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Revisiting the impact of per-unit duties on agricultural export prices

Dela-Dem Fiankor[1] | **Fabio G. Santeramo**[2,3,4]

[1]Economic Modelling and Policy Analysis, Agroscope, Tänikon, Switzerland

[2]Department Dafne, University of Foggia, Foggia, Italy

[3]Robert Schuman Center, European University Institute, Fiesole, Italy

[4]Institute of Economics and Rural Development, Lithuanian Centre for Social Sciences, Vilnius, Lithuania

Correspondence
Fabio G. Santeramo, Department DAFNE, University of Foggia, Foggia, Italy.
Email: fabio.santeramo@unifg.it

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Abstract

We replicate the findings of Emlinger and Guimbardr (ERAE, 2021) on the heterogeneous effects of per-unit tariffs on trade patterns for developed and developing countries. Analyzing import and export data from 2001 to 2013, they confirm the Alchian-Allen conjecture that per-unit trade costs induce higher export unit values. However, the effects are more pronounced for developed country exporters. Understanding the effects of per-unit trade costs *vis-a-vis* ad valorem tariffs is important to level the playing field of trade negotiations that involve pricing and non-pricing policies. We extend the original study with data for 191 exporting (190 importing) countries, and 670 HS6 digit products, covering the period 2001–2019 period. The general findings of the original study hold, with remarkable differences. First, using a data set that is constructed in a replicable way and introducing highly relevant bilateral fixed effects reduce effect sizes and the level of statistical significance. Second, the Alchian-Allen effect is not clearly separated by the economic development dimension of the exporter, but rather dependent on the price levels of the traded goods. These results have important policy implications as they call for deeper investigation of countries' industrial structures of exports to better shape the international debate on trade negotiations.

KEYWORDS
ad valorem, gravity, per-unit, replication, trade

JEL CLASSIFICATION
F13, Q17, Q18

One persistent empirical regularity in the trade literature is the observation that exporting firms charge different free-on-board (FOB) export prices for the same products they ship to various destinations (e.g., Martin, 2012; Manova and Zhang, 2012). For instance, Swiss HS8 product-level hard cheese (HS 04069099) exported by the same firm can yield FOB prices ranging from a low of 11 Swiss Francs (CHF) in Peru to a high of 16 CHF in South Korea (Fiankor, 2022). One mechanism that explains this systemic export price variation across destinations is a demand-driven composition effect known as the Alchian and Allen (1964) "shipping the good apples out" effect (Hummels & Skiba, 2004). It predicts that higher per-unit trade costs—for example, transport costs, or per-unit duties—tend to reduce the relative price of high-quality products vis à-vis lower-quality products subject to the same cost.[1] However, the export price variation induced by the Alchian-Allen (AA) effect can be driven by quality sorting, variable markups, or a combination of both mechanisms (Chen and Juvenal, 2022; Fiankor, 2022). Thus, evaluating potential gains from trade linked with this empirical regularity in trade data requires heterogeneous analyses of different dimensions. Our work revisits the AA conjecture in agriculture from an economic development perspective.

Evidence of the AA effect exists in agricultural trade. Using data on the EU-15, Curzi and Pacca (2015) show that the price and the quality of food exports are influenced differently by ad valorem and specific trade costs. While ad valorem tariffs have a negative impact on the quality of exported products, specific tariffs[2] induce higher export prices but tend to have no effect on quality upgrading.[3] Miljkovic and Gómez (2019) and Miljkovic, Gómez, Sharma, and Puerto (2019) examine the relative demand for quality-differentiated coffee varieties exported globally and confirm that a common per-unit charge increases the overall quality of coffee demanded.[4] Fiankor (2022) also provides supportive evidence that Swiss agri-food exporting firms increase their export prices when faced with a per-unit trade cost. We replicate and extend the evidence provided by Emlinger and Guimbard (2021), published in the European Review of Agricultural Economics. Emlinger and Guimbard (2021) is novel in providing evidence on the heterogeneous effects of per-unit trade costs—in their case, per-unit tariffs (referred to as "specific duties")—on trade patterns across developed and developing countries. They show that the Alchian-Allen conjecture is more pronounced for developed country exporters vis-à-vis their developing country counterparts. Per-unit tariffs induce higher export prices. This effect is more pronounced in developed countries.

Investigating the development perspective is relevant for the policy debate. Per-unit tariffs are more restrictive than their ad valorem counterparts when targeted against cheap exports, which are mainly from developing countries. For developing countries, transforming per-unit into ad valorem tariffs may help to increase participation in GVC and participation in high-value markets (*cfr*. Antimiani & Cernat, 2021).

Theoretically, our work is situated within advances in international trade theory that emphasize product quality differences as an additional source of comparative advantage (Crozet, Head, & Mayer, 2012; Hallak, 2006; Kugler & Verhoogen, 2012). This literature extends neoclassical trade models (e.g., Ricardian, Heckscher–Ohlin, Krugman) with vertical product differentiation as a driver of export performance. Insights from this literature show that product quality differences drive both the direction of trade and firm- and country-level export performance. Moreover, the empirical evidence suggests that successful exporters use higher-quality inputs and more skilled workers to produce higher-quality outputs that sell at higher prices. Yet, the role of product quality in driving trade in the agricultural sector remains an under-investigated and controversial topic (Martin, 2018; Fiankor et al., 2021). This is despite the fact that the influence of food safety and quality is pervasive in agriculture. Product quality affects not only firms' business strategies but also countries' trade policy interventions. For instance, trade measures, such as tariffs and non-tariff measures, tend to be levied on specific types of products (i.e., high-quality products) (Ghodsi & Stehrer, 2022), and therefore have heterogeneous impacts on the extent to which developing and developed countries participate in global markets. Whether these trade costs are per-unit or ad valorem determines how they affect trade patterns. Thus, how per-unit tariffs, ad valorem tariffs, and non-tariff measures affect the decision-making of agricultural firms in terms of the quality of exported products is a nascent but promising avenue to conduct policy-relevant research.

Our replication exercise proceeds as follows. First, we repeat the empirical investigation in Emlinger and Guimbard (2021) by running the authors' code on their original data. We call this the push-button replication. Second, we construct the original dataset following the description provided by the authors in the paper and reconduct the empirical analysis. We call this the pure replication. Third, we conduct several sensitivity analyses, twisting the econometric specification (i.e., using different sets of fixed effects and redefining clusters for the standard errors), estimating the model on random subsamples, and challenging the results with a misspecified model. Then we extend their analysis to recent years using two more waves of data. Finally, we comment in detail on the effects of the ad valorem duties to better place the contribution of the replicated paper into the economic debate.

