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Abstract

While it is well-recognized that there are differences in the trade values reported by exporters and importers, a literature has emerged linking this trade gap to tariff evasion. These efforts, however, lack a structural theoretic underpinning and limit their product-level investigations to a small number of countries. Our first contribution is to provide a structural model of endogenous tariff evasion, one which then highlights the importance of both tariffs and border enforcement. Our second contribution is to use a global, product-level dataset from 2002-2019, the analysis of which is consistent with our model's predictions.

JEL-Codes: F130, F140, H260.

Keywords: tariff evasion, structural gravity, trade gap, border controls.

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1 Introduction

As any empirical researcher knows, all data have their idiosyncrasies. Trade data on exports and imports are no exception. One well-known feature of such data is that the reported volume of trade differs between the values reported by the exporting country and the importing country. While this "trade gap" can be partially explained by transport costs (which are included in the importer's valuation but not the exporter's) and noisy clerical errors, a body of literature has also linked them to tariff evasion. By understating the unit values and quantities reported to customs authorities – or circumventing the customs process altogether – traders can reduce their tariff liabilities. At the same time, this reduces the importer's official trade statistics relative to the exporter's value for the same shipment. Thus, as initially examined by Fisman and Wei (2004), the trade gap can result from tariff evasion. Subsequent papers, including Javorcik and Narciso (2008, 2017) and Kellenberg and Levinson (2019), have confirmed this pattern. Nevertheless, the literature to date lacks a theoretical model of endogenous tariff evasion to underpin its empirical investigations. Furthermore, when using disaggregated trade data, the existing studies involve at most a handful of countries. This then begs the question of the external validity of those results. In our current study, we aim to fill both of these voids.

For our first contribution, we develop a structural model of endogenous tariff evasion which arises from traders balancing reduced tariffs with evasion costs.[1] This contrasts with the model of Egger and Larch (2016) in which the extent of evasion is exogenous. We then use our model to derive the trade gap itself, measured as the logged difference between imports and exports. This indicates that the trade gap is a function not just of transport costs but also the extent of evasion which itself is a function of the tariff rate and the extent of border control enforcement. This last matter is generally omitted from the empirical analyses of the trade gap.[2]

Our second contribution stems from our dataset, which covers trade between 164 exporters and 172 importers at the six-digit product level from 2002-2019. This is far more extensive than existing work on product-level trade gaps. For example, the seminal article by Fisman and Wei (2004) used only exports from Hong Kong to China. Similarly, Javorcik and Narciso (2008) analyze data on trade between Germany and ten Eastern European nations, with a follow-up paper (Javorcik and Narciso, 2017) considering fifteen WTO accession countries. Other papers using product-level data include Rotunno and Vézina (2012), who use Chinese export and migration information to estimate the trade gap, and Bressan and Mattos (2022), who examine the link between non-tariff barriers and the trade gap for Brazil.

One benefit of using a small number of importers is that it then becomes feasible to gather detailed product-level value-added tax rates so that one can

[1] The flavour of this approach is comparable to Allingham and Sandmo's (1972) model of optimal tax evasion.

[2] An exception here is Kellenberg and Levinson (2019) who use information on accounting standards and corruption.

analyse both tariff and VAT evasion. Papers in this line include Fisman and Wei (2004), Levin and Widell (2014) who use Kenyan and Tanzanian imports, Yousefi and Vesal (2021) who focus on Iran, and Mengistu, Molla, and Mascagni (2022) who use Ethiopian data. We instead opted for a larger selection of countries but do not include VAT in our analysis. It is worth noting that Fisman and Wei (2004) indicate that when using only tariffs, their results are virtually identical to those using the tariff and VAT. Therefore, we hope that the country breadth of our choice outweighs the tax limitation. We should note in any case that Farhad, et al. (2018) and Kellenberg and Levinson (2019) use a global set of trading partners. That said, they use aggregate trade values rather than product-level information as per the rest of the literature (ourselves included).

Beyond the set of countries, our data expand on earlier work by using three proxies for border controls: the rule of law, whether or not a country has had a terrorist attack, and whether a product is "dual use", that is, it has both civilian and military uses.[3] These then give us measures of how well a country enforces its laws in a broad sense, how it may respond to short-run border security issues, and how these may be spread differently across products. Since we anticipate that all of these are positively related to the amount of border enforcement, we expect them to reduce tariff evasion and thus the trade gap.

Using our data and the regression specification arising from our model, we find a very strong and robust negative relationship between tariffs and the trade gap, a result which is consistent with evasion. Given our sizable dataset, we are able to explore various subsamples, finding that this result is robust across sectors and regions. As such, this provides an indication of the external validity of the existing, single-country studies. In fact, our baseline specification suggests that a one percent increase in the tariff lowers the trade gap by 0.02 percent, a magnitude very similar to the average effect found by Javorcik and Narciso (2008) for Eastern European trade with Germany. In addition, we find that the gap depends significantly on the distance between countries and a shared border, both of which are common transport cost proxies. Finally, we find a significant effect from our border control measures which suggests that stronger enforcement reduces evasion.

The rest of the paper proceeds as follows. Section 2 presents our model of trade in the presence of endogenous tariff evasion and develops our main hypotheses. Section 3 describes our empirical approach and data. Our estimates are found in Section 4 and Section 5 concludes.

2 A Structural Model of Tariff Evasion

Our model builds from the standard structural model of international trade with one addition – traders can choose to hide some of their business deals from

[3] Although we do not estimate the volume of trade, our use of terrorist attacks relates to Nitsch and Schumacher (2004), Fratianni and Kang (2006), and Egger and Gassebner (2015), all of whom find that terrorist attacks decrease aggregate trade volumes.

customs authorities. This is similar to the model of Egger and Larch (2016) except that we endogenize the amount of tariff evasion. We begin by describing tariff evasion and then show how this can be inserted into an otherwise standard structural model of trade with tariffs to solve for the trade gap.

