The (Non-)Neutrality of Value-Added Taxation[1]

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Abstract

The value-added tax (VAT) is commonly regarded to be non-distortionary due to their *de jure* trade neutrality. We analyze the effects of the VAT on trade in final goods in the European Union (EU) from 1988 to 2019, and we find that the VAT is *de facto* non-neutral. Using a gravity approach, we show that a one percentage point VAT increase implies a 5.45% reduction of foreign imports relative to internal trade. While institutional quality, EU accession, and preferential Common Market access cannot explain the over-proportionate reduction in imports, we provide evidence that foreign firm exit drives non-neutrality.

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1 Introduction

It is a common (mis-)perception that value-added taxes (VAT) are trade-neutral. The reason is a border adjustment under which inflows of goods, services, and transactions are subject to the domestic tax provisions, while outflows are generally exempt. Destination-based taxes with a border adjustment mechanism are thus *de jure* trade-neutral as domestic and imported economic activity are treated equally. This paper shows that the VAT is *de facto* non-neutral. In particular, for the European Union (EU) from 1988 to 2019, a one percentage point VAT increase results on average in a 5.45% decrease in imports relative to domestic trade of final goods in the EU.

The innovation of our paper is that we estimate with the differential impact of the VAT on inter- and intra-national trade by employing an estimation approach that builds on recent innovations in modeling the effects of non-discriminatory, country-specific trade policies. Consequently, our approach identifies the impact of the VAT on domestic trade and imports *within* a given country and thus directly tests trade neutrality. Furthermore, focusing on EU countries yields several advantages: Imports into the EU face the same tariff- and non-tariff barriers, and the application of the VAT is largely harmonized between members states. Finally, concerns about data quality for inter- and intra-national trade are small (see Emran and Stiglitz, 2005; Morrow et al., 2022).

The VAT is the most commonly applied form of BATs with almost 90% of the world's countries currently applying some form of value-added taxation. Thus, roughly 75% of world GDP, 92% of the world population, and 81% of global imports are subject to a VAT.[1] *De jure* trade neutrality is legally guaranteed by Article III of the General Agreement on Tariffs and Trade.[2] Early theoretical contributions have developed conditions under which any border adjustment is trade-neutral (see Grossman, 1980; Feldstein and Krugman, 1990). Thus, it is generally accepted by scholars, policymakers, and the World Trade Organization (WTO) that the VAT is neutral due to its destination principle and border

[1] In fact, the United States of America remain the only major country in the world that has not introduced a VAT. Calculations are based on the UN Comtrade database, World Bank GDP and population data and self-collected VAT regime information for the year 2020.

[2] The WTO has been involved in disputes over the VAT's trade neutrality, focusing on specific provisions rather than the VAT in general (see Cuadros, 2016). It has adopted a more aggressive stance on direct taxation, such as the US Extraterritorial Income Exclusion Act and the Foreign Sales Corporation Scheme (see Daly, 2005).

adjustment. However, several authors have identified conditions under which this may not be the case, including substitution between distortionary taxes or tariffs and the VAT (see Feldstein and Krugman, 1990; Keen and Lahiri, 1998; Haufler et al., 2005). The question of non-neutrality is particularly important in light of the historical trend towards higher VAT rates and falling tariff levels around the globe (see Büttner and Madzharova, 2018).[3] This is because the arguments for the efficiency and equity of Border Adjustment Taxes (BATs) largely depend on their neutrality.

Still, the claim of trade neutrality under the VAT remains yet to be empirically tested, and our paper fills this void. Our non-neutrality result is also immune against several robustness checks. Non-neutrality is still prevalent when we take a potential decrease in reported domestic trade due to potential inefficient tax collection into account. Furthermore, we also demonstrate that these effects are not driven by EU accession or Single Market benefits, but we can show that the VAT has a differential effect on the extensive margin. Thus, it is foreign firm exit that derives this result.

This paper is not the first to evaluate the relationship between the VAT and trade, but the first to directly test for trade neutrality by studying the impact of the VAT on internal and international trade *within* a given country. Thus, it contributes to several strands of the international trade and public finance literature. First, we add to the empirical trade literature, analysing the impact of the VAT on trade. Desai and Hines (2003) conduct a cross-sectional country-level analysis, finding a negative relation between VAT revenue and exports as well as imports. Keen and Syed (2006), also looking at the country-level but using panel data, find no effect of VAT on trade. In an industry-level panel analysis Nicholson (2010) finds negative effects of the VAT on both exports and imports. Sharma (2020) finds that industries with a high intermediate goods share of output decrease exports substantially when the VAT increases. This effect is driven by developing countries and most likely attributable to imperfect refunding for exporters. More recently, Benzarti and Tazhitdinova (2021) analyze the effect of the VAT on international trade using an two-way-fixed-effects approach, regressing imports and exports on the reporting country's tax rate and country-level controls. Similar to our analysis, they focus on EU countries, but they do not include intra-national trade in their estimation. They find a VAT elasticity of trade close to zero, with no significant anticipatory or delayed effects. Second, we

[3]Thunecke (2023) provides illustrative evidence for the development of the VAT over time.

contribute to the public economics literature analysing the effects of consumption tax reforms on prices and demand (see Doyle Jr. and Samphantharak, 2008; Chetty et al., 2009; Kosonen, 2015; Benzarti and Carloni, 2019; Benzarti et al., 2020; Bachmann et al., 2021; Büttner, T.; Fuest et al., 2025). This literature illustrates that VAT rate changes affect consumer prices and unit sales significantly exploiting quasi-experimental policy interventions.