The contribution of this replication exercise is at least twofold. First, we show that most of the results presented in Emlinger and Guimbard (2021) are valid. We confirm the Alchian-Allen effect. The additive nature of per-unit trade costs makes them a decreasing function of the price of the imports. Furthermore, the elasticity of export prices to per-unit tariffs is more pronounced for developed country exporters compared to developing country exporters subject to the same per-unit tariff. However, once we control for potential endogeneity of the import duties and export price relationship, this heterogeneity across the development level of the exporting country disappears, unless we consider products in the high and low price ranges. Second, we show that the validity of the AA effect along the economic development dimension and for ad valorem duties requires further research. Finally, we also conclude on the importance of linking the AA effect with topical issues in agricultural trade: falling transportation costs, increasing relevance of quality issues, the heterogeneous participation of developed and developing countries in GVCs, and the effects that trade policies have on their welfare gains.[5]

EMPIRICAL FRAMEWORK AND DATA

To assess how per-unit tariffs affect trade patterns, we follow Emlinger and Guimbard (2021) and estimate the following generic equation using ordinary least squares (OLS)[6]:

$$\ln Z_{ijkt} = \alpha \ln \text{Per} - \text{unit}_{ijkt} + \beta \ln \text{Ad} - \text{valorem}_{ijkt} + \mathbf{X}_{ijt} + \lambda_{ihs2t} + \lambda_{jt} + \lambda_{kt} + \epsilon_{ijkt} \quad (1)$$

where Z_{ijkt} is the bilateral export price (measured as unit values) of the product k exported by country i to country j at time t. Lacking objective measures of product quality, we follow a standard approach in the literature (Emlinger & Guimbard, 2021) and use prices as a measure of unobserved product quality. The assumption here is that, on average, higher-quality products are also sold at higher prices. The variables Per-unit and Ad-valorem are explanatory variables, standing, respectively, for the per-unit and ad valorem tariffs.[7] The export prices are proxied by the free-on-board (FOB) export values, calculated as the ratio of trade values in United States dollars (USD) and trade quantities in tons. $\boldsymbol{X}_{ijt}$ is a vector of bilateral time-varying and invariant variables, including geographical distance, contiguity, common language, and membership of a regional trade agreement. To proxy the theoretical multilateral resistance terms, the authors include exporter-HS2 product group-time (λ_{ihs2t}), importer-time (λ_{jt}), and product-time (λ_{kt}) fixed effects. ϵ_{ijkt} is the error term for which we cluster at the importer-exporter-product level.

Because we are interested in assessing how the elasticity varies across developed and developing countries, we estimate a second model as follows:

$$\begin{aligned} \ln Z_{ijkt} = {} & \alpha_1 \ln \text{Per} - \text{unit}_{ijkt} \times \text{Dvping}_i + \alpha_2 \ln \text{Per} - \text{unit}_{ijkt} \times \text{Dvped}_i + + \beta_1 \ln \text{Ad} - \text{valorem}_{ijkt} \\ & \times \text{Dvping}_i + \beta_2 \ln \text{Ad} - \text{valorem}_{ijkt} \times \text{Dvped}_i + \mathbf{X}_{ijt} + \lambda_{ihs2t} + \lambda_{jt} + \lambda_{kt} + \epsilon_{ijkt} \end{aligned} \quad (2)$$

where the variables in Equation (2) remain as defined in Equation (1). However, α_1 and α_2 capture the effect of per-unit tariffs on export prices if the exporter is a developing or developed country, respectively. β_1 and β_2 capture the effect of ad valorem duties on export prices if the exporter is a developing or developed country, respectively. To assess if the α_1 and α_2 estimates are statistically different from each other, we conduct a Wald test. The same is true for β_1 and β_2. We define developed and developing countries following the definition in the original paper. An exporter is classified as developing if its per capita Gross Domestic Product (GDP) falls within the first quartile of the per capita GDP distribution across all countries in 2013. All other exporting countries falling outside this quartile are classified as developed countries.[8]

It is possible that the per-unit and the ad valorem tariffs are endogenous to FOB export prices. This is true if bilateral FOB Export prices and customs duties are determined by common unobserved factors. A country with high domestic prices due to consumer preferences for quality may tend to protect it domestic market with per-unit tariffs to ward off cheap imports (Emlinger & Guimbard, 2021). These concerns are also legitimate in the case of ad valorem duties, since countries generally impose higher duties on expensive products to collect higher revenue. To address this potential source of endogeneity, we also estimate instrumental variable regressions. We adopt the instruments used in the original paper. To instrument per-unit tariffs, we use the share of product lines subject to per-unit tariffs in the HS4 sector of the HS6 product, while excluding the specific HS6 digit product under consideration from the share (IV: Per unit$_{ijkt}$). To instrument ad valorem duties, we use the average ad valorem duties in the HS4 sector of the product HS6, excluding the HS6 digit product itself (IV: Ad-valorem$_{ijkt}$).

The data we use for the analyses come from different secondary sources. The key data we require for the analyses are information on tariffs and trade data. For data on per-unit and ad valorem tariffs, we use data from the MAcMap-HS6 database maintained by the Centre d'Études Prospectives et d'Informations Internationales (CEPII) and the International Trade Center (ITC) See Guimbard, Jean, Mimouni, and Pichot (2012) for a description of the most recent version of the methodology used for its construction. This data set provides exhaustive and bilateral measurements of applied tariff duties at the product level, using the World Customs Organization's six-digit Harmonized System (HS) classification (hereafter HS6). We obtain data on trade values and quantities across country pairs from the BACI (Base pour l'Analyze du Commerce International) dataset maintained by CEPII. Data on the time-invariant gravity variables in vector $\boldsymbol{X}$ are from CEPII, and data on regional trade agreements are from Egger and Larch (2008). Summary statistics on the variables are presented in the Appendix S1.

REPLICATING EMLINGER AND GUIMBARD (2021)

Push-button replication

The first step of our analysis is to conduct what we call a "push-button" replication of the results presented in Emlinger and Guimbard (2021). This exercise is not trivial for at least three reasons. First, accessing the original data of a scientific paper implies transparency, clarity, and care. In our case, we received the original dataset used in the paper directly from the authors. Second, the codes and the scripts used for the analyses may contain errors, and typos, or they may simply be too personalized to be replicated by another researcher. Third, comparing the results presented in the paper with those obtained from a push-button replication process may reveal (potentially worrisome) biases in the presentation of the findings. As has been shown in several meta-analyses (Stanley, 2005; Doucouliagos and Stanley, 2013; Santeramo & Lamonaca, 2019), empirical findings tend to have two types of biases: type I bias due to over-report of findings that (i) do not contradict the existing theory and empirical evidence, (ii) do not contrast with the rationale of the paper; and (iii) are statistically and economically significant, type II bias consisting in more favorable outcomes in the publication process for papers presenting (i) thought-provoking results, (ii) results connected to the literature hosted in top journals, (iii) statistically solid results. These biases reinforce the need to promote replication studies.