When an exporter in country i exports a product k, it collects a "factory-door" free on board (fob) price p_{ik} per unit, a price which is the same across destinations. This is not, however, the price an importer in country j pays. First, regardless of whether the product is imported legally or illegally, the importer must cover iceberg shipping costs, denoted r_{ij}. If the unit is imported legally, the import is registered in the customs data and the importer pays an ad valorem tariff τ_{ijk}. Thus, the price from above-the-board imports are $(1+\tau_{ijk})\, r_{ij} p_{ik}$. In this, the cost, insurance and freight price (cif) is $r_{ij} p_{ik}$.

On the other hand, the importer can seek to evade the tariff. This can occur by understating the price and/or the quantity purchased, both of which reduce both the tariff liability and the official value of imports. Doing so, however, comes at a cost $v(s_{ijk}, b_{ijk}) \geq 1$ which, comparable to transport costs, is an iceberg cost. This cost can be thought of as the units lost when circumventing normal entry points, making them essentially additional transport costs, or as the expected penalty if caught evading tariffs. This evasion cost depends on two things. First, it is an increasing, convex cost of s_{ijk} which is the share of imports which are brought in via the black market. We assume that $v(0, b_{ijk}) = 1$ and $v_s(0, b_{ijk}) = 0$ so that when there is no tariff evasion, both the total and marginal cost of evasion are zero. We likewise assume that $v_s(1, b_{ijk}) = \infty$ or at least that complete evasion is sufficiently costly that it does not happen in equilibrium. Second, the evasion cost depends on the level of border enforcement, b_{ijk}. Note that this varies by exporter, importer, and product, with the intuition being that an importer's border officials may concentrate more on stopping evasion for some products from certain countries. Let $v_b(s_{ijk}, b_{ijk}) > 0$ so that as border controls increase, so does the cost of evasion. Also, let $v_{bs} \geq 0$, so that the marginal cost of increased evasion is increasing in border enforcement. Combining these, when importing via the black market, the importer pays $v(s_{ijk}, b_{ijk})\, r_{ij} p_{ik}$ per unit.

Given the quantity of imports q_{ijk}, the importer will seek to minimize total expenditures, that is, they will choose the share of black market imports to minimize:

$$((1-s_{ijk})(1+\tau_{ijk}) + s_{ijk} v(s_{ijk}, b_{ijk}))\, r_{ij} p_{ik} q_{ijk}. \tag{1}$$

Note that in this, we see that whether evasion occurs by reporting an artificially small p_{ik} or q_{ijk} the result is the same, i.e. it does not matter whether evasion happens in prices or quantities. Minimizing this yields an optimal share of black market imports, s^*_{ijk}, which is where:

$$v\left(s^*_{ijk}, b_{ijk}\right) - (1+\tau_{ijk}) + s^*_{ijk} v_s\left(s^*_{ijk}, b_{ijk}\right) = 0. \tag{2}$$

Note that since the marginal cost of evasion is zero at $s_{ijk} = 0$, evasion will occur whenever the tariff is positive.[4] Likewise, since the marginal cost of

[4]This then means that there is no evasion when $i = j$ since internal trade is not subject to

evasion becomes arbitrarily large as this share increases, legitimate trade is not fully replaced by the black market. Totally differentiating Equation 2, we see that:

$$\frac{ds^*_{ijk}}{d\tau_{ijk}} = \frac{1}{2v_s\left(s^*_{ijk}, b_{ijk}\right) + s^*_{ijk} v_{ss}\left(s^*_{ijk}, b_{ijk}\right)} > 0 \tag{3}$$

and

$$\frac{ds^*_{ijk}}{db_{ijk}} = -\frac{v_b\left(s^*_{ijk}, b_{ijk}\right) + s^*_{ijk} v_{sb}\left(s^*_{ijk}, b_{ijk}\right)}{2v_s\left(s^*_{ijk}, b_{ijk}\right) + s^*_{ijk} v_{ss}\left(s^*_{ijk}, b_{ijk}\right)} < 0 \tag{4}$$

meaning that as the tariff rises or border enforcement falls, a greater share of imports will arrive via the black market.

With this result in hand, we can define total average trade costs as:

$$t_{ijk} = \left(\left(1 - s^*_{ijk}\right)\left(1 + \tau_{ijk}\right) + s^*_{ijk} v\left(s^*_{ijk}, b_{ijk}\right)\right) r_{ij} \tag{5}$$

so that the average price importer i pays for product k from j is $t_{ijk} p_{ik}$.

Combining the above, when q_{ijk} is the quantity traded, the official fob value of trade reported by the exporter is $p_{ik} q_{ijk}$. The cif value of trade reported by the importer on the other hand is $\left(1 - s^*_{ijk}\right) r_{ij} p_{ik} q_{ijk}$, differing both because it includes transport costs r_{ij} and because trade is underreported by s^*_{ijk}.[5] Defining the trade gap as the log ratio of cif imports to fob exports, we find that:

$$g_{ijk}\left(r_{ijk}, \tau_{ijk}, b_{ijk}\right) = ln\left(r_{ij}\right) + ln\left(1 - s^*_{ijk}\right) \tag{6}$$

which is a function directly of transport costs and indirectly of border enforcement and tariffs since these influence the evasion share.[6] Note that when the tariff is zero, and therefore $s^*_{ijk} = 0$, the trade gap will be positive due to the transport costs borne by importers. As the tariff rises, this leads to illicit imports, making the final term negative. This can then lead to a negative trade gap despite the fact that importers incur transport costs on their legal imports. Using the results of Equations 3 and 4, this means that the trade gap should be increasing in transport costs and border enforcement but decreasing in the tariff. These are the three hypotheses we wish to take to the data.

