

**APPENDIX FOR ONLINE PUBLICATION**  
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**for “Do Value-Added Taxes Affect International Trade Flows?**  
**Evidence from 30 Years of Tax Reforms”**

SAMPLE SELECTION AND CONSTRUCTION

**DATA AGGREGATION.** — We run our estimation on data that is aggregated either at the partner or at the product category level. We do this in order to reduce noise (some bilateral flows are very infrequent and small), and also because the disaggregated data is very large. In order to aggregate at the partner level, we simply add flows to/from multiple partner countries into one observation. In order to aggregate at the commodity level, we categorize commodities into groups that are subject to the same type of VAT rate and then collapse the data by the VAT type. Practically, we categorize all commodities into seven groups that are subject to the same VAT rate: commodities subject to the standard VAT rate, food (subject to the reduced VAT rate), pharmaceuticals (often subject to a super-reduced VAT rate), books, newspapers, agricultural goods, and works of art, all of which can be subject to reduced rates. We then aggregate our data at this seven-product categories level.

**HS COMMODITY CATEGORIES.** — The Harmonized Commodity Description and Coding System, often referred to as the Harmonized System (HS), is an international nomenclature for the classification of products, which has been adopted by most countries in the world. It allows countries to categorize their commodities into a unified system, making tracking them (and taxing them) easier across borders. Detailed descriptions and categories of this nomenclature can be found on the United Nations Trade Statistics website.<sup>19</sup>

The HS nomenclature is a six-digit code system that contains approximately 5,300 six-digit categories. The first two digits (HS2) classify a broad category (also called chapter), the next two digits are narrower and the final two digits are even more detailed. For example, the HS6 number for Green tea is 09.02.10, where the HS2 category 09 refers to “coffee, tea, mate and spices”, and the HS4 category 09.02 refers to “tea, whether or not flavored”. There are 96 HS2 categories. The full list of categories can be downloaded from the the United Nations Trade Statistics website.<sup>20</sup> In this paper we use HS4 categories.

**NARRATIVE APPROACH.** — The narrative approach consists of analyzing the historical context of each of the VAT changes using either official documents or press

<sup>19</sup>Link: <https://unstats.un.org/unsd/tradekb/Knowledgebase/50018/Harmonized-Commodity-Description-and-Coding-Systems-HS>

<sup>20</sup><http://unstats.un.org/unsd/tradekb/Attachment439.aspx?AttachmentType=1>

coverage of the reforms. We tag any reforms that are found to have been implemented as part of either fiscal stimulus packages or austerity measures. These reforms are excluded only as a robustness check, in the specification used to estimate Figures 3 (f) and B.3 (h). Specifically, VAT changes that occur in the following countries and year are excluded: Cyprus in March 2012, January 2013 and January 2014; the Czech Republic in January 2008 and January 2012; Estonia in July 2009; Greece in March 2010 and January 2011; Spain in July 2010; Finland in July 2010 and January 2013; France in August 1995; Hungary in July 2009; Ireland in January 2001, July 2011 and January 2012; Lithuania in September 2009; Latvia in January 2009 and January 2011; the Netherlands in October 2012; Poland in January 2011; Portugal in July 2010; Romania in January 2000 and July 2010; the UK in December 2008.

FIGURE 1. — This set of Figures is the result of estimating equation (8) on the full sample of reforms and trade flows where trade flows are aggregated across origin countries (for imports) or destinations countries (for exports). Figure 1 (a) uses the full sample of imports in Euros, Figure 1 (b) the full sample of imports in tons, Figure 1 (c) the full sample of exports in euros and Figure 1 (d) the full sample of exports in tons.

FIGURE 2. — This set of Figures is the result of estimating equation (9) on the full sample of reforms and trade flows where trade flows are aggregated across product categories. Figure 2 (a) uses the full sample of imports in Euros, Figure 2 (b) the full sample of imports in tons, Figure 2 (c) the full sample of exports in euros and Figure 2 (d) the full sample of exports in tons.

FIGURE 3. — This set of Figures plots estimates of equation (8) on different subsamples of the data. We construct all of these subsamples in a similar way. We first identify the “treatment” of interest, i.e., the type of VAT change we want to analyze and then run our specification using only that type of variation on a set of “treated” observations, i.e., commodity\*time pairs that experience a VAT change of the type we are considering (VAT increase, reduced rate VAT change etc.), and “control” observations, i.e., commodity\*time pairs that do not experience a VAT change. We detail each of the treatment and control observations for each figure below.