Pure replication

The second step of our replication exercise involves repeating the analysis in Emlinger and Guimbard (2021) using a new script, code, and dataset. We begin by trying to reconstruct the original dataset, following closely the information provided by the authors in their paper. There were, however, some differences in our dataset compared to those from the original paper. Some of these discrepancies are worthy of note. First, is the total number of observations. Our reconstructed dataset includes information on a total sample of 3,428,594 observations, excluding zero trade values. This encompasses 187 exporting countries, 182 importing countries, and 670 HS6 digit products over the years 2001, 2004, 2007, 2010, and 2013.[9] A list of importing and exporting countries is provided in Supplementary Appendix Table A1. We also present summary statistics in Supplementary Appendix Table A2, which allows us to compare sample averages across the datasets.

Sensitivity analyses: clusters, sub-samples, and stringent fixed effects

The third step of our replication exercise, and in our view, the novel contribution to the scientific debate, involves subjecting the findings of Emlinger and Guimbard (2021) to a battery of sensitivity analyses. There are several potential sources of discretion in the empirical specification of the gravity model adopted by Emlinger and Guimbard (2021). Without prejudice, we ran alternate econometric specifications to verify the validity of their findings. The analyses in this subsection are based on the dataset generated in Section 2.2.

First, the authors cluster their standard errors by country pair and product. A general criticism against the clustering of standard errors is that the inclusion of fixed effects (a general norm in gravity-type models) eliminates the need to cluster standard errors (Arellano, 1987). Indeed, Abadie, Athey, Imbens, and Wooldridge (2020, 2022) argue that this is not necessarily the case, because the within-cluster correlations of residuals may not necessarily be eliminated by fixed effects. However, adopting a specific level of clustering for standard errors does not come without limitations. By defining the level of the specific clusters, the researcher assumes the level at which the variability is "naturally" bounded. In other terms, the cluster defines the boundaries within which the observations of a random variable are expected to be related. However, as pointed out by Abadie et al. (2022), "*because correlation may occur across more than one dimension [...]it (is) difficult to justify [...] clustering in some dimensions (rather than others)*". We relax the level of clustering by country pair and product and instead cluster them at the country pair level.[10]

A further exercise we undertake to validate the results presented in Emlinger and Guimbard (2021) is splitting the sample into four random subsamples. The rationale of this exercise is to verify the internal validity of the findings. This is confirmed if the estimates on subsampled observations do not contradict those obtained on the whole sample. This procedure, which is suggested in randomized controlled experiments (Athey & Imbens, 2017), allows us to conclude on the regularity of the estimates. We adopt an admittedly simple yet rigorous sub-sampling procedure. To preserve the structure of the panel data, we randomly assign importing and exporting countries into one of four subsamples. To avoid having heterogeneous samples in terms of the level of economic development of the countries, we impose an additional constraint of having, in all subsamples, both developed and developing countries.

We also test the robustness of the results using a more stringent econometric specification. We replace the vector of time-invariant country-pair variables (i.e., contiguity, language, and distance) in Equations (1) and (2) with country-pair-product fixed effects. The country-pair-product fixed effects are better measures of bilateral trade costs than the standard set of bilateral varying gravity variables. They are used in several papers (e.g., Vandenbussche & Zanardi, 2010; Grant, Arita, Emlinger, Johansson, & Xie, 2021; Fiankor et al., 2021) to account for much of the unobserved heterogeneity and isolate the effect of the independent variable of interest. In addition, we also define another specification that includes exporter-product-time (λ_{ikt}) and importer-product-time (λ_{jkt}) fixed effects. In both cases, these are more stringent specifications compared to the exporter-HS2 product group-time (λ_{ihs2t}), importer-time (λ_{jt}), and product-time (λ_{kt}) fixed effects used in Emlinger and Guimbard (2021).

Extending the dataset to recent years

Finally, we extend the dataset with two more waves of tariff data for the years 2016 and 2019. The extended dataset includes 191 exporting countries, 190 importing countries, and 670 HS6-digit agricultural products. Here we define the developed or developing country status using the per capita GDPs of the exporting country in 2019.

RESULTS AND DISCUSSION

Results

We begin by presenting the results from the baseline model in Equation (1). The results of the push-button replication are reported in column (1) of Tables 1–5. A few words suffice to describe our findings here. The replication was smooth and successful. We encountered no difficulties and can replicate the coefficients as reported in Emlinger and Guimbard (2021) using the data and Stata "do files" provided by the authors. Where necessary, we will highlight any discrepancies when we discuss the other results.

In column (2), we build the dataset as described by the authors in the original paper. We then estimate the baseline model on our dataset. To see how well our control variables behave vis-à-vis the results from the push-button replication, we compare all the coefficients in column (1) against those in column (2). In most cases, where the effects are statistically significant, the variables in both columns have the same signs. The exception is the RTA variable, where we find a negative effect on export prices, contrary to the positive effect reported in Emlinger and Guimbard (2021). We estimate a positive (and statistically significant) effect of per-unit tariffs on export prices and negative (but statistically insignificant) effects of ad valorem tariffs. The latter finding is contrary to Emlinger and Guimbard (2021). Before we take this as conclusive evidence, it is important to note that there are some differences in the datasets used for both estimations. Notice that the number of observations differs between columns (1) and (2).[11] Thus, the extent to which the differences in sample sizes drive the differences in our findings is not clear. However, it is also clear that using a dataset that is constructed in a replicable way leads to smaller estimates and lower levels of statistical significance (from 0.013, statistically significant at the 1% level, to 0.008 and to 0.003, statistically significant only at the 5% level).

Going forward, we base the extension and sensitivity analyses on our version of the original dataset and discuss mainly the coefficient on per-unit tariffs.[12] In columns (3)–(6), we subject our findings in column (2) to a series of sensitivity analyses. As a rule of thumb, the estimates are robust if different econometric specifications lead to similar results. In column (3), we relax the level at which the standard errors are clustered. In column (4), we drop the variable contiguity from the regression model.[13] In column (5), we introduce country-pair-product fixed effects to account for much of the unobserved heterogeneity and isolate the effect of the independent variable of interest. In column (6), we report coefficient estimates identified from a representative sub-sample.[14] In all four sensitivity analyses (columns 3–4), our main findings in column (2) are confirmed. However, the magnitudes are much lower in column (5) when we introduce country-pair-product fixed effects. Consistent with the literature that uses bilateral fixed effects (e.g., Fiankor et al., 2021), we find that their exclusion overstates the policy effect. In column (7), we extend the analysis to recent years. Here too, our main findings are in line with those reported for the first five waves of data.[15]

Next, we discuss the results from estimating Equation (2). This step allows us to assess how the effects we identify for per-unit tariffs vary across developed and developing countries. To see if the coefficients on the differences in the effects of our variables of interest across developed and developing countries are statistically significant, we conduct a Wald test and report the p-values at the lower panels of the Tables. For brevity, here and hereafter we report only the most relevant results and focus on the findings related to the per-unit tariffs, which are the focus of the replicated paper.[16] We present the results in Table 2. Our findings in column (2) are in line with those of Emlinger and Guimbard (2021) in column (1), though like before the magnitudes

TABLE 1 The effect of per-unit tariffs on trade unit values.