Note that if the evasion share is constant, as in Egger and Larch (2012), then the trade gap would be invariant to the tariff and border enforcement as they only affect the trade gap indirectly via the evasion share. Furthermore, the trade gap is a function only of relative cif and fob prices, not the quantity traded. As such, features of trade models including national income and the multilateral

tariffs.

[5] Note that the cif value is gross of tariffs.

[6] Some studies define the trade gap as the log ratio of fob exports to cif imports. We do not do this for exposition as that requires a "double negative" on s^*_{ijk}.

resistance terms do not affect the trade gap even though they do affect quantity and therefore the reported values of trade. If one were to structurally estimate trade values, to incorporate evasion into the general framework provided by Yotov, et. al (2016) two modifications are needed. First, the evasion-inclusive trade cost in Equation 5 should be inserted as needed (including in the multilateral resistance terms). Second, as per Egger and Larch (2016) national income must account for net government revenues with government income arising from tariffs and, if desired, penalties paid by captured evaders. Government costs, meanwhile, could be made to depend on border enforcement, something that would be useful if the aim was to examine optimal border controls. Nevertheless, as our goal is not to consider total trade but rather the trade gap, we leave this exercise aside.

3 Empirical Approach and Data

In this section, we describe our empirical specification and data. Based on Equation 6, the trade gap is a function of both transport costs and the evasion share which is in turn a function of the tariff and border controls. Therefore we estimate:

$$Gap_{ijkt} = \beta_0 + \beta_1 Transport_{ijt} + \beta_2 Tariff_{ijkt} + \beta_3 Border_{ijkt} + \gamma_{ijkt} + \varepsilon_{ijkt} \quad (7)$$

where Gap_{ijkt} is the trade gap. This is expected to be increasing in $Transport_{ijt}$ which is a vector of trade cost measures, decreasing in the $Tariff_{ijkt}$, and increasing in a vector of proxies for $Border_{ijkt}$ controls. In addition, we control for γ_{ijkt}, a set of fixed effects described below (with country pair, ij, product k, and year t ultimately forming our preferred specification).[7] Finally, ε_{ijkt} is the error term which we cluster by country pair and product.[8]

3.1 Trade Gap

To construct our dependent variable, we use annual bilateral trade data at the six-digit HS2002 product-level taken from Comtrade.[9] Our time period runs from 2002-2019. Using these, for exporter i, importer j, product k, and year t, the trade gap is the logged difference between imports as reported by the importer (cif values) and exports as reported by the exporter (fob values).[10] Note that this measure is the opposite of the trade gap measure as defined by

[7]When we use the term country pair, we are specifically referring to a direction-specific pair of exporter and importer.

[8]Fisman and Wei (2004) and Yousefi and Vesal (2021) cluster at the four-digit, not six-digit, product level because of potential evasion arising by mislabelling products. We find similar results when doing likewise or when using alternative clustering groups. These are available on request.

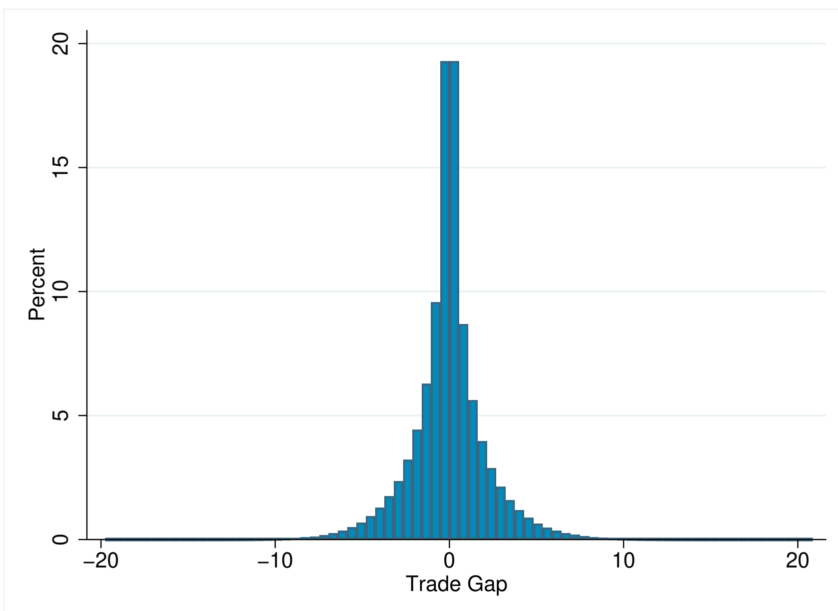
[9]These are found at https://comtrade.un.org/.

[10]Fisman and Wei (2004) also use the difference in trade values. Others, such as Javorcik and Narciso (2008, 2017) use the difference in unit values or quantities.

Javorcik and Narciso (2008, 2017) but is the same as Kellenberg and Levinson (2019). We use this formulation in order to match our model. This approach also implies that if there is no evasion and transport costs are positive, then the trade gap should be positive. If, however, the trade gap is negative, then this would be suggestive of tariff evasion. That said, evasion can still occur when the trade gap is positive since even as evasion lowers the reported value of imports, trade costs would increase them. Note that when exports and/or imports are missing or zero, this exporter-importer-year-product observation is dropped since we cannot take logs.

Figure 1 plots the distribution of the trade gap across all country pairs, products, and years. As it shows, the distribution is roughly normal with a mean value just below zero. This would be consistent with tariff evasion occurring on average.