Figure 3 (a) considers the effect of changes in the reduced VAT rate on imports. To do this, we estimate (8) on the set of commodities that are subject to reduced VAT rates. Figure 3 (b) similarly estimates (8) on the set of commodities that are subject to standard VAT rates.

The samples for Figures 3 (c), (d), (e) and (f) are all constructed in a similar manner (but different from Figure 3 (a) and (b)). Here, again we only consider specific VAT changes and so restrict the sample of treated observations to the

treatment of interest. For the control observations, we include all of them. For example, when considering the effect of VAT *increases* on imports, we only consider observations that are treated by a VAT increase in our treatment group but include all untreated observations in our control group. An observation is considered “untreated” as long as there was no VAT *decrease* 12 quarters before/after a given date. We proceed similarly for the VAT decreases (Figure 3 (d)), large VAT changes (Figure 3 (e)) and VAT changes that are not part of austerity measures (Figure 3 (f)).

For Figure 3 (g) and (h), only treated and control observations for euro-zone importers are included in Figure 3 (g), and only non-euro-zone importers are included in Figure 3 (h).

FIGURE 4. — This set of figures uses the same underlying dataset as the one used to estimate Figure 2. The only difference is that the estimation uses the VAT rates of both countries of origin and of destination. Therefore, we only include observations in which both countries are EU members. In the case of countries that have joined the EU more recently, trade flow information may be asymmetric. For example, flows from Croatia to France are not included until Croatia joined the EU, but flows from France to Croatia are included, as long as information on Croatian tax rates is available.

TABLE 2. — This table reports the results of several regressions that mirror the approach trade economists have used to estimate the effect of trade costs on imports. It uses the same sample as the one used in Figures 1 and 2.

APPENDIX FIGURE B.1. — This Figure uses a disaggregated version of the data used to estimate Figure 1, estimated using differences (rather than levels).

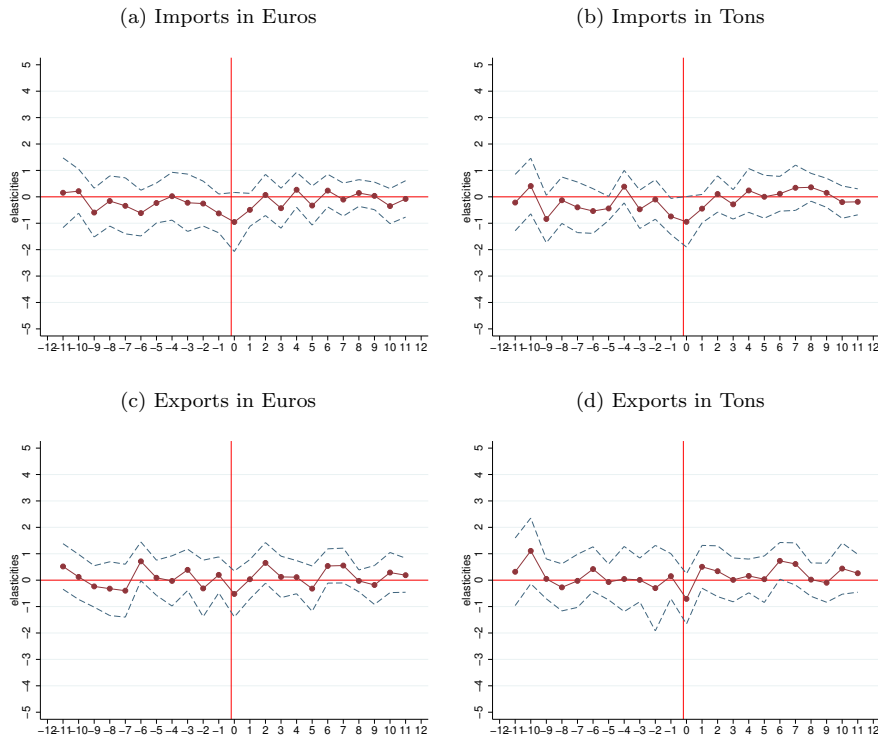
APPENDIX FIGURE B.2. — This Figure uses the same samples as in Figures 1 and 2 but at monthly intervals.