	Push button (1)	Own data (2)	Cluster (3)	Omitted variable (4)	Bilateral FE (5)	Sub-sample sample (6)	Extended data (7)
Per-unit$_{ijkt}$	0.013***	0.008***	0.008***	0.007***	0.003**	0.008***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ad-valorem$_{ijkt}$	0.018**	−0.007	−0.007	−0.007	−0.011	−0.026**	−0.006
	(0.007)	(0.008)	(0.008)	(0.008)	(0.013)	(0.013)	(0.007)
Distance$_{ij}$	0.090***	0.079***	0.079***	0.102***		0.079***	0.085***
	(0.001)	(0.001)	(0.001)	(0.001)		(0.002)	(0.001)
Contiguity$_{ij}$	−0.090***	−0.118***	−0.118***			−0.124***	−0.121***
	(0.003)	(0.003)	(0.003)			(0.005)	(0.003)
Language$_{ij}$	0.024***	0.020***	0.020***	0.004*		0.025***	0.016***
	(0.003)	(0.002)	(0.002)	(0.002)		(0.004)	(0.002)
RTA$_{ijt}$	0.011***	−0.055***	−0.055***	−0.053***	0.023***	−0.058***	−0.053***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.002)
Observations	1,855,975	2,408,092	2,408,092	2,408,092	2,038,191	599,806	3,428,577
R^2	0.682	0.578	0.578	0.578	0.816	0.589	0.578
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS

Note: The dependent variable is FOB export prices of product *k*, from exporting country *i* to importing country *j* in year *t*. Fixed effects included but not reported. Standard errors are in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. All models include exporter-HS2 product-time, importer-time, and HS6 product-time fixed effects. Column (1) contains the results of the push-button replication of Emlinger and Guimbard (2021). Columns (2)–(6) replicate the original analysis using data that we created from scratch closely following the descriptions provided in the original paper. Column (7) replicates the analysis but extends the data with two more waves in 2016 and 2019. In column (3), we estimate the baseline model but cluster the standard errors at the country-pair level. In all other cases, the standard errors are clustered at the country-pair product level. In column (4), we omit the contiguity variable. In column (5), we include country-pair-product fixed effects. In column (6) we estimate the baseline model on four sub-samples that retain the structure of the original dataset. We only report one of the subsamples here and relegate the rest to the Appendix S1. Per-unit$_{ijkt}$ and Ad-valorem$_{ijkt}$ stand, respectively, for per-unit tariffs and ad valorem tariffs. This table replicates column (1) of Table 1 in Emlinger and Guimbard (2021).

TABLE 2 The effect of per-unit tariffs on trade unit values across development status.

	Push button (1)	Own data (2)	Cluster (3)	Omitted variable (4)	Bilateral- FE (5)	Sub- sample (6)	Extended data (7)
Per-unit$_{ijkt}$	0.007***	0.003***	0.003***	0.003**	−0.001	0.001	0.000
× Dvping$_i^A$	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)
Per-unit$_{ijkt}$	0.013***	0.009***	0.009***	0.009***	0.004***	0.011***	0.012***
× Dvped$_i^B$	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ad-valorem$_{ijkt}$	−0.154***	−0.191***	−0.191***	−0.194***	−0.065*	−0.228***	−0.083***
× Dvping$_i^C$	(0.024)	(0.016)	(0.016)	(0.016)	(0.035)	(0.028)	(0.014)
Ad-valorem$_{ijkt}$	0.031***	0.031***	0.031***	0.032***	−0.001	0.016	0.010
× Dvped$_i^D$	(0.008)	(0.008)	(0.008)	(0.008)	(0.014)	(0.014)	(0.007)
Observations	1,855,975	2,408,092	2,408,092	2,408,092	2,038,191	599,806	3,428,577
R^2	0.682	0.579	0.579	0.578	0.816	0.589	0.578
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Prob > F (A = B)	0.004	0.000	0.000	0.000	0.179	0.004	0.000
Prob > F (C=D)	0.000	0.000	0.000	0.000	0.084	0.000	0.000

Note: The dependent variable is FOB export prices of product *k*, from exporting country *i* to importing country *j* in year *t*. Fixed effects included but not reported. Standard errors are in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. All models include exporter-HS2 product-time, importer-time, and HS6 product-time fixed effects. Columns 1–6: see note in Table 1. We only report one of the subsamples here and relegate the rest to the Appendix S1. Per-unit$_{ijkt}$ and Ad-valorem$_{ijkt}$ stand, respectively, for per-unit tariffs and ad valorem tariffs. Dvped$_i$ and Dvping$_i$ abbreviate, respectively, the words developed and developing countries. This table replicates column 2 of Table 1 in Emlinger and Guimbard (2021).

TABLE 3 The effect of per-unit tariffs on trade unit values across development status (IV regression).

	Push button (1)	**Own data (2)**	**Cluster (3)**	**Omitted variable (4)**	**Bilateral- FE (5)**	**Sub- sample (6)**	**Extended data (7)**
Per-unit$_{ijkt}$	0.014***	0.007***	0.007***	0.006***	−0.000	0.009***	−0.002
× Dvping$_i$^{A}	(0.003)	(0.002)	(0.002)	(0.002)	(0.009)	(0.003)	(0.002)
Per-unit$_{ijkt}$	0.015***	0.005***	0.005***	0.005***	0.003	0.007***	0.008***
× Dvped$_i$^{B}	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)
Ad-valorem$_{ijkt}$	−0.122***	−0.160***	−0.160***	−0.159***	−0.035	−0.164***	−0.051**
× Dvping$_i$^{C}	(0.028)	(0.024)	(0.024)	(0.024)	(0.117)	(0.049)	(0.020)
Ad-valorem$_{ijkt}$	0.066***	0.110***	0.110***	0.110***	0.011	0.104***	0.114***
× Dvped$_i$^{D}	(0.011)	(0.013)	(0.013)	(0.013)	(0.024)	(0.023)	(0.012)
Observations	1,855,975	2,408,092	2,408,092	2,408,092	2,038,191	599,806	3,428,577
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Prob > F (A = B)	0.542	0.414	0.414	0.441	0.077	0.716	0.000
Prob > F (C=D)	0.000	0.000	0.000	0.000	0.664	0.000	0.000

Note: The dependent variable is FOB export prices of product *k*, from exporting country *i* to importing country *j* in year *t*. Fixed effects are included but not reported. Standard errors are in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. All models include exporter-HS2 product-time, importer-time, and HS6 product-time fixed effects. Columns 1–6: See note in Table 1. We only report one of the subsamples here and relegate the rest to the Appendix S1. Per-unit$_{ijkt}$ and Ad-valorem$_{ijkt}$ stand, respectively, for per-unit tariffs and ad valorem tariffs. Dvped$_i$ and Dvping$_i$ abbreviate, respectively, the words developed and developing countries. This table replicates column 3 of Table 1 in Emlinger and Guimbard (2021).