Our analysis differs in two key aspects from the previous literature. First and most importantly, we explicitly account for domestic trade which is essential to directly test the trade neutrality of the VAT in the first place.[4] By focusing on the relative response of imports vis-à-vis internal trade we go beyond the analysis of recent papers and directly test for trade neutrality defined as the relative, rather than the absolute elasticity of international trade.Second, we employ a gravity approach with a Poisson Pseudo Maximum Likelihood (PPML) estimator following Santos Silva and Tenreyro (2006). PPML allows us to properly account for zero trade flows, heteroskedasticity, and non-linearities which may bias results when log-linearizing trade flows. Additionally, the gravity approach allows for a rich fixed effects structure that controls for general equilibrium effects. Unlike a two-way fixed effects (event study) estimation, the gravity approach identifies how VAT changes affect imports relative to domestic trade within a country, rather than comparing log-linearized imports and exports across treated and not (yet) treated countries.

The remainder of this paper is organized as follows. Section 2 sets up a model in which we demonstrate the VAT neutrality result and the effect on maximized profits for many competition modes. Section 3 provides an overview of the data and descriptive statistics. Section 4 presents our identification approach and our empirical results, including several robustness checks that validate our results. It also shows that our results can be explained by extensive margin responses of foreign firms. Section 5 concludes.

[4]The prior literature has relied on (log-linearized) import or export data while disregarding internal trade due to data constraints preventing an explicit test of trade neutrality and potentially leading to biased results (see Santos Silva and Tenreyro, 2006; Yotov, 2022). Additionally, McConnell (2024) highlights several issues of using log-dependent variables in Difference-in-Differences settings that we avoid by employing PPML.

2 Theoretical framework

Since we will employ a gravity-like estimation, we use a model that is the basis of structural gravity models. However, we proceed by making this model as general as possible. First, we allow for several final good sectors, and the goods offered by national and international firms are not only differentiated, but demand across countries is allowed to differ. Second, our model is flexible in terms of the competition mode in this final goods industry. Thus, we do not rely on specific assumptions about markups that could restrict the scope of our analysis.[5]

In particular, we consider a country j for which final goods demand is determined by the behavior of a representative consumer whose utility function is given by

$$U_j = \int_0^1 U_{js}^{\alpha_{js}} d\alpha_{js}, \sum_{s=1}^{m} \alpha_{js} = 1, U_{js} = \left(\sum_{i \in M_{js}} q_{i\ell(i)jk}^{\frac{\sigma_{js}-1}{\sigma_{js}}} \right)^{\frac{\sigma_{js}}{\sigma_{js}-1}}, \tag{1}$$

where M_{js} denotes the set of firms of final goods sector s that are active in country j. $q_{f\ell(f)js}$ denotes the quantity of sales of a specific firm f in sector s located at $\ell(f)$ to country j, so q_{fjjs} is part of country j's internal trade since $\ell(f) = j$. The upper tier of (1) is Cobb-Douglas, and we allow the expenditure shares α_{js} to be country j and industry s specific. The lower tier of (1) has a general CES structure where the elasticity of substitution $\sigma_{js} > 1$ is also both industry- and country-specific.

Each final good sector in country j is thus served by a number of local firms and importers, and the decision to serve a market will depend on the fixed cost of serving this market. Note that there can be more than one local firm that is active in its home market. Importers face trade restrictions which may include a potential tariff unless both countries are part of a regional trade agreement. We allow firms to have market power, such that markups will be endogenous and will depend on how many and which firms the market will carry, as our model can also accommodate firm heterogeneity.[6] We have

[5]For a recent analysis of concentration in European industries, see Bighelli et al. (2023).