APPENDIX FIGURE B.3. — This Figure is constructed similarly to Figure 3 but uses data aggregated across the product categories instead of the trading partner level.

APPENDIX FIGURE B.4. — This Figure uses the same samples as in Figures 1 and 2.

## APPENDIX FIGURES

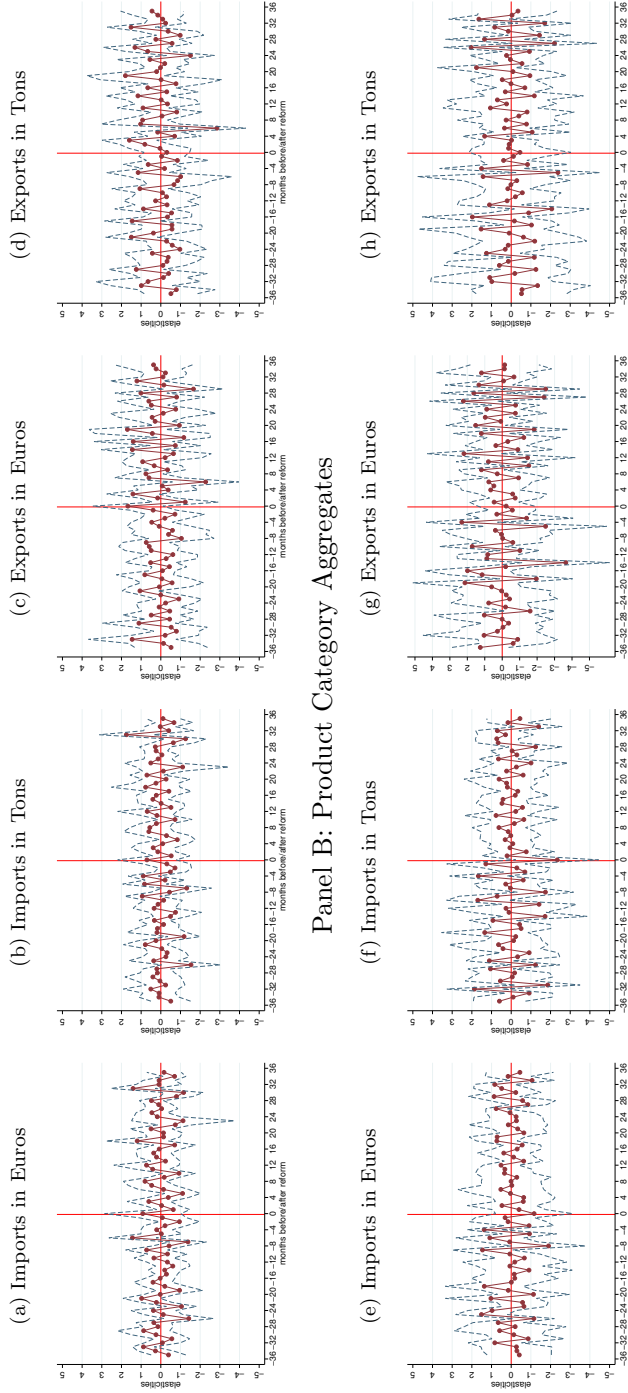
Figure B.1. : Distributed Lag-Model: HS4 Disaggregated Categories



*Notes:* This figure plots the estimates of  $\theta_k$ , where  $\theta_0$  is the elasticity of trade flows with respect to destination (for imports) or origin (for exports) VAT rates, and the corresponding 95% confidence intervals from regression model (7), with 12 quarters of leads and lags included. The model is estimated in first differences. All specifications include year-quarter fixed effects, as well as the following controls: the GDP of the origin and destination countries, whether the origin country (for exports) or destination country (for imports) is a Eurozone member, whether a tax change is an increase. The outcome variable is imports or exports in euros or in tons, depending on the figure. Standard errors are clustered by destination (for imports) or origin (for exports) country. The number of observations are shown in Panel C of Table 1.