Figure 1: Distribution of Trade Gap



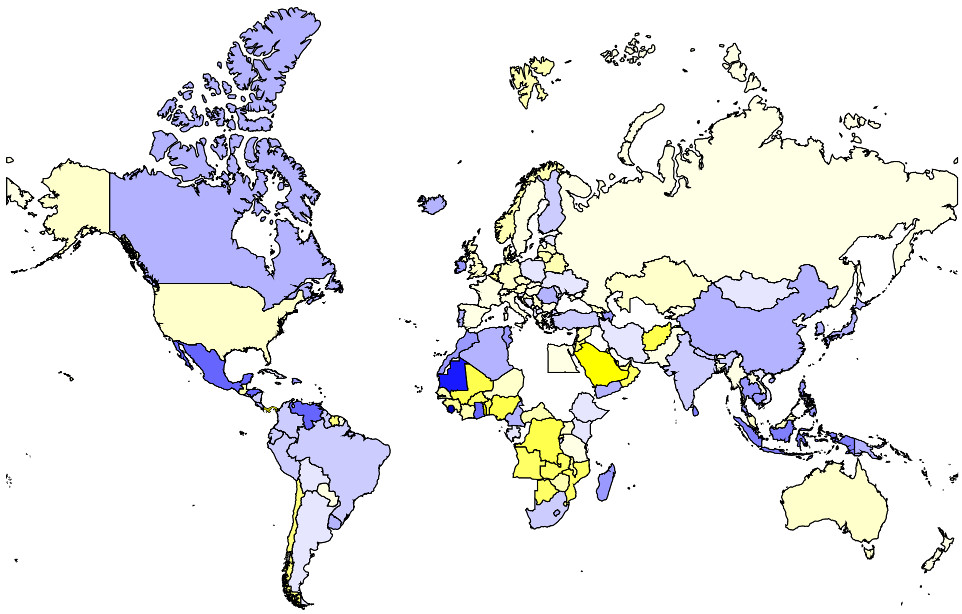
Source: Own calculations based on the Comtrade data.

In Figures 2 and 3, we illustrate the average trade gap for exporters and importers respectively.[11] In Figure 2, countries with negative average trade gaps are in yellow; those with positive average trade gaps are in blue. Further darker shading indicates a larger trade gap in absolute value. There is significant variation across exporters, with South America and Asia tending towards positive

[11] Although we offer a list of the exporters and importers on request, we refer readers to the maps to see which countries are in the sample.

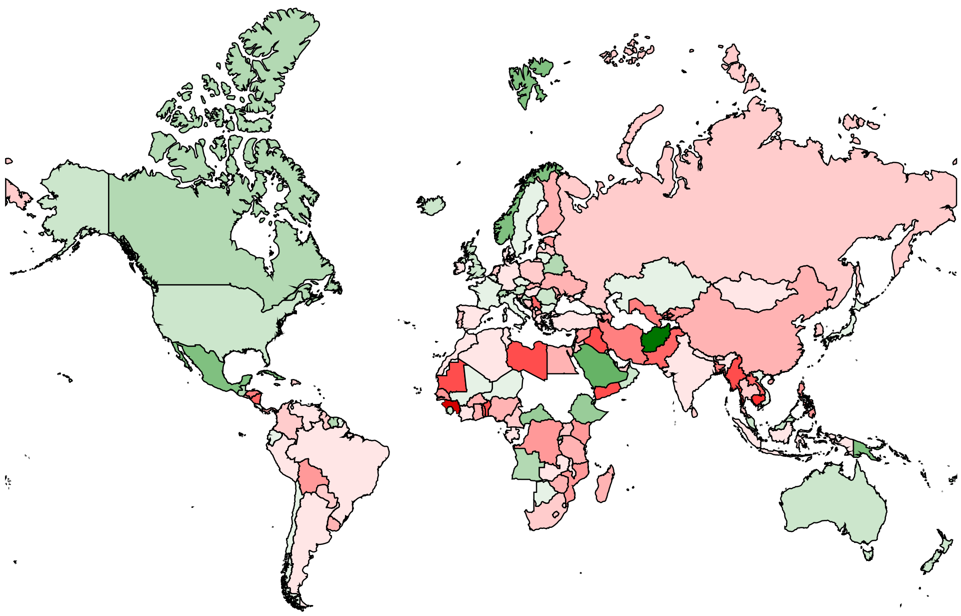
trade gaps. The OECD and Africa, on the other hand, tend towards negative trade gaps, with especially negative ones for Africa. Turning to Figure 3, we plot importers' average trade gaps with negative values in red and positive gaps in green. As before, darker shades indicate larger trade gaps in absolute value. Here too there is variation, but now we tend to see positive trade gaps in the OECD and negative trade gaps in the developing countries. This potentially suggests that tariff evasion is less common in OECD importers, perhaps because of their stronger border controls.

Figure 2: Average Trade Gap of Exporters



Countries with negative (positive) means are in yellow (blue) with darker shading indicating a more negative (positive) value. Source: Own calculations based on the Comtrade data.

Figure 3: Average Trade Gap of Importers



Countries with negative (positive) means are in red (green) with darker shading indicating a more negative (positive) value. Source: Own calculations based on the Comtrade data.

3.2 Transport Costs

For our transport cost measures, we use those common to the trade literature. These variables were all obtained from the CEPII database (Conte, Cotterlaz, and Mayer, 2022).[12] The first of them is the population-weighted logged distance between countries which we expect to have a positive coefficient since more distant trading partners incur higher transport costs. In addition, we include dummy variables which are equal to one if the countries are contiguous, share a common official language, and/or have ever been in a colonial relationship. Since these are often presumed to signal lower transport costs, we expect these to have negative coefficients. Other geographic factors such as whether a country is landlocked or an island are controlled for via fixed effects. Similarly, differences across products in the transport and insurance costs are controlled for by product fixed effects (Javorcik and Narciso, 2008).