[6]The role of market power and markups has been emphasized recently in the literature, see for example Amiti et al. (2019), Asprilla et al. (2019), Bernard et al. (2003), De Loecker et al. (2016), De Loecker and Eeckhout (2018), Feenstra and Weinstein (2017), Holmes et al. (2014) and Hsu et al. (2020).

relegated the details of specifying the equilibrium profits and how they depend on VAT rates to Appendix A.1. We find:

Proposition 1. *Irrespective of the type of competition, any increase in country j's VAT rate does not change relative prices in country j if all firms stay active in country j. The equilibrium operating profit is smaller for firms with larger variable costs, and it decreases proportionately with the VAT rate.*

Proof. See Appendix A.1. □

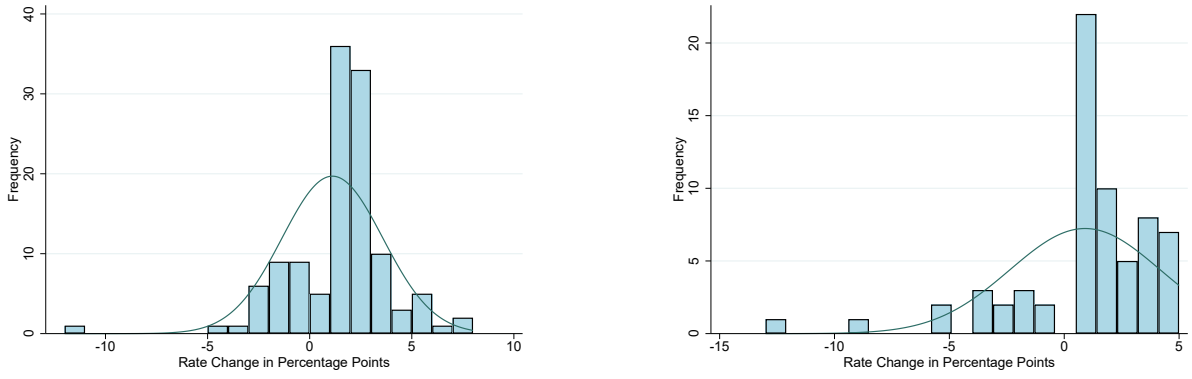
Proposition 1 shows that a change in the VAT rate does not change relative prices if all firms that were active before a VAT increase also stay active after this increase. Thus, without any adjustment at the extensive margin, we would expect that relative demand for domestic and foreign goods should not change. At the same time, however, the operating profit decreases proportionately with the VAT. Eventually, the VAT increase will reduce the operating profits of firms with the largest variable costs in this market to a point where they can no longer cover their fixed costs. At that stage, these firms will exit the market.

Consequently, a VAT increase has the potential to make firms whose operating profit was close to their fixed costs leave the market. Typically, these firms are foreign firms that have to carry the additional trade friction and are not much more productive than domestic firms. This market exit reduces imports while all remaining foreign firms face less competition. All remaining firms are likely to increase their markups, and the domestic firms will increase their market share overproportionately if also the remaining foreign firms have to carry larger variable costs. Both exit and more market power for domestic firms will reduce the relative supply of imports over domestic supply. We will show at the end of section 4 that the extensive margin response can explain our results. The next section explains the data we use.

3 Data

The VAT data set used in the analysis contains a panel of the 28 (eventual) EU member countries from 1967 to 2020 and is provided by the European Commission.[7] It contains information on standard VAT rates and the reduced rates applied to foodstuffs. DELETE: We exclude fiscally motivated tax changes during the Global Financial Crisis and countries that had to take severe austerity measures during the European sovereign debt crisis to avoid reverse causality.[8] Summary statistics are displayed in Table 1. Not including initial introductions, we record 122 exogenous standard VAT changes, 95 of which are positive and 27 of which are negative. The average rate change was an increase by 1.11 percentage points, with a median value of 1 percentage point. We observe fewer reduced rate changes compared to the standard rate with an average rate change of 1 percentage point and a standard deviation of 2.5. For the reduced rate we record 66 exogenous changes with the average and median change being 0.91 and 1 percentage point with a standard deviation of 3.3. The distribution of standard and reduced VAT rate changes is displayed in Figure 1. Most changes were smaller than five percentage points.

Figure 1: Variation of VAT Rates of Eventual EU Members



(a) Standard Rate

(b) Reduced Rate

The trade data used for the analysis is the *International Trade and Production Database*

[7]The United Kingdom did not formally leave the EU and its customs union until after our period of analysis.

[8]In particular, we disregard changes in Great Britain, Greece, Ireland, Italy, Portugal and Spain. These changes are excluded by holding the VAT rates in these countries at the pre-global financial crisis level.

(ITPD) from the US International Trade Commission (see Borchert et al., 2021, 2022). The ITPD database contains detailed and global trade information for the manufacturing sector from 1988 to 2019. For our analysis we distinguish between manufactured foodstuffs and manufactured non-food goods. The former is commonly subject to a reduced VAT rate, while the standard VAT rate is applied to the latter. The analysis focuses on trade in final goods as the VAT is fully rebated on intermediate inputs. Similarly, exports are exempt from VAT and thus excluded from the analysis. The data are converted from the International Standard Industrial Classification (ISIC) to the Broad Economic Category (BEC) level to filter for inter- and intranational trade in food and consumption goods.[9] We conduct a standard rest of world (RoW) aggregation as in Yotov et al. (2016). The panels were balanced by adding zero trade flows for any missing dyadic observation. Trade flows are reported net of VAT, just as they are reported net of tariffs.