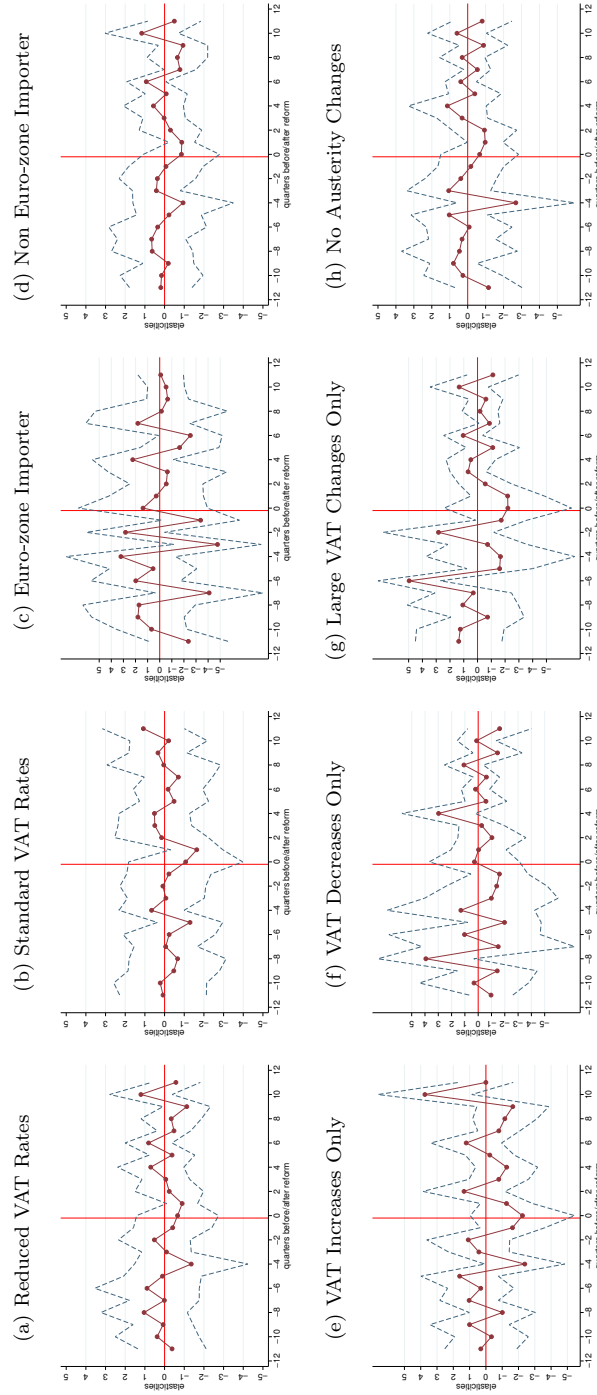
Figure B.2.: Robustness Checks (monthly)