A further trade cost measure we include is a dummy equal to one if there is a regional trade agreement (RTA) in force between two countries in a given year. Beyond RTAs lowering tariffs (which are controlled for separately), they may also reduce regulatory barriers between nations, thereby lowering trade costs.

[12] This can be found at http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=8.

As such, we expect that RTAs will be associated with smaller trade gaps, an expectation that mirror's Javorcik and Narciso's (2017) finding that the trade gap fell after a country joined the WTO. This variable comes from Egger and Larch (2008).[13]

3.3 Tariffs

Our tariff data come from the TRAINS database.[14] We converted these from HS1996 to HS2002 product codes. Note that in the raw data, tariffs are often missing. For the European Union, we repopulated the data by setting tariffs between members equal to zero and those on imports from non-members equal to the mode of the tariff reported by other member states.[15] Note that common internal and external tariffs are not universal across customs unions and we, therefore, did not do this for other agreements. In addition, if the tariff importer j imposes on product p from exporter i is missing in year t but is reported in the preceding or following year, then we repopulate the data with the minimum of those two values.[16] Following our model, we then control for the log of one plus the tariff where we expect a negative coefficient so that as the tariff increases, imports fall relative to exports and the trade gap moves into negative territories.

3.4 Border Controls

We employ three variables intended to capture enforcement at the border.[17] The first of these is the rule of law measure provided in the World Bank's World Governance Indicators.[18] These data, which are available by country-year, were normalized to run from zero to one, with one being the strongest rule of law. Overall, we anticipate that countries with stronger rules of law have stronger border controls and therefore expect a positive coefficient.

Second, we include a dummy variable indicating whether a country suffered a terrorist attack in a given year.[19] These data come from the Global Terrorism Database.[20] Operating under the assumption that countries who have experienced a terrorist attack monitor their borders more fiercely, something

[13] This can be found at `https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html`.

[14] These can be found at `https://databank.worldbank.org`.

[15] When there were multiple modes, we used the lowest value. We also did this for the EU agreement with Andorra and, for non-agricultural products, Türkiye.

[16] A similar approach was used by Javorcik and Narciso (2008).

[17] In unreported results, we tried further proxies for border enforcement, including the World Bank's Logistics Performance Index (`https://lpi.worldbank.org/international`) for the exporter-year and importer-year and the United Nations voting similarity index which operates at the country pair-year level (see Voeten, Strezhnev, Bailey (2009) for details on construction). These were not significant. One possible explanation is that the World Bank measure was only available for seven years and varied little over time so that the fixed effects potentially captured much of their explanatory power.

[18] See `https://databank.worldbank.org/source/worldwide-governance-indicators`.

[19] In unreported results, we instead used the number of attacks with similar results.

[20] See `https://www.start.umd.edu/gtd/`.

suggested by Fratianni and Kang (2006), we expect a positive coefficient for the importer. Similarly, we anticipate a positive coefficient when there is an attack in the exporter under the assumption that countries also scrutinize what is coming from a terror-ridden country.

Finally, we use a dummy variable indicating whether a product is dual, meaning that it has both civilian and military uses. While the dummy variable itself is captured by the product fixed effects, we interact it with other key variables anticipating that since such goods are already heavily monitored, the impact of tariffs and the other border measures will be muted. Our list of dual-use products comes from the European Commission.[21]

Table 1 provides summary statistics for all our variables.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade Gap$_{ijkt}$	41,799,922	-0.027	2.125	-19.765	20.864
Tariff$_{ijkt}$	41,799,922	0.555	1.016	0	8.517
Exporter Rule of Law$_{ijt}$	41,799,922	0.699	0.217	0	1
Importer Rule of Law$_{ijt}$	41,799,922	0.681	0.219	0	1
Exporter Terrorism$_{ijt}$	41,799,922	0.685	0.465	0	1
Importer Terrorism$_{ijt}$	41,799,922	0.603	0.489	0	1
RTA$_{ijt}$	41,799,922	0.698	0.459	0	1
Distance$_{ij}$	41,799,922	7.758	1.118	4.546	9.886
Contiguity$_{ij}$	41,799,922	0.157	0.364	0	1
Common Language$_{ij}$	41,799,922	0.164	0.370	0	1
Colony$_{ij}$	41,799,922	0.042	0.201	0	1
Dual Product$_k$	41,799,922	0.223	0.416	0	1
Year$_t$	41,799,922	2011.7	4.916	2002	2019

Summary statistics are for the sample in Table 2 column (1). The trade gap, tariff, and distance are in logs.

4 Results

In Table 2 we experiment with different fixed effects to establish our baseline specification. In column (1) we use exporter, importer, product, and year fixed effects. Column (2) instead uses exporter-year, importer-year, and product fixed effects. Note that this means we cannot estimate coefficients for the rule of law and terrorism variables which vary by country-year. Column (3) uses exporter-importer (direction-specific country pair), product, and year fixed effects. When doing so, RTA is the only transport cost measure for which we can estimate a coefficient. Finally, column (4) uses exporter-importer-year and product fixed

[21] This can be found at `https://circabc.europa.eu/ui/group/654251c7-f897-4098-afc3-6eb39477797e/library/db6cd5e6-6600-498e-a5bf-f1f4065dbab4?p=1&n=10&sort=modified_DESC`.

effects, meaning that only the tariff coefficient can be estimated. Note that by virtue of our estimation command (*reghdfe*) which drops observations when the constellation of fixed effects explains all the variation, the number of observations varies slightly across specifications.