The core advantage of the ITPD data over most other databases is that it contains information on domestic trade which is constructed by subtracting total exports from production. Previous empirical studies have focused on the impact of the VAT on international trade, disregarding domestic trade data. However, answering the question of trade neutrality – i.e. estimating the VAT effect on external versus internal trade – necessarily requires reliable data on internal trade. In our sample, the average European country sources 56% of final goods from domestic producers, and 24% and 19% are imported from other EU countries and from countries outside the EU, respectively.

For the robustness checks in Section 4 we take data on institutional quality from the *Worldwide Governance Indicators* of the World Bank and choose the pre-standardized perceived Control of Corruption score as a proxy for institutional quality (see Kaufmann and Kraay, 2024). Data for the extensive margin estimation is taken from Eurostat. We use the *International Trade by Enterprise Characteristics* (TEC) dataset for the number of importers into European countries and the *Structural Business Statistics* (SBS) for the number of domestic wholesalers and retailers.

[9]The conversion from ISIC to BEC is implemented using the *concordance* package in R (see Liao et al., 2020).

Table 1: Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Trade Flow (m.)	100,620	261	2,592	0	0.052	37	93,695
Standard Rate Change	122	1.1	2.5	-12	0.5	2	8
Food Rate Change	66	0.91	3.3	-13	0.5	3	5
Institutional Quality	27	1.1	0.76	-0.21	0.39	1.7	2.3

4 Identification Strategy and Empirical Results

To investigate the trade neutrality of the VAT we follow the gravity approach of Beverelli et al. (2018) and Heid et al. (2021) to analyze non-discriminatory trade policies.[10] For our estimation we distinguish between a non-food and a food final goods sector. The former is subject to the standard VAT rate, while the latter is only subject to a reduced one. We estimate the following model with PPML:

$$X_{ijst} = exp\left(\beta \times BORDER_{ij} \times VAT_{jst} + \eta_{ist} + \nu_{jst} + \xi_{ijs} + BORDER_{ijt}\right) \times u_{ijst}, \quad (2)$$

where X_{ijst} is the trade flow of final goods in sector s between country i and country j in year t. Thus, trade flows are imports if $i \neq j$ and domestic if $i = j$. VAT_{jst} denotes the VAT rate in the importing country j that applies to goods in sector s in year t. We control for exporter-time-sector (η_{ist}), importer-time-sector (ν_{jst}), and (symmetric) pair-sector (ξ_{ijs}) fixed effects.[11] These fixed effects account for any unobserved annual shocks at the country-sector level including business cycles, elections, policy changes like tax reforms, austerity measures and stimulus programs as well as time-invariant determinants of bilateral trade, i.e., geographical distance, common language etc. Additionally, we control for globalization effects like the reduced costs of international trade relative to domestic trade due to changed economic interdependence and integration by including a border-year fixed effect ($BORDER_{ijt}$). Similarly, $BORDER_{ij}$ is an indicator that takes

[10] For the seminal contribution setting up the structural gravity model, see Anderson and van Wincoop (2003) See also Anderson (1979) and Eaton and Kortum (2002).

[11] Our results are robust to using asymmetric pair fixed effects and available upon request.

on the value one if a trade flow crosses a border ($i \neq j$) and zero if it is domestically produced and sold ($i = j$).[12] u_{ijst} denotes the model residual.

The coefficient of interest is β which measures the *differential* impact of the VAT of importer j in year t in sector s on trade flows from exporter i compared to internal trade. Given that $BORDER_{ij}$ is an indicator, internal trade ($BORDER_{ii} = 0$) serves as the baseline category. In particular, differentiation of equation (2) yields $\beta = (\partial X_{ijst}/X_{ijst})/\partial VAT_{jst}$ if $BORDER_{ij} = 1$. Thus, β is the semi-elasticity of international trade flows relative to internal trade w.r.t. marginal VAT rate changes. In the baseline specification β is identified from variation in VAT rates over time and between sectors for imports relative to domestic trade. A coefficient close to zero would indicate *de facto* neutrality. We focus on imports and internal trade, since exports are exempt from the VAT.[13] From equation (2) we identify β from the direct impact of VAT changes on imports relative to domestic trade within a country, rather than obtaining a treatment effect from a between country comparison.[14]

We estimate equation (2) both for a pooled sample including the food and non-food sectors, as well as for each sector separately. Results are shown in Table 2. We observe sizable negative coefficients for the interaction between cross-border flows and VAT rates that are statistically significant at the 1 percent level in columns (1) and (3). In particular, results for the pooled sample imply that on average a one percentage point increase in the applied VAT rate of the importing country leads to a decrease in imports from a foreign country relative to internal trade by 5.45 %. Thus, we can reject the null hypothesis of trade neutrality of the VAT. The results in columns (2) and (3) indicate that the baseline effect is quantitatively and qualitatively driven by the non-food sector.

[12]The border indicator equals one for imports, irrespective of whether countries are both members of the same regional trade agreement (e.g. the EU). While the EU as a customs union imposes uniform tariffs, intra-EU trade frictions still exist; see, for example, Chen (2004) and Chen and Novy (2011).