## Panel A: Partner Country Aggregates



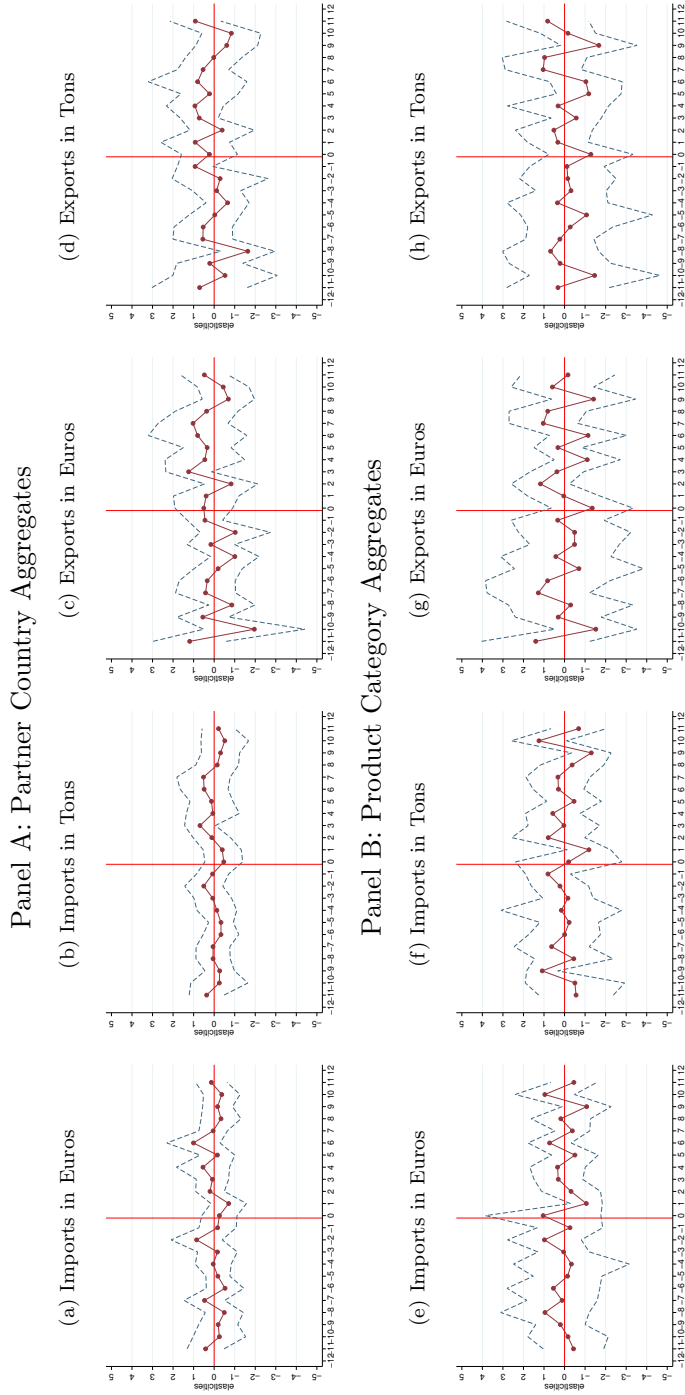
Notes: This figure plots the estimates of  $\theta_k$ , where  $\theta_0$  is the elasticity of trade flows with respect to destination (for imports) or origin (for exports) VAT rates, and the corresponding 95% confidence intervals from regression model (8) and (9), with 36 months of leads and lags included. The outcome variable measures import or export flows in euros or in tons. Standard errors are clustered by destination (for imports) or origin (for exports) country. Specifications in Panel A include the destination country (for imports) or the origin country (for exports), product category, and year-quarter fixed effects, as well as the following controls: the GDP of the destination country (for imports) or origin country (for exports), whether the destination country (for imports) or the origin country (for exports) is a Eurozone member, whether a tax change is an increase. Specifications in Panel B include the destination country and origin country, tax rate type, and year-quarter fixed effects, as well as the following controls: the GDP of the destination country and the origin country, whether the destination country (for imports) or the origin country (for exports) is a Eurozone member, whether a tax change is an increase. The number of observations are shown in Panel C of Table 1.

Figure B.3.: Distributed Lag-Model: Heterogeneity (Product Aggregates)



Notes: This figure plots the estimates of  $\theta_k$ , where  $\theta_0$  is the elasticity of imports with respect to destination VAT rates, and the corresponding 95% confidence intervals from regression model (9), with 12 quarters of leads and lags included. All specifications include the destination country and origin country, tax rate type, and year-quarter fixed effects, as well as the following controls: the GDP of the origin and destination countries, whether the destination country is a Eurozone member, whether a tax change is an increase. The outcome variable measures import flows in euros. Standard errors are clustered by destination country. The number of observations are shown in Panel B of Table 1.

Figure B.4.: Robustness Checks: with destination-country-year and origin-country-year fixed effects



*Notes:* This figure plots the estimates of  $\theta_k$ , where  $\theta_0$  is the elasticity of trade flows with respect to VAT rate of the country of destination (for imports) or origin (for exports), and the corresponding 95% confidence intervals from regression models (8) and (9), with 12 quarters of leads and lags included. All specifications include year-quarter fixed effects and the following controls: the GDP of the origin country (for exports) or destination country (for imports), whether the origin country (for exports) or destination country (for imports) is a Eurozone member, whether a tax change is an increase. In addition, Panel A includes destination-country-year (for imports) or origin-country-year (for exports) and product category fixed effects, while Panel B includes origin-country-year and destination-country-year, and tax rate type fixed effects. The outcome variable is exports or imports in euros or tons depending on the specification. Standard errors are clustered by destination (for imports) or origin (for exports) country. The number of observations are shown in Panel A of Table 1.