Across all four columns, we find a significantly negative coefficient on the tariff as expected.[22] The magnitude of this effect points to a one percent increase in the tariff being associated with a 0.02 percent reduction in the trade gap. The size of this effect is fairly stable across the specifications, albeit slightly smaller when controlling for country-year fixed effects in the even-numbered columns. Comparing our result to Javorcik and Narciso (2008), we find that our estimate is essentially the average of their country-by-country results.

In columns (1) and (3), we see that the importer rule of law is significantly positive as anticipated. In terms of magnitude, a 10 percentage point increase in the rule of law index – roughly going from India to Italy for example – would be associated with a 0.19 percent increase in the trade gap. The exporter rule of law is however insignificant, suggesting that border enforcement is perhaps more important on the importing than the exporting side of the transaction. This also underlies the suggestion by Yotov, et al. (2016) to use import rather than export values when estimating trade volumes since importing officials may have a greater incentive to monitor imports due to the revenues tariffs generate. Both terrorism variables meanwhile are positive and strongly significant. This would be consistent with stronger efforts to monitor borders after an importer terrorist attack as well as those imports coming from countries suffering similar instabilities. For each, a terrorist attack increases the trade gap by just over 0.01 percent. Although small, this is roughly one-tenth the size of the above-noted improvement in the importer's rule of law.

Turning to our transport costs, the RTA variable is negative and significant when controlling for exporter and importer fixed effects. This is consistent with RTAs lowering trade costs beyond their tariff reductions. Although the coefficient is still negative when using pair fixed effects in column (3), the lack of time series variation leads to insignificance. For the other gravity transport cost controls, we find the anticipated sign in each case, although significance is only found for distance and contiguity (with the latter relatively weak).

With the above in mind, we proceed using column (3), with country pair, product, and year fixed effects, as our preferred specification. Results using the other options are available on request. As a final point, note that even when using country pair-year and product fixed effects our adjusted R-squared remains fairly small. This suggests that a large part of the variation in the trade gap is driven by noise such as administrative errors.

In Table 3, we make use of the product-level dual variable. To begin with, we split the sample between non-dual (column 1) and dual (column 2) products. Comparing the two, we find the estimates to be quite similar in terms of sign and significance with two exceptions. First, the exporter rule of law is now

[22] Recall that our trade gap is the ratio of imports to exports which is the opposite of Fisman and Wei (2004) and Javorcik and Narciso (2008, 2017). This is why our coefficient is negative while theirs is positive.

Table 2: Baseline results

	(1)	(2)	(3)	(4)
Tariff_{ijkt}	-0.0204***	-0.0165***	-0.0211***	-0.0189***
	(0.00488)	(0.00510)	(0.00405)	(0.00475)
Exporter Rule of Law_{it}	-0.00611		-0.0827	
	(0.0889)		(0.0849)	
Importer Rule of Law_{jt}	0.189**		0.185**	
	(0.0784)		(0.0776)	
Exporter Terrorist_{it}	0.0161***		0.0156***	
	(0.00454)		(0.00391)	
Importer Terrorist_{jt}	0.0137***		0.0120***	
	(0.00411)		(0.00356)	
RTA_{ijt}	-0.0911***	-0.103***	-0.0219	
	(0.0181)	(0.0194)	(0.0189)	
Distance_{ij}	0.117***	0.114***		
	(0.0127)	(0.0134)		
Contiguity_{ij}	-0.0531*	-0.0487*		
	(0.0283)	(0.0279)		
Common Language_{ij}	-0.00396	-0.00673		
	(0.0281)	(0.0279)		
Colony_{ij}	-0.00690	-0.0134		
	(0.0304)	(0.0302)		
Constant	-0.996***	-0.823***	-0.0865	-0.0166***
	(0.133)	(0.114)	(0.0834)	(0.00260)
Observations	41,799,922	41,799,911	41,799,019	41,786,042
Adjusted R-squared	0.032	0.035	0.053	0.060
Fixed Effects:				
Exporter	Y			
Importer	Y			
Product	Y	Y	Y	Y
Year	Y		Y	
Exporter-Year		Y		
Importer-Year		Y		
Pair			Y	
Pair-Year				Y

Dependent variable: $\ln(\text{imports}_{ijkt})$-$\ln(\text{exports}_{ijkt})$. Standard errors are clustered by country pair and product. *** p<0.01, ** p<0.05, * p<0.1.

negative and significant for dual products. This could be because exporters of products with potential military use are especially keen to monitor their exports, reducing potential underreporting. The second difference is that now, even with pair fixed effects, we obtain a significant negative sign on RTA for dual products. This could be due to special provisions in trade agreements facilitating trade in such goods.

The rest of the table returns to the full sample but interacts the dual variable with our other controls, building up the number of interactions across the columns. We do so to examine whether the point estimate differences between columns (1) and (2) are significant. Doing so suggests two significant differences. First, the net effect of the importer rule of law is half as large for dual products, potentially because such products are carefully monitored by all countries regardless of their rule of law. Second, as before, we find a significant coefficient for RTA only for dual products.

Table 4 splits our sample across several broad product groups (HS sections), including agricultural, mineral, and different manufactured products. Across the different subsamples, the coefficients are robust and similar to the baseline estimates in sign and significance. There are, however, some notable exceptions. In particular, we find a positive, significant coefficient for the tariff on vehicles. Other than that, however, the estimates generally suggest tariff evasion can be found across a range of products. In column (10), we specifically consider trade in guns, a commonly-traded dual product. There, the results are similar to those found in Table 3's column (2) where we use only dual products.