[13]Some research has indicated imperfect rebating of the VAT for Chinese exports (see Chandra and Long, 2013). Since this effect is confined to China, we do not expect any variation of aggregate exports with the VAT for a representative country in our samples.

[14]DELETE: Based on the comprehensive fixed effects structure, the main threat to our identification approach is potential reverse causality. However, as the VAT is widely considered to be trade neutral, it is highly unlikely that rates are influenced by trade related considerations. Although cyclical fluctuations are captured in our fixed effects, we do exclude rate changes explicitly motivated by fiscal consolidation to mitigate concerns about unobserved factors influencing both VAT rates and trade flows.

Table 2: Trade Neutrality of the VAT

	Final Good (1)	Food (2)	Non-Food (3)
Variables			
VAT × Border	-0.0545***	-0.0065	-0.0647***
	(0.0177)	(0.0217)	(0.0198)
Fixed-effects			
Importer-Year-Sector	Yes	Yes	Yes
Exporter-Year-Sector	Yes	Yes	Yes
Symmetric Pair-Sector	Yes	Yes	Yes
Border-Year	Yes	Yes	Yes
Observations	94,614	46,849	47,765

Note: Shown are results estimating equation (2) using PPML. Standard errors are clustered at the importer-sector level and shown in parentheses. The dependent variable is trade flows at the importer-exporter-sector-year level. The independent variable is the interaction between an indicator for trade flows crossing an international border and the applicable VAT rate in percent. VAT rate changes motivated by fiscal policy considerations are excluded.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Based on the results in Table 2, we can conclude that the VAT is non-neutral. To ensure the validity of these baseline results, we conduct several robustness tests. First, our results blend the effects of VAT changes and EU accession of eventual members. To address this concern, we re-estimate equation (2) dropping all non-founding EU members from the sample. The results are presented in Table 3. We obtain qualitatively robust and quantitatively larger coefficients compared to the baseline specification, suggesting that our baseline coefficients are a conservative estimate.

Second, the EU membership status of exporters and its potential effects on the non-neutrality of the VAT could explain our results. Non-EU imports are subject to customs duties, more stringent documentation requirements, and differing VAT treatment compared to intra-EU international trade. Most notably, a reverse charge mechanism for

Table 3: Trade Neutrality of the VAT - Founding EU Members

	Final Good (1)	Food (2)	Non-Food (3)
Variables			
VAT × Border	-0.0810***	0.0732	-0.0861***
	(0.0231)	(0.0994)	(0.0237)
Fixed-effects			
Importer-Year-Sector	Yes	Yes	Yes
Exporter-Year-Sector	Yes	Yes	Yes
Symmetric Pair-Sector	Yes	Yes	Yes
Border-Year	Yes	Yes	Yes
Observations	54,722	27,238	27,484

Note: Shown are results estimating an augmented equation (2) using PPML. Standard errors are clustered at the importer-sector level and shown in parentheses. The dependent variable is trade flows at the importer-exporter-sector-year level. The independent variable is the interaction between an indicator for trade flows crossing an international border and the applicable VAT rate in percent. VAT rate changes motivated by fiscal policy considerations are excluded. Only founding members of the EU are included in the sample.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

intra-EU trade shifts the legal incidence from the seller to the buyer (see Bohne et al., 2024).[15] All these aspects make trading with EU members relatively more attractive and thus may also drive the non-neutrality of the VAT. To investigate the role of non-EU imports, we augment equation (2) to include an interaction with an indicator that is equal

[15] A producer sourcing inputs domestically pays VAT on inputs and deducts that amount from their VAT bill on their sales. A producer sourcing inputs from other EU countries does not pay VAT on the input and pays the full VAT amount on their sales to the government.

to one if the exporter is an EU member and zero otherwise. The model we estimate is:

$$X_{ijst} = exp(\beta \times BORDER_{ij} \times VAT_{jst} + \gamma \times BORDER_{ij} \times VAT_{jst} \times EU - Exporter_{it} + \eta_{ist} + \nu_{jst} + \xi_{ijs} + BORDER_{ijt}) \times u_{ijst}. \quad (3)$$

The results are depicted in Table 4. We find that the VAT is non-neutral for imports from EU countries as well as from non-EU countries. Though the effect is dampened for imports from EU countries, the overall effect is still sizeably negative.