TABLE 4 The effect of per-unit tariffs on trade unit values across development status for high-priced products.

	Push button (1)	Own data (2)	Cluster (3)	Omitted variable (4)	Bilateral- FE (5)	Sub- sample (6)	Extended data (7)
Per-unit$_{ijkt}$	0.024***	−0.007**	−0.007**	−0.007**	−0.005	−0.007**	−0.008***
× Dvping$_i^{A}$	(0.007)	(0.003)	(0.003)	(0.003)	(0.022)	(0.003)	(0.002)
Per-unit$_{ijkt}$	0.014***	0.004***	0.004***	0.004***	0.010	0.004***	0.003***
× Dvped$_i^{B}$	(0.002)	(0.001)	(0.001)	(0.001)	(0.008)	(0.001)	(0.001)
Ad-valorem$_{ijkt}$	0.066	0.151***	0.151***	0.152***	1.328	0.151***	0.044
× Dvping$_i^{C}$	(0.095)	(0.057)	(0.057)	(0.057)	(1.782)	(0.057)	(0.036)
Ad-valorem$_{ijkt}$	0.043***	0.023	0.023	0.023	0.021	0.023	0.018
× Dvped$_i^{D}$	(0.014)	(0.015)	(0.015)	(0.015)	(0.056)	(0.015)	(0.014)
Observations	180,095	464,621	464,621	464,621	244,354	464,621	656,552
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
A = B	0.160	0.000	0.001	0.001	0.386	0.000	0.002
C = D	0.806	0.024	0.024	0.022	0.462	0.024	0.489

Note: The dependent variable is FOB export prices of product *k*, from exporting country *i* to importing country *j* in year *t*. Fixed effects are included but not reported. Standard errors are in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. All models include exporter-HS2 product-time, importer-time, and HS6 product-time fixed effects. Columns 1–6: see note in Table 1. We only report one of the subsamples here and relegate the rest to the Appendix S1. Per-unit and Ad-valorem stand, respectively, for per-unit tariffs and ad valorem tariffs. Dvped and Dvping abbreviate, respectively, the words developed and developing. This table replicates column 4 of Table 1 in Emlinger and Guimbard (2021).

TABLE 5 The effect of per-unit tariffs on trade unit values across development status for low-priced products.

	Push button (1)	Own data (2)	Cluster (3)	Omitted variable (4)	Bilateral- FE (5)	Sub- sample (6)	Extended data (7)
Per-unit$_{ijkt}$	0.017	−0.005*	−0.005*	−0.005**	0.005	−0.003	−0.005*
× Dvping$_i$^{A}	(0.016)	(0.003)	(0.003)	(0.003)	(0.013)	(0.005)	(0.003)
Per-unit$_{ijkt}$	−0.016	0.001	0.001	0.001	0.011*	0.006*	0.002
× Dvped$_i$^{B}	(0.029)	(0.002)	(0.002)	(0.002)	(0.006)	(0.003)	(0.002)
Ad-valorem$_{ijkt}$	0.085	−0.130***	−0.130***	−0.133***	−0.150*	−0.167**	−0.050
× Dvping$_i$^{C}	(0.117)	(0.031)	(0.031)	(0.031)	(0.089)	(0.073)	(0.038)
Ad-valorem$_{ijkt}$	0.017	−0.005*	−0.005*	−0.005**	0.005	−0.003	−0.005*
× Dvped$_i$^{D}	(0.016)	(0.003)	(0.003)	(0.003)	(0.013)	(0.005)	(0.003)
Observations	2165	405,261	405,261	405,261	332,710	99,076	583,212
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Prob > F (A = B)	0.318	0.000	0.000	0.387	0.000	0.036	0.006
Prob > F (C=D)	0.248	0.024	0.022	0.463	0.024	0.000	0.000

Note: The dependent variable is FOB export prices of product *k*, from exporting country *i* to importing country *j* in year *t*. Fixed effects included but not reported. Standard errors are in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10%, respectively. All models include exporter-HS2 product-time, importer-time, and HS6 product-time fixed effects. Columns 1–6: see note in Table 1. We only report one of the subsamples here and relegate the rest to the Appendix S1. Per-unit and Ad-valorem stand, respectively, for per-unit tariffs and ad valorem tariffs. Dvped and Dvping abbreviate, respectively, the words developed and developing. This table replicates column 5 of Table 1 in Emlinger and Guimbard (2021).

differ. More precisely, we found that using a data set that is constructed in a replicable way and introducing highly relevant bilateral fixed effects reduce effect sizes and the level of statistical significance. The conclusion that the effect of per-unit tariffs on export prices is higher for developed country exporters compared to their developing country counterparts nevertheless remains the same across both papers. If we subject this finding to a host of sensitivity analyses in columns (3)–(6), we find that but for column (5), the main findings are confirmed. In extending our dataset to 2019, we confirm the main findings again in column (7). The Alchian-Allen effect is, however, no longer statistically significant for developing countries.[17]

To address potential endogeneity in our estimates, we estimate Equation (2) using two-stage least squares (2SLS) instead of OLS. The results are presented in Table 3. Column (1) replicates and reports the findings in Emlinger and Guimbard (2021). The findings in columns (2)–(7), which are based on our own dataset, confirm those in column (1). What is interesting here, however, is that the coefficients on the per-unit tariffs are no longer statistically significantly different between developing and developed countries. This contradicts the findings reported in Emlinger and Guimbard (2021). However, the Wald test of equality we perform in the push-button replication confirms that the findings reported by Emlinger and Guimbard (2021) are also not statistically different between developing and developed countries once we use the instrumental variable regressions.[18] Here again, before we take this contradiction as conclusive, we need to point out that we are only able to replicate the instrumental variables we use here by closely following the definitions provided in the paper.[19] Nevertheless, a look at the summary statistics presented in Supplementary Appendix Table A2 reveals that the sample means for the IVs for per-unit and ad valorem tariffs are close to those from Emlinger and Guimbard (2021). Our findings imply that once we control for endogeneity, the heterogeneity of the AA effect across developed and developing country exporters disappears.