Our final two examinations of the data split the sample by region of the exporter (Table 5) or importer (Table 6). As with the product subsamples, the results are robust and on the whole similar to those from the full dataset. The exception to this is when considering only Oceania importers in Table 6's column (5), where the tariff is insignificant and the importer rule of law is negative. However, given that this subsample is much smaller than any of the others, we are hesitant to draw firm conclusions regarding this deviation.

Table 3: Dual products

Sample:	(1) Non-dual	(2) Dual	(3) All	(4) All	(5) All	(6) All
Tariff_{ijkt}	-0.0121***	-0.0428***	-0.0217***	-0.0221***	-0.0211***	-0.0192***
	(0.00401)	(0.00886)	(0.00433)	(0.00411)	(0.00405)	(0.00402)
Exporter Rule of Law_{it}	-0.0224	-0.300***	-0.0829	-0.0859	-0.0827	-0.0809
	(0.0883)	(0.105)	(0.0850)	(0.0853)	(0.0849)	(0.0853)
Importer Rule of Law_{jt}	0.193**	0.174**	0.186**	0.205***	0.185**	0.205***
	(0.0818)	(0.0827)	(0.0776)	(0.0782)	(0.0776)	(0.0782)
Exporter Terrorist_{it}	0.0143***	0.0205***	0.0157***	0.0157***	0.0156***	0.0157***
	(0.00411)	(0.00483)	(0.00391)	(0.00391)	(0.00391)	(0.00391)
Importer Terrorist_{jt}	0.0111***	0.0160***	0.0120***	0.0120***	0.0120***	0.0121***
	(0.00381)	(0.00387)	(0.00356)	(0.00356)	(0.00356)	(0.00356)
RTA_{ijt}	-0.00283	-0.0616***	-0.0217	-0.0218	-0.0219	-0.0111
	(0.0199)	(0.0202)	(0.0189)	(0.0189)	(0.0189)	(0.0192)
Tariff_{ijkt}*Dual_k			0.00488	0.00661		-0.00454
			(0.00807)	(0.00736)		(0.00747)
Ex. Rule of Law_{it}*Dual_k				0.0134		0.00744
				(0.0391)		(0.0394)
Im. Rule of Law_{jt}*Dual_k				-0.0872**		-0.0779**
				(0.0340)		(0.0341)
Ex. Terrorist_{it}*Dual_k						2.86e-05
						(4.36e-05)
Im. Terrorist_{jt}*Dual_k						2.78e-05
						(3.15e-05)
RTA_{ijt}*Dual_k						-0.0396***
						(0.0130)
Constant	-0.161*	0.139	-0.0868	-0.0871	-0.0865	-0.0937
	(0.0868)	(0.0938)	(0.0834)	(0.0834)	(0.0834)	(0.0834)
Observations	32,481,291	9,316,804	41,799,019	41,799,019	41,799,019	41,799,019
Adjusted R-squared	0.052	0.064	0.053	0.053	0.053	0.053

Dependent variable: $\ln(\text{imports}_{ijkt})$-$\ln(\text{exports}_{ijkt})$. Standard errors are clustered by country pair and product. *** p<0.01, ** p<0.05, * p<0.1. All specifications include country pair, year, product fixed effects.

Table 4: Sectors

Sample:	(1) Agriculture	(2) Minerals	(3) Chemicals	(4) Wood	(5) Textiles	(6) Metals	(7) Machinery	(8) Vehicles	(9) Optic	(10) Guns	(11) Other
Tariff_{ijkt}	-0.0155**	-0.0712***	-0.00119	-0.0459***	0.0141**	0.00432	-0.0507***	0.0382**	0.00795	0.115	-0.00218
	(0.00606)	(0.0264)	(0.00635)	(0.0119)	(0.00714)	(0.00722)	(0.00981)	(0.0172)	(0.0134)	(0.106)	(0.0105)
Exporter Rule of Law_{it}	-0.153	-0.547**	-0.0533	-0.350**	0.183	0.0370	-0.305***	-0.0723	0.0521	-0.0382	0.0629
	(0.105)	(0.239)	(0.0912)	(0.149)	(0.152)	(0.108)	(0.112)	(0.176)	(0.161)	(0.648)	(0.147)
Importer Rule of Law_{jt}	0.295***	0.112	0.248***	0.0830	0.0363	0.237***	0.178**	0.174	0.224*	-0.0332	0.304**
	(0.111)	(0.180)	(0.0767)	(0.117)	(0.140)	(0.0873)	(0.0898)	(0.141)	(0.117)	(0.615)	(0.126)
Exporter Terrorist_{it}	0.00515	-0.000234	0.0139***	0.0112	0.0190**	0.00783	0.0218***	0.0105	0.0289***	-0.0753*	0.0160*
	(0.00565)	(0.0108)	(0.00463)	(0.00714)	(0.00760)	(0.00508)	(0.00511)	(0.00881)	(0.00731)	(0.0373)	(0.00818)
Importer Terrorist_{jt}	0.0149***	0.00754	0.0117***	0.0129**	0.00740	0.0123***	0.0136***	-0.00107	0.0162***	0.0769**	0.0183***
	(0.00550)	(0.0109)	(0.00396)	(0.00634)	(0.00678)	(0.00448)	(0.00421)	(0.00699)	(0.00586)	(0.0319)	(0.00670)
RTA_{ijt}	-0.0252	-0.0666	-0.0216	-0.0798***	0.0800**	0.00777	-0.0438**	0.0274	0.00622	0.0976	-0.00981
	(0.0265)	(0.0415)	(0.0215)	(0.0288)	(0.0366)	(0.0210)	(0.0208)	(0.0354)	(0.0252)	(0.109)	(0.0318)
Constant	-0.0569	0.540***	-0.0949	0.352***	-0.414***	-0.189*	0.119	-0.210	-0.308**	-0.220	-0.354***
	(0.109)	(0.207)	(0.0846)	(0.131)	(0.145)	(0.102)	(0.100)	(0.156)	(0.143)	(0.420)	(0.134)
Observations	3,748,637	415,066	6,957,939	1,917,102	7,376,491	6,520,776	9,463,788	1,107,648	2,384,275	52,695	1,846,496
Adjusted R-squared	0.045	0.046	0.045	0.048	0.097	0.046	0.073	0.084	0.088	0.094	0.091

Dependent variable: $\ln(\text{imports}_{ijkt})$-$\ln(\text{exports}_{ijkt})$. Standard errors are clustered by country pair and product. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All specifications include country pair, year, product fixed effects.