Table 4: EU Exporter

	Final Good (1)	Food (2)	Non-Food (3)
Variables			
VAT × Border	-0.0913***	-0.0061	-0.1210***
	(0.0286)	(0.0317)	(0.0327)
VAT × Border × EU-Exporter	0.0304*	-0.0072	0.0509**
	(0.0184)	(0.0163)	(0.0238)
Food Trade	Yes	Yes	No
Non-Food Trade	Yes	No	Yes
Fixed-effects			
Importer-Year-Sector	Yes	Yes	Yes
Exporter-Year-Sector	Yes	Yes	Yes
Symmetric Pair-Sector	Yes	Yes	Yes
Border-Year	Yes	Yes	Yes
Observations	33,750	16,870	16,880

Note: Shown are results estimating an augmented equation (2) using PPML. Standard errors are clustered at the importer-sector level and shown in parentheses. The dependent variable is trade flows at the importer-exporter-sector-year level. The independent variables are an interaction between an indicator for trade flows crossing an international border and the applicable VAT rate in percent and a triple interactions between these two variables and an indicator for intra-EU trade flows. VAT rate changes motivated by fiscal policy considerations are excluded.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Finally, we have to investigate whether and how institutional quality affects the non-neutrality of the VAT. Domestic tax collection efficiency depends on institutional quality, potentially resulting in differential treatment of imports and domestic trade due to a strong enforcement capacity at the border and a lower capacity to monitor domestic economic activity. Morrow et al. (2022) provide evidence that increases in VAT rates in countries with lower institutional quality lead to increased evasion by shifting domestic economic activity to the informal sector while imports are still registered at the border (see also Emran and Stiglitz, 2005).[16] It should be clear that countries with a relatively weak perceived institutional quality may report lower domestic trade since domestic – but not cross-border – trade may move to the informal sector following VAT rate increases, counteracting the negative effect we found in our baseline specification (2). Thus, we augment equation (2) by interacting the $Border \times VAT$ term with an indicator for below median institutional quality within the EU and estimate the following model:

$$X_{ijst} = exp(\beta \times BORDER_{ij} \times VAT_{jst} + \gamma \times BORDER_{ij} \times VAT_{jst} \times LowInstQuality_{jt} + \eta_{ist} + \nu_{jst} + \xi_{ijs} + BORDER_{ijt}) \times u_{ijst}. \quad (4)$$

Table 5 presents the results. We find sizable, negative, and statistically significant effects of the VAT on imports relative to domestic trade for the baseline category of high institutional quality. For countries with below-median institutional quality, however, the overall effect of the VAT on imports relative to domestic trade is indeed positive. Thus, similar to Morrow et al. (2022) we find that poorer institutional quality leads to enforcement gaps in internal trade, even in an otherwise relatively strong institutional environment like the EU. VAT increases prompt firms to move domestic transactions to the shadow economy but not imports, which are documented at the border. Thus, the negative baseline coefficient in Table 2, if anything, underestimates the impact of the VAT. Since a relatively weak institutional quality reduces the size of *reported* domestic trade due to a potential increase in tax evasion, our estimate in Table 2 is conservative and a lower bound.

So far, we have shown that neither institutional quality nor eventual EU membership

[16]The so-called VAT gap in the EU is considered to be substantial. The gap originates from a policy gap due to reduced rates and a compliance gap due to lack of enforcement. The VAT compliance gap has been estimated to be as large as EUR 89.3 billion in the EU in 2022 which is 7% of the total VAT liability, with substantial heterogeneity across countries. See European Commission et al. (2024).

Table 5: Institutional Quality

	Final Good (1)	Food (2)	Non-Food (3)
Variables			
VAT × Border	-0.0800***	-0.0231	-0.0839***
	(0.0203)	(0.0486)	(0.0214)
VAT × Border × Low Inst. Qual.	0.1050***	0.0256	0.1324**
	(0.0385)	(0.0606)	(0.0590)
Food Trade	Yes	Yes	No
Non-Food Trade	Yes	No	Yes
Fixed-effects			
Importer-Year-Sector	Yes	Yes	Yes
Exporter-Year-Sector	Yes	Yes	Yes
Symmetric Pair-Sector	Yes	Yes	Yes
Border-Year	Yes	Yes	Yes
Observations	92,690	45,939	46,751

Note: Shown are results estimating an augmented equation (2) using PPML. Standard errors are clustered at the importer-sector level and shown in parentheses. The dependent variable is trade flows at the importer-exporter-sector-year level. The independent variables are an interaction between an indicator for trade flows crossing an international border and the applicable VAT rate in percent and a triple interaction between these two variables and an indicator for below median institutional quality. VAT rate changes motivated by fiscal policy considerations are excluded.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

status nor non-EU imports change our main result: the VAT is discriminatory as a tax rate increase reduces final goods imports more than domestic trade of final goods. Consequently, it must be the market response itself that drives *de facto* non-neutrality. We now show that differential adjustments at the extensive margin can explain our results.

ADD: no pre-trend, no reverse causality.

