094*****	**0.0044*****	**0.0048*****
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**0.0119*****	**0.0120*****	**0.0028*****	**0.0030*****
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.1333***	-0.1543***	-0.0776***	-0.1001***
	[0.014]	[0.014]	[0.014]	[0.014]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	293512	293512	293512	293512
Adjusted R-squared	0.017	0.024	0.101	0.108

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table 18. Trade gap pre- and post-WTO accession. Regressions on individual countries

	ALB	ARM	CHN	CPV	ECU	GEO	LTU	LVA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff	-0.0034	**0.0403*****	**0.0087*****	**-0.0099****	**0.0205*****	0.0311	**0.0150*****	**0.0222*****
	[0.010]	[0.012]	[0.001]	[0.004]	[0.005]	[0.036]	[0.002]	[0.003]
Tariff x WTO	**0.0204***	0.0035	**0.0248*****	0.0120	**-0.0108****	-0.0309	**0.0581*****	**-0.0116*****
	[0.011]	[0.014]	[0.002]	[0.011]	[0.005]	[0.036]	[0.020]	[0.004]
Exporter FE	yes	yes	yes	yes	Yes	yes	yes	yes
Year FE	yes	yes	yes	yes	Yes	yes	yes	yes
Observations	5,252	4,795	86,948	1,160	30,522	7,427	16,864	10,947
Adjusted R-squared	0.018	0.025	0.025	0.051	0.007	0.035	0.028	0.011

	MDA	MKD	NPL	OMN	SAU	UKR	VNM	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Tariff	**0.0197*****	**0.0566*****	-0.0014	-0.0002	0.0005	**0.0517*****	**0.0111*****	
	[0.005]	[0.013]	[0.005]	[0.039]	[0.004]	[0.002]	[0.001]	
Tariff x WTO	**0.0177*****	-0.0197	0.0092	-0.0254	**-0.0580***	**0.0259*****	-0.0029	
	[0.006]	[0.013]	[0.016]	[0.040]	[0.032]	[0.008]	[0.003]	
Exporter FE	yes	yes	yes	yes	Yes	yes	yes	
Year FE	yes	yes	yes	yes	Yes	yes	yes	
Observations	8,129	11,549	233	13,862	46,220	30,973	18,631	
Adjusted R-squared	0.022	0.029	-0.009	0.017	0.008	0.081	0.022	

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Appendix A. Robustness Checks

Table A1. Unit value gap pre- and post-WTO accession. Including non-WTO members in the control group

	(1)	(2)	(3)	(4)
Tariff	**0.0089***	**0.0083***	**0.0051***	**0.0046***
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**-0.0073***	**-0.0073***	**-0.0100***	**-0.0099***
	[0.000]	[0.000]	[0.000]	[0.000]
WTO	-0.0842***	-0.0850***	-0.0707***	-0.0728***
	[0.008]	[0.008]	[0.007]	[0.007]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	459582	459582	459582	459582
Adjusted R-squared	0.043	0.048	0.105	0.110

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A2. Ecuador

	Unit value gap	Quantity gap	Trade gap
Tariff	**0.0191***	-0.0033	**0.0158***
	[0.003]	[0.004]	[0.004]
Tariff x WTO transition period	-0.0040	-0.0072	**-0.0113**
	[0.003]	[0.006]	[0.005]
Tariff x WTO post transition period	**-0.0190***	**0.0146***	-0.0044
	[0.003]	[0.005]	[0.004]
Exporter FE	yes	yes	yes
Year FE	yes	yes	yes
Observations	30,522	30,522	30,522
Adjusted R-squared	0.023	0.012	0.007

Test Tariff x WTO transition period= Tariff x WTO post transition period

p-value	0.000	0.000	0.068

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A3. Quantity gap pre- and post-WTO accession by unit of measurement

	(1)	(2)	(3)	(4)
	Quantities measured in kilograms			
Tariff	-0.0047***	-0.0040***	-0.0051***	-0.0046***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	0.0112***	0.0115***	0.0078***	0.0082***
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.0742***	-0.0942***	-0.0637***	-0.0826***
	[0.018]	[0.018]	[0.017]	[0.017]
Observations	234,514	234,514	234,514	234,514
Adjusted R-squared	0.029	0.033	0.105	0.110
	Quantities measured in terms of the number of items			
Tariff	0.0112***	0.0117***	0.0044***	0.0054***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	0.0248***	0.0260***	0.0056***	0.0073***
	[0.002]	[0.002]	[0.002]	[0.002]
WTO	-0.2000***	-0.2186***	-0.0166	-0.0376
	[0.045]	[0.045]	[0.043]	[0.043]
Observations	53,485	53,485	53,485	53,485
Adjusted R-squared	0.082	0.095	0.204	0.216
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A4. Unit value gap pre- and post-WTO accession by unit of measurement