In Table 4, we restrict the sample to observations with unit values in the upper decile of the distribution of the unit values. The original finding from Emlinger and Guimbard (2021) in column (1) shows that the effect of per-unit tariffs on developing countries' trade unit values is no longer significantly different from developed countries. Our replication and extension exercises, on the other hand, find that even at the high end of the unit value distribution, the magnitude of the Alchian-Allen effect is bigger for developed countries compared to developing countries. The differences here may also arise from an oversight we noticed in the original script by Emlinger and Guimbard (2021). When the authors analyze the effects for high and low-priced products, they only instrument the per-unit tariffs and not the ad valorem duties. In our replication, we instrument both tariff types.

In Table 5, we only consider product-country pairs with low range of unit values (with a standard deviation of unit values in the first decile of the distribution of standard deviation of unit values by product). Consistent with the findings in column (1), the effects are almost zero.

FURTHER SENSITIVITY ANALYSIS

The first analysis is on fixed effects. If we replace the set of fixed effects in Equations (1) and (2) with importer-product-time (i.e., λ_{jkt}) and exporter-product-time (i.e., λ_{ikt}) fixed effects, our general conclusions from this section remain largely the same. However, the magnitudes of the estimated coefficients on our variable of interest are larger compared to those reported in Emlinger and Guimbard (2021). We present the results in Supplementary Appendix Table A3. This finding and those reported in columns (5) of Tables 1–5, coupled with the fact that

Emlinger and Guimbard (2021) offer no justifications for their fixed effects, show that the choice of fixed effects used in the empirical analyses does matter for the results.

A second check is made by dropping a relevant variable. We employ the method developed by Oster (2019) to estimate the bias that arises from omitting relevant variables on both export prices and per-unit tariffs. This analysis allows us to "transparently reveal how susceptible results are to unobserved confounders" (Cinelli & Hazlett, 2020, p. 66). We omit an explanatory variable that matters for the analysis: the contiguity (i.e., border) variable. Apart from a purely statistical point of view, the choice of omitting the contiguity variable relies on the theory of gravity models (Anderson, 1979). Distance is generally explained by physical distance and by the contiguity of the trading partners (Cheng & Wall, 2005; Pfaffermayr, 2019), which are good proxies for trade costs (Beghin & Schweizer, 2021). Through the approach described by Oster (2019), we bound the bias that arises from omitting important controls by comparing uncontrolled and controlled regressions under a set of assumptions about the relationship between observable and unobservable selection. The results are presented in Supplementary Appendix Table A18. All point estimates are statistically significant at the 1% level, and the confidence intervals do not contain the value of zero.

A third analysis is made by using our version of the dataset used in the original paper. We reach conclusions similar to those in the original paper, but our findings, in terms of magnitudes, do not correspond one-to-one with those presented in Emlinger and Guimbard (2021). Since the sample sizes differ between the original study and ours, we consider it important to see if the findings from the original dataset provided by the authors survive the sensitivity analyses we conduct. Thus, we conduct another replication exercise and subject the original dataset from Emlinger and Guimbard (2021) to the various sensitivity analyses we propose in our paper. The results are presented in Supplementary Appendix Tables A4–A7.

Finally, while not a key part of our replication exercise—since we are more interested in the effects of tariffs on export prices—Emlinger and Guimbard (2021) also assessed the effect of per-unit and ad valorem tariffs on trade flows. We replicated this analysis using our version of their data and also extend the analysis with the years 2016 and 2019. We estimate Equations (1) and (2) and replace the dependent variable with trade quantities. Here again, there are differences in the total number of observations and magnitudes of the effects we estimate. However, the overall conclusion is the same as in the original paper. See Supplementary Appendix Tables A9–A10.

CHALLENGING THE GENERALIZATION OF THE ALCHIAN-ALLEN EFFECT

In the present section, we discuss the main contribution of the paper by Emlinger and Guimbard (Emlinger & Guimbard, 2021, Table 1), namely, the empirical validation of the Alchian-Allen (AA) effect. The AA effect postulates that a (equal) fixed-amount increase in the prices of substitutes increases the demand of the high-priced good to the detriment of the low-priced good, as the former becomes relatively cheaper with respect to the latter (Alchian & Allen, 1964). This applies to trade as well, where we tend to observe that, due to transportation costs, firms tend "*to ship high-quality goods abroad while holding lower-quality goods for domestic consumption*" (Hummels & Skiba, 2004). The rationale is simple (Figure 1). Consumers buy a bundle (x and y, which we assume as *numeraire*), which includes less quantity of the expensive good (say x_H), and more of the cheap good (x_L). A per-unit tariff (T) on the composite good

(x) makes it more expensive with respect to the numeraire and decreases the utility (the two shifts are denoted by *i*), due to an income effect. In addition to these changes, the consumer will find it more convenient to substitute the low-price good with the high-price good (substitution effect, denoted by *ii*), which will become relatively cheaper. Another intuitive explanation of the effects that a tax has on differently priced (substitutable) goods can be appreciated by the relationships of the price ratio of the two goods before and after the addition of a fixed tax ($\frac{P_H}{P_L} > \frac{P_H+T}{P_L+T}$), showing that any positive fixed tax applied to both decreases the price ratio, making the expensive good relatively cheaper.[20]

Emlinger and Guimbard (2021) show that (i) the effect of per-unit tariffs on export prices is positive and (ii) the effects are more pronounced for higher priced goods. Although the manuscript focuses on per-unit tariffs, the authors also present the findings for the ad valorem duties, for which the effects tend to be lower with respect to those observed for the per-unit tariffs and are expected to be lower than the effects of the per-unit, especially for the higher priced goods. The rationale is simple: per-unit tariffs are likely to be applied to goods that have higher unit value,[21] whereas the opposite is likely to be true for ad valorem duties.[22] In this latter situation, the changes in price have a marked income effect, shifting the budget line toward the origin. To better interpret and compare the coefficients on per-unit and ad valorem tariffs, we compute the effects of a 1% change in the customs duties on import prices by multiplying the marginal effects by the unit values (cf. Supplementary Appendix Table A2, panel b): the effects of a one percent increase in the per-unit tariff are about ten times bigger than a 1% increase in the ad valorem duty.[23]

The novelty in Emlinger and Guimbard (2021) is that they investigate the heterogeneity of the AA effect across the level of economic development of the exporting country. In the OLS models, our replication exercises find that the AA applies both for developing and developed countries (i.e., the coefficient of the per-unit duty is positive), as postulated by the theory.[24] However, once we account for endogeneity, any differences in the AA effect across income levels disappear. In short, while the AA effect is supported by (average) estimates, we cannot be conclusive on its heterogeneous effects along the economic development dimension.