Table 5: By exporter region

Sample:	(1) Africa	(2) Americas	(3) Asia	(4) Europe	(5) Oceania
Tariff_{ijkt}	-0.0374***	-0.0257***	-0.0212***	-0.0111*	-0.0245***
	(0.0109)	(0.00619)	(0.00591)	(0.00619)	(0.00933)
Exporter Rule of Law_{it}	-0.0357	-0.263*	-0.209	-0.0380	-0.735**
	(0.232)	(0.144)	(0.177)	(0.118)	(0.336)
Importer Rule of Law_{jt}	-0.110	0.398**	-0.0770	0.253**	-0.205
	(0.240)	(0.178)	(0.141)	(0.115)	(0.236)
Exporter Terrorist_{it}	0.0464**	0.0370***	0.0353***	0.00569	0.0448**
	(0.0190)	(0.0114)	(0.0119)	(0.00448)	(0.0190)
Importer Terrorist_{jt}	-0.0281	0.0323***	0.00458	0.0148***	0.00502
	(0.0178)	(0.0104)	(0.00939)	(0.00450)	(0.0183)
RTA_{ijt}	-0.0655	-0.139***	0.00764	0.0345	0.000163
	(0.0557)	(0.0503)	(0.0269)	(0.0296)	(0.0348)
Constant	-0.0520	0.0336	0.117	-0.227*	0.818***
	(0.190)	(0.138)	(0.145)	(0.132)	(0.287)
Observations	2,033,582	4,979,621	8,318,259	25,596,457	870,939
Adjusted R-squared	0.064	0.091	0.066	0.045	0.103

Dependent variable: $\ln(\text{imports}_{ijkt})$-$\ln(\text{exports}_{ijkt})$. Standard errors are clustered by country pair and product. *** p<0.01, ** p<0.05, * p<0.1. All specifications include country pair, year, product fixed effects.

Table 6: By importer region

Sample:	(1) Africa	(2) Americas	(3) Asia	(4) Europe	(5) Oceania
Tariff_{ijkt}	-0.0135*	-0.0161**	-0.0231***	-0.0136**	0.00251
	(0.00793)	(0.00636)	(0.00614)	(0.00682)	(0.0131)
Exporter Rule of Law_{it}	0.120	-0.764***	-0.351**	-0.0270	-0.440
	(0.205)	(0.156)	(0.140)	(0.140)	(0.346)
Importer Rule of Law_{jt}	-0.409	0.199	-0.123	0.283**	-0.440***
	(0.317)	(0.149)	(0.150)	(0.120)	(0.166)
Exporter Terrorist_{it}	0.000723	0.0248*	0.0542***	0.0111**	-0.0442***
	(0.0199)	(0.0133)	(0.0121)	(0.00457)	(0.0157)
Importer Terrorist_{jt}	-0.000343	0.0148*	0.0133*	0.0130***	-0.0194
	(0.0264)	(0.00756)	(0.00769)	(0.00466)	(0.0142)
RTA_{ijt}	-0.0610	-0.112**	-0.0169	0.0356**	0.0177
	(0.0626)	(0.0472)	(0.0317)	(0.0165)	(0.0322)
Constant	0.351	0.454***	0.313**	-0.303**	0.654*
	(0.217)	(0.140)	(0.127)	(0.144)	(0.336)
Observations	1,075,573	5,604,534	10,561,799	23,784,307	772,557
Adjusted R-squared	0.064	0.090	0.091	0.039	0.061

Dependent variable: ln(imports_{ijkt})-ln(exports_{ijkt}). Standard errors are clustered by country pair and product. *** p<0.01, ** p<0.05, * p<0.1. All specifications include country pair, year, product fixed effects.

5 Conclusion

Building from the long-standing recognition that trade values reported by exporters and importers differ, a growing literature has attempted to not only explain what drives those differences but to ascribe them to choices made by traders. Tariff evasion in particular has received the bulk of the attention. To date, however, this literature has generally lacked a solid theoretic foundation for its empirical specifications. Our first contribution is therefore to provide such a structural gravity model of trade. Doing so points to key roles for transport costs, tariffs, and border enforcement, the latter of which is often omitted from existing studies.

Our second contribution is to take these predictions to a product-level dataset that is significantly broader in country scope than what is used elsewhere. Our estimates confirm the existing literature's results for transport costs and tariffs, namely, that transport costs increase the value of imports relative to exports while tariffs reduce it. This suggests that the results from current studies have strong external validity. Beyond that, we find estimates suggesting that countries with a strong rule of law tend to have less evasion in their imports. Such a finding then provides support for improving the quality of governance, something which can be partially self-funding via increased tariff revenues. In addition, we find that terrorist attacks in either the exporter or the importer seem to lower the extent of evasion. While we by no means suggest encouraging such activity to reduce tariff evasion, it does point to the possibility for governments to make significant changes in evasion by increasing border scrutiny for both economic and public safety reasons.

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