	(1)	(2)	(3)	(4)
	Quantities measured in kilograms			
Tariff	**0.0114*****	**0.0113*****	**0.0084*****	**0.0084*****
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**-0.0050*****	**-0.0058*****	**-0.0075*****	**-0.0082*****
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.0283***	-0.0202**	-0.0159*	-0.0079
	[0.009]	[0.009]	[0.009]	[0.009]
Observations	234,514	234,514	234,514	234,514
Adjusted R-squared	0.055	0.060	0.114	0.119
	Quantities measured in terms of the number of items			
Tariff	**0.0036*****	**0.0033*****	**0.0027*****	**0.0022*****
	[0.000]	[0.000]	[0.001]	[0.001]
Tariff x WTO	**-0.0017**	**-0.0019***	**-0.0032*****	**-0.0034*****
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	0.0725***	0.0777***	0.0712***	0.0762***
	[0.025]	[0.025]	[0.024]	[0.024]
Observations	53,485	53,485	53,485	53,485
Adjusted R-squared	0.087	0.096	0.225	0.234
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A5. Non-differentiated products

	(1)	(2)	(3)	(4)
	Unit value gap			
Tariff	**0.0045***	**0.0044***	**0.0027***	**0.0027***
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	0.0009	0.0006	**-0.0013**	**-0.0016**
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.1022***	-0.0979***	-0.0923***	-0.0881***
	[0.011]	[0.011]	[0.011]	[0.011]
Observations	130,735	130,735	130,735	130,735
Adjusted R-squared	0.046	0.048	0.117	0.119
	Quantity gap			
Tariff	-0.0001	-0.0002	**-0.0018**	**-0.0020**
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**0.0084***	**0.0087***	**0.0072***	**0.0074***
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	0.0315	0.0237	0.0323	0.0247
	[0.025]	[0.025]	[0.024]	[0.024]
Observations	130,735	130,735	130,735	130,735
Adjusted R-squared	0.038	0.040	0.117	0.119
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Table A6: Misclassification. Trade gap

	(1)	(2)	(3)	(4)
Tariff	**0.0073***	**0.0072***	**0.0075***	**0.0075***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**0.0141***	**0.0143***	**0.0154***	**0.0155***
	[0.002]	[0.002]	[0.002]	[0.002]
Tariff on similar products	0.0001	0.0005	**-0.0054***	**-0.0050***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x Tariff on similar products	-0.0022	-0.0023	**-0.0131***	**-0.0132***
	[0.002]	[0.002]	[0.002]	[0.002]
WTO	-0.1984***	-0.1989***	-0.1347***	-0.1356***
	[0.012]	[0.012]	[0.012]	[0.012]
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes
Observations	392,614	392,614	392,614	392,614
Adjusted R-squared	0.018	0.025	0.094	0.102

Notes: The dependent variable is the trade gap. Tariff on similar products is defined as the weighted average tariff on all products within the same 4-digit HS code. Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

Appendix B. Impact of Non-tariff Measures

To shed light on the link between tariff evasion and quantitative restrictions, we use data on non-tariff measures implemented in China prior to its WTO accession. Detailed information on such measures can obtained from WITS for the year 2001.[24] We focus on three measures: quantitative restrictions on imports (quotas), licensing requirement and mandatory inspection. For each of these measures we create a dummy equal to one if any 8-digit products within a 6-digit HS code were subject to the measure, and zero otherwise. As shown in table below, we find no evidence of underreporting of quantities in products subject to quotas and licensing, which confirms our priors. Mandatory inspections do not seem to have a similar effect.

Underreporting of prices seems to be eliminated by mandatory inspections. At the same time, underreporting of prices is not affected by quotas or licensing, again confirming our priors.

Table B1. China. Non-tariff measures prior to WTO accession

| | Year 2001 | | | | | |
| | Unit value gap | | | Quantity gap | | |
	Quota	Inspection	License	Quota	Inspection	License
Tariff	**0.0112***	**0.0114***	**0.0104***	**0.0227***	**0.0237***	**0.0237***
	[0.002]	[0.002]	[0.002]	[0.004]	[0.004]	[0.004]
Tariff x NTB	-0.0066	**-0.0163***	-0.0024	**-0.0317***	-0.0086	**-0.0233***
	[0.005]	[0.004]	[0.004]	[0.009]	[0.008]	[0.008]
NTB dummy	-0.5445***	-0.0018	-0.7233***	1.5327***	0.2412	1.0587***
	[0.204]	[0.087]	[0.132]	[0.369]	[0.176]	[0.201]
Exporter FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Observations	6,122	6,122	6,122	6,122	6,122	6,122
Adjusted R-squared	0.036	0.035	0.045	0.034	0.031	0.035

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

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[24] Information for other years appears to be quite limited.