Focusing briefly on the ad valorem duties, a null or negative effect on export prices would not be in contrast with the AA effect. This is because an ad valorem duty leaves unaltered the

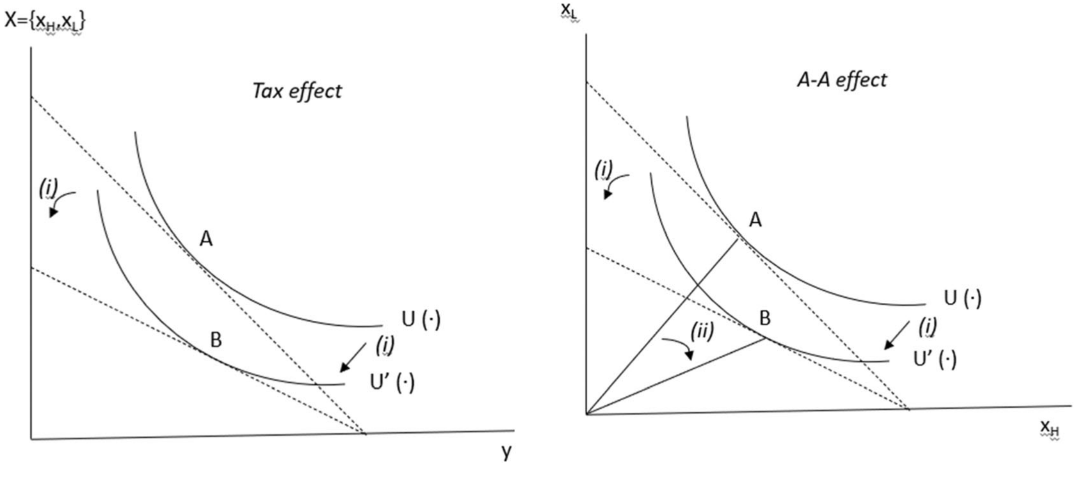

FIGURE 1 The rationale of the AA effect. Adapted from Saito (2008)

relative prices and increases the expenditure for the two goods. If separability in consumption holds and goods are normal, we should expect a decrease in consumption.[25] However, the direction of the effect remains an empirical question that deserves further attention; exporters can price-to-market, where they absorb part of the ad valorem charges and thus charge lower export prices. They may also pass on the costs of the ad valorem tariffs to consumers in the importing country as higher prices. This aspect deserves further investigation in future research and should also be related to the different trade regimes and pricing vis-a-vis non-pricing mechanism being adopted by developed and developing countries.[26]

Another puzzling result is related to the irregularities observed for low- and high-priced goods (columns 4 and 5, in Table 1 of Emlinger & Guimbard, 2021). We found that the coefficient of the per-unit duty is positive (as it should) for high-price goods (column 4) and for developed countries; the coefficient of the ad valorem duty is mixed and heterogeneous for developed and developing countries.[27]

We do not intend to undermine the value of the paper we have replicated, which clearly focuses on the impact of the per-unit component of tariffs and analyses heterogeneities across developed versus developing countries and high- and low-priced products. As the authors have stated in private correspondence, the effects on ad valorem and per-unit components of the tariffs should not be directly compared as the two components do not enter with the same unit, but are expressed, respectively, as a percentage of the value and as dollar per tons. As they claim, understanding whether the two effects are comparable is an open question that goes beyond the scope of their paper.

FINAL REMARKS

Replication of economic studies is a costly exercise in that posited data and software are often hard to be used by other researchers (Anderson & Kichkha, 2017). Despite the high costs, the replication of economic papers is an important activity to decrease the potential paucity that may be perceived in studies that do not have transparent and fully replicable accompanying data and codes (Hamermesh, 2007). It is also important to validate the findings and detect potential biases in the existing literature. However, these exercises are not exempt from threats in that the replication itself is subject to incentives that may lead to biases, such as the "overturn bias", where authors report false positives or claim mistakes in the original analysis without solid justifications (Galiani, Gertler, & Romero, 2017).

Our replication exercise consisted of several steps: we executed the authors' code on their original data (push-button replication), constructed the dataset following the information provided in the original paper, and repeated the analysis (pure replication). We found that using a data set that is constructed in a replicable way and introducing highly relevant bilateral fixed effects reduces effect sizes and the level of statistical significance. We also conduct several sensitivity analyses to test the sensitivity of the results in the original paper from several points of view (i.e., using different sets of fixed effects and levels of clusters for the standard errors, by estimating the model on subsamples, and using a misspecified model), and extend the original analysis with two more waves of data for 2016 and 2019. In many cases, we conclude that the finding that the Alchian-Allen effect is heterogeneous across developed country status of the exporter reported in Emlinger and Guimbard (2021) weakly holds: when we use a dataset that is replicable, and control for stringent fixed effects, the statistical and economic differences are negligible.

We found that the generalization of the Alchian–Allen effects along the economic development dimension is still not clear and leaves room for further research and should be coupled with more information on recent dynamics in global trade (e.g., declining transportation costs, rising attention to food quality, tariff escalation, and participation in the GVC).

Furthermore, once we control for endogeneity of the unit duties and export price relationship, the differences in estimated effects for per-unit and ad valorem tariffs are evident only for the high-priced products. Future research should focus on exploring the heterogeneity along the price dimension, with rich and informative dataset, such as firm-level datasets. Likewise, our analysis points to the need for policymakers to gain insights on the differential effects that per-unit and ad valorem tairffs may exert across industries. For instance, our results are informative to feed the debate on how to shape tariffs to increase the participation of LDCs into the GVC. Antimiani and Cernat (2021, p.700) suggests to "*offer dutyfree access to LDC value-added that 'travels' inside finished products exported by all other WTO members*". To the extent that upstream and downstream produce are priced differently, bringing the price dimension into the debate on reforming trade policies to facilitate participation in the GVCs would be an important addition.

A few words of caution are needed. This empirical exercise is not itself exempt from limitations[28] and should be taken as an exercise to set boundaries on what we may learn from the paper by Emlinger and Guimbard (2021) and what still deserves investigation. More specifically, while we have asserted that the AA effect holds, our warning sentences on difficulties in finding heterogeneous effects along the economic development dimensions do not need to be generalized to the point of concluding that the AA does not hold in these cases. Instead, we encourage further investigation into this promising area of research. Finally, it remains to be seen whether the higher AA effect for developed country exporters is driven by their ability to produce higher-quality products or their ability to vary their markups. Recent firm-level analyses in this literature have tried to disentangle the markup and quality elements (Chen and Juvenal, 2022; Fiankor, 2022) and found, for instance, that the markup components are lower for high-quality products. It will be an important future contribution to assess if these conclusions are also heterogeneous across the development status of the exporting country. These aspects are particularly relevant in a GVC context, which poses new challenges to the understanding of the global trade regime.