Empirically, the average change in market composition is also absorbed by the importer-

year fixed effect in equation (2). However, domestic and importing firms will be affected differently by changes in market shares. This deviation from the mean would then be captured by the coefficient of interest and can explain our empirical finding of *de facto* non-neutrality. Fortunately, we can test the notion of extensive margin responses directly using Eurostat data on the total number of importing firms into European countries as well as the number of wholesale and retail businesses registered in the respective countries between 2012 and 2019.[17] More specifically, we investigate how the number of importers and the number of domestic wholesalers and retailers respond to VAT rate changes. We estimate an event study approach following Chaisemartin et al. (2024) to allow for continuous treatment with heterogeneous treatment effects and staggered adoption. The model we estimate is given by

$$N_{jt} = \alpha + \sum_{\substack{t=-3 \\ t\neq -1}}^{3} \beta_t \cdot VAT_{jt} + \delta \cdot g_{jt} + \gamma_j + \zeta_t + \varepsilon_{jt}. \tag{5}$$

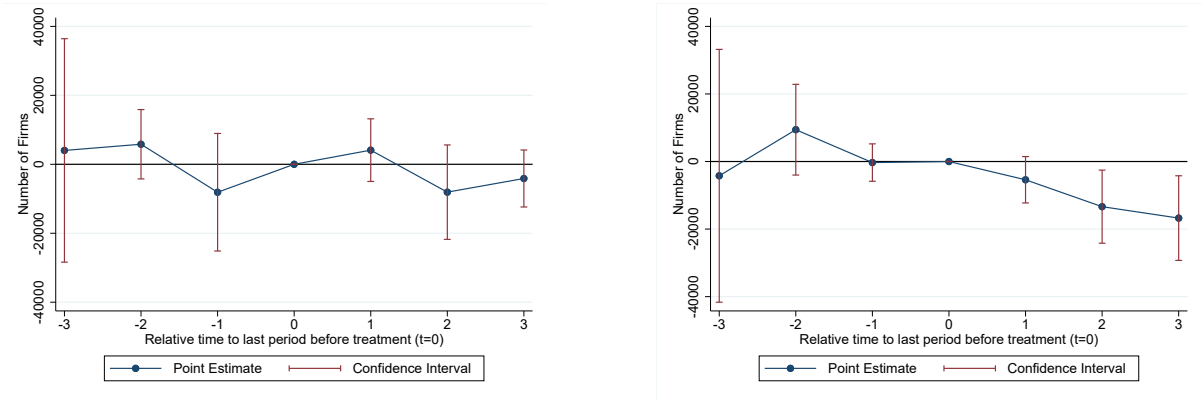
N_{jt} represents the absolute number of wholesale and retail firms registered in country j or the number of firms importing goods into country j.[18] g_{jt} captures country j's GDP growth in year t in percent. γ_j and ζ_t represent country and year fixed effects, respectively. The coefficient of interest is β_t. For our results to be valid, countries that experience a VAT change (treatment) and countries that have not yet experienced one (control) should exhibit similar developments in the number of firms prior to the VAT change. For the parallel trends assumption to hold, we require β_t to be small and statistically insignificant for all $t < -1$. The results of estimating equation (5) are depicted in Figure 2.

Looking at panel (a), we observe that domestically registered wholesale and retail firms do not exhibit significant pre-trends prior to any VAT rate change. Additionally, the number of domestic firms remains stable after a VAT rate change. In fact, all β_t's for $t > -1$ are quantitatively small and statistically insignificant with no clear post treatment pattern. Panel (b) depicts the results for the number of importing firms. Similar to the domestic

[17] This data window is due to data availability. Note carefully that the TEC dataset does not provide any information on the sectoral affiliation of importers while the SEC dataset allows us to focus on firms close to consumers. Hence, we stack the deck against an extensive margin response of importers which we will nevertheless find.

[18] Since we are interested in differences in firm exit and not in differences in growth rates, we follow McConnell (2024) and estimate equation (5) in levels and not in logarithmic levels.

Figure 2: Effects of VAT on Number of Firms



(a) Domestic Firms

(b) Importers

Confidence intervals are calculated at the 95% level. Standard errors are clustered at the country level. The estimations are based on 195 county-year level observations in panel (a) and 211 observations in panel (b).

firms we observe no significant pre-trend, implying that treatment and control countries exhibit similar developments in the number of importing firms prior to a VAT change. However, following a VAT change the number of importing firms gradually and significantly decreases by almost 2,000 firms (approx. 2%) three years after the VAT change. Thus, while we do not observe a change in the number of domestic firms, the number of importers decreases. Given these results, we do observe a change in the extensive margin composition of importers and domestic firms that is in line with the model. Consequently, the result of *de facto* non-neutrality of the VAT can be explained by extensive margin responses of importing firms.[19]

5 Concluding remarks

In general, border adjustment taxes (BATs) like the destination-based cash flow tax (DBCFT), the carbon border adjustment mechanism or the value-added tax (VAT) aim to raise revenue while leveling the international playing field by avoiding tax discrimination, promoting fair competition, preventing unintended economic distortions (see e.g. Auerbach and Devereux, 2018) and promoting efficiency and equity (see Brockmeyer et al.,

[19] As a robustness check, we confirm this result in a simple two-way fixed effects model in Appendix A.2.

2024). The key feature of BATs to ensure these outcomes is neutrality implying that the inflows of goods, services, and transactions are subject to the same legal provisions as domestic economic activities.