Appendix C. Controlling for Computerization

Table A6. Introduction of ASYCUDA

	(1)	(2)	(3)	(4)
	Unit value gap			
Tariff	**0.0084***	**0.0083***	**0.0063***	**0.0062***
	[0.000]	[0.000]	[0.000]	[0.000]
Tariff x WTO	**-0.0065***	**-0.0071***	**-0.0084***	**-0.0089***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x ASYCUDA	-0.0008	-0.0004	0.0013	**0.0018**
	[0.001]	[0.001]	[0.001]	[0.001]
WTO	-0.0283***	-0.0233***	-0.0173**	-0.0134
	[0.009]	[0.009]	[0.009]	[0.009]
ASYCUDA	0.0284**	0.0385***	0.0241*	0.0345***
	[0.013]	[0.013]	[0.013]	[0.013]
Observations	293,512	293,512	293,512	293,512
Adjusted R-squared	0.045	0.048	0.118	0.121
	Quantity gap			
Tariff	0.0006	**0.0011**	**-0.0015***	**-0.0010***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x WTO	**0.0188***	**0.0194***	**0.0129***	**0.0136***
	[0.001]	[0.001]	[0.001]	[0.001]
Tariff x ASYCUDA	0.0001	0.0005	**-0.0099***	**-0.0103***
	[0.001]	[0.002]	[0.002]	[0.002]
WTO	-0.1132***	-0.1381***	-0.0786***	-0.1044***
	[0.017]	[0.017]	[0.016]	[0.016]
ASYCUDA	0.0274	0.0140	0.0479**	0.0358
	[0.023]	[0.023]	[0.023]	[0.023]
Observations	293,512	293,512	293,512	293,512
Adjusted R-squared	0.030	0.035	0.109	0.114
Exporter fixed effect	yes	no	yes	no
Importer fixed effect	yes	no	yes	no
Country-pair fixed effect	no	yes	no	yes
6-digit HS product fixed effect	no	no	yes	yes
Year fixed effect	yes	yes	yes	yes

Notes: Heteroskedasticity-robust standard errors are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively.

In this appendix, we address the possibility that our findings are capturing computerization of customs services, which may have taken place around the time of the WTO accession. We do so by controlling for countries adopting the ASYCUDA system and examining whether the effect of the tariff rate changed in the post-adoption period.

ASYCUDA is a computerized customs management system which covers most foreign trade procedures. It handles manifests and customs declarations, accounting procedures, transit and suspense procedures. The software was developed by UNCTAD and is often offered to developing countries as part of an aid package, where it may be co-financed by international organizations such as the World Bank or the IMF. ASYCUDA takes into account the international codes and standards developed by ISO (International Organisation for Standardisation), WCO (World Customs Organization) and the United Nations. It can also be configured to suit the national characteristics of individual customs administrations. We collected information on the year of ASYCUDA adoption from the www.asycuda.org webpage, IMF documents, European Commission documents, and books.

Our baseline results are not affected by this augmentation to the model. We find that introduction of ASYCUDA lowers the responsiveness of the quantity gap to the tariff rate, as we would expect, but it does not have a similar effect on the unit value gap.

Appendix D. A Simple Framework

Here we present a simple framework following Yang (2008). A firm intending to import a fixed amount M chooses to misreport a fraction of imports δ in order to evade import duties. A firm may choose evasion through underreporting of prices or underreporting of quantities (smuggling). Both method require a fixed cost F and a variable cost c. The variable cost varies for the two evasion methods (it equals c_p for the former, and c_q for the latter method). The variable cost is convex in the square of the import value being underreported (δM), as authorities are likely to devote more effort to fighting large-scale underreporting, or perhaps because it is more difficult to hide evidence of large scale underreporting.

The importer's maximization problem is

The optimal rate of evasion is thus

The importer will choose the evasion method with a lower cost. Assume that initially, $c_p < c_q$ and hence import duties are evaded through underreporting of prices.

The WTO accession increases the cost of evasion through underreporting of prices from c_p to c_p^{wto}. The importer will switch to evasion through underreporting quantities if $c_p^{wto} > c_q$ and continue using the original method if $c_p^{wto} < c_q$.