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ENDNOTES

[1] To understand the mechanism, consider a competitive sector in country i that exports two quality grades (q) of the same product k. Let $q = H, L$ for high- and low-quality grades of k, respectively. If prices at the destination j depend on prices at i (piH, pi L), and a per-unit charge, t_j, such that $p_{jk} = p_{ik} + t_j$. Supposing there is no loss in quality due to transport, and consumers in the destination perceive H and L as two grades of the same good, the Alchian and Allentheorem conjecture is that an increase in t_j will lower the relative price of, and raise the relative demand for, high-priced (quality) goods.

[2] In some papers, the terms "specific duties", "per-unit duties" and "per-unit tariffs," may be used interchangeably. For sake of clarity, we prefer to use the term "per-unit tariffs".

[3] Curzi and Pacca (2015) argue against using price as a measure of product quality. In their work, they recover quality directly from trade data, following Khandelwahl, Schot & Wei (2013). This allows them to conclude separately on the effects of trade costs on prices and quality.

[4] The authors define coffee quality as follows: Colombian Arabica (high-quality), Brazilian Arabica (medium-quality), and Brazilian Robusta (low-quality).

[5] The decline in transportation costs and the increasing attention to food quality call for a better understanding of the role of the duties in those high-quality products (which are mainly produced by developed countries), tend to be both highly priced and highly protected, implying ambiguous and dynamic effects on trade (Hummels, 2007). Tariff escalation and participation in GVCs are also aspects that deserve further investigation: upstream and high-priced products are more protected in developed countries, and this may, in turn, explain (with a reserve causality logic) the positive correlation of ad valorem duties and exports (Cheng, 2007; Ghodsi & Stehrer, 2022).

[6] Due to the host of fixed effects and the large number of observations, we estimate all the models (IV and OLS) using the standard least squares dummy variable estimator. We use the user-written command Reghdfe in Stata (Correia, 2017), as reported in Supplementary Appendix Table A8.

[7] The tariff variables are transformed into log form as $\text{Log}\,(1 + \text{Tariff})$

[8] In the published version of the manuscript, reference is made to the GDP per capita in 2003. We assume this is a typo as the authors do not use data from 2003 in their analysis.

[9] Over the same time period, the dataset in Emlinger and Guimbard (2021) covers 185 importing countries, 196 exporting countries, and 677 HS6 digit agricultural products.

[10] Excessively restrictive clusters may lead to excessively small standard errors and possibly to severely inflated standard errors (Athey and Imbens, 2022), resulting in statistically non-significant coefficients. We believe that the country-pair level is a sufficient clusterization. In any case, as the reader will note, this robustness check does not affect the results at all.

[11] It is not clear where this discrepancy arises from, especially given that in Section 2.2, we show that the total number of importers and products is slightly higher in the original dataset compared to the version we recreate.

[12] For completeness, we also conducted the robustness checks on the original dataset but relegated the results to Supplementary Appendix Table A11–A14, column 1.

[13] As it is evident from columns (2) and (3), the contiguity variable is always statistically significant (at the 1% significance level), and the estimates are more than ten times larger than the estimated standard errors. Thus, we expect the omission of this relevant variable to alter the results.

[14] Here, we only report the results of one sub-sample and relegate the results for the other sub-samples in Supplementary Appendix Tables A19 and A20.

[15] For completeness, we also conducted the four different sensitivity analyses on the extended dataset. We present the results in Supplementary Appendix A5.

[16] We present the full results table with all the variables in Supplementary Appendix A4.

[17] We are grateful to the authors of the replicated papers for having pointed out that while the BACI, TUV, and Geodist raw are available until 2019, the updated version of BACI and TUV has been slightly modified from the one used in the replicated paper in that the procedure of CIF conversion and the data cleaning use the whole period each time as a benchmark. Moreover, the MacMap dataset has been updated as well.

[18] Even if the effects for developed and developing countries in Emlinger and Guimbard (2021) are statistically different from each other, the magnitudes of 0.014 and 0.015 are very close to each other. A potential problem associated with IV estimations is the so-called "generated regressor" problem, consisting of the over-rejection of null hypotheses and finding statistical significance more often than it should (Croissant & Millo, 2018). The lack of statistical significance when we use IVs signal there is not such a caveat in our study.

[19] We acknowledge the authors who were kind enough to share the script used for the creation of the IV in SAS. Having no access to SAS, we replicated the process in Stata.

[20] This intuition is also discussed in Emlinger and Lamani (2020).

[21] Exception, of course, exists. For instance, Switzerland relies almost exclusively on per-unit tariffs.

[22] Our estimates include product-fixed effects that address this issue, unless differences in the unit values of the same product/good across different countries result in different choices regarding per-unit and ad valorem tariffs across the countries. This has not been investigated and is left for future research. We gratefully acknowledge an anonymous reviewer for pointing this out.

[23] We gratefully acknowledge the comment, raised by the anonymous reviewer, on the importance of making comparable the effects of the ad valorem and the per-unit tariffs. Since we have a log–log model, the coefficients are directly interpreted as elasticities.

[24] In a private correspondence, the authors of the paper argued that the AA effect seems stronger for developed exporters due to a composition effect exactly because it is found stronger for per-unit tariffs applied on high-priced products. We believe this is a valid statement that deserves further investigation.

[25] Despite this logical explanation, it needs to be pointed out that Curzi, Raimondi, and Olper (2015) found a negative coefficient of ad valorem duties on unit values in European trade. Further research is needed.

[26] The evidence on the different trade regimes applied by developed and developing countries in the agri-food sector is vast and growing (e.g. Beghin & Schweizer, 2021; Santeramo & Lamonaca, 2022). We believe that focusing on the heterogeneous effects of ad valorem and per-unit tariffs is a promising area of research.

[27] Notably, for Developing countries, the coefficient of the per-unit duty is positive (as it should be) for high-priced goods and not statistically significant for low-priced goods. Thus, there is no a violation of the AA effect.

[28] For instance, we have not included other pricing and non-pricing mechanisms (e.g. quota, NTMs, etc.), as suggested by a reviewer, nor have we investigated the political economy of trade regimes in developing and developed countries. Our exercise has to be interpreted as a descriptive analysis of the average effects of the per-unit and ad valorem tariffs in the agri-food sector. Needless to say, this contribution is per se a good addition to the extant empirical literature.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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