This paper empirically tests the notion of neutrality for the most commonly applied BAT, the value-added tax (VAT), and demonstrates that the VAT is *de facto* non-neutral. Building on recent advancements in the estimation of non-discriminatory trade policies, we employ a gravity-style approach to test the neutrality of the VAT by explicitly distinguishing between inter- and intranational trade. Our analysis focuses on trade flows to and between (eventual) European Union (EU) members from 1988 to 2019 in the food and non-food finals goods sector. We find that a one percentage point VAT increase results on average in a 5.45% reduction in imports relative to domestic trade. This result is primarily driven by the non-food final goods sector and accounts for country-sector-time specific shocks, globalization trends, and time-constant country-pair characteristics. Our finding cannot be explained by differences in institutional quality, EU accession, or preferential Common Market access. Seminal theoretical contributions have shown that VAT changes should not affect relative prices, and consequently relative demand for imports and domestically produced goods trade should remain unchanged. However, this finding is true only if all domestic and importing firms continue to serve the respective market after a VAT reform. We demonstrate that importing firms leave the market following a VAT increase and thus that non-neutrality is driven by foreign firm exit.

In contrast to the previous literature, we explicitly test for non-neutrality by quantifying the impact of VAT changes on imports relative to domestic trade. Furthermore, our estimation approach leverages *within* country variation over time between sectors of imports relative to domestic trade while properly accounting for zero values, heteroskedasticity, and non-linearities in trade flows. Prior studies have leveraged *between* country variation in imports and/or exports to identify the impact VAT on (log-linearized) trade flows, while disregarding domestic trade. Ultimately, our approach allows us to directly test the trade neutrality of the VAT by estimating the response of imports relative to domestic trade to a VAT increase.

Given our results, policy-makers should be aware that VAT changes have substantial effects on trade patterns – most likely through differential responses in market participation – and subsequently welfare implications. Consequently, increasing the VAT to

provide additional public goods and/or to substitute for other tax instruments should be carefully reconsidered. More generally, our results imply that the neutrality of BATs is not guaranteed. If the VAT proves to be non-neutral in a comparably strong institutional environment with a well-defined tax base like the EU, the desired efficiency and equity gains of recent proposals like the destination-based cash flow tax or the carbon border adjustment mechanism cannot be taken for granted. Thus, BATs may implicitly or explicitly serve as a discriminatory policy instrument, in particular if extensive margin responses are stronger for foreign firms. Exploring the details of non-neutrality in the context of BATs requires a model that can explain both the pricing and market entry behavior of domestic and foreign firms as presented by us in the context of the VAT.[20] Furthermore, it would be interesting to explore whether the non-neutrality of the VAT is particularly relevant in common markets like the EU or whether it also extends to regional trade agreements. We leave such an analysis to future research.

Appendix

A.1 Proof of Proposition 1

Importers face a trade friction such that a firm at location ℓ has to carry iceberg-type trade cost which are denoted by $t_{\ell(f)js}$ for its sales in country j where $t_{\ell(f)js} \geq t_{jjs}$ if $\ell(f) \neq j$.[21] Consumer good prices are given by $p_{f\ell(f)js}\tau_{js} = \mu_{f\ell(f)js}c_{fk}t_{\ell(f)js}\tau_{js}$, where $p_{f\ell(f)js}$ is the c.i.f. producer price, $\mu_{f\ell(f)js}$ is the markup and $\tau_{js} = 1 + \psi_{js}$ denotes country j's VAT rate as it applies to the final goods sector s which is defined as one plus the statutory commodity tax rate ψ_{js}. $\mu_{f\ell(f)js}$ is the markup charged by firm f for its sales in country j. c_{fk} is the firm-specific cost of firm f so our model also allows for firm heterogeneity.

The upper-tier Cobb-Douglas structure of (1) implies that the representative consumer in country j spends a fraction α_{js} of her income E_j on consumption goods of sector s, and thus utility maximization implies demand for final goods equal to:

[20] An emerging literature investigates differential markup behavior in imperfectly competitive markets in a trade context. See, for example, Atkeson and Burstein (2008), Edmond et al. (2015), Arkolakis et al. (2019), Behrens et al. (2020), Breinlich et al. (2020), and Heid and Stähler (2024).

[21] Note that $t_{\ell(f)js}$ includes any EU tariff if $\ell(f)$ is outside of the EU as the VAT tax base is the c.i.f. value including tariffs; see Council Directive 2006/112/EC.

$$q_{f\ell(f)js} = \frac{\alpha_{js} E_j p_{f\ell(f)js}^{-\sigma_{js}}}{P_{js}^{1-\sigma_{js}}}, \text{ where } P_j = \left[\sum_{n \in M_{js}} p_{n\ell(n)js}^{1-\sigma_{js}} \right]^{\frac{1}{1-\sigma_{js}}}$$

is the CES price index of final goods sector s in country j. The aggregate profit of an industry k firm f located in $\ell(f)$ is given by

$$\Pi_{f\ell(f)s} = \sum_{j \in L_{f\ell(f)s}} \left(\pi_{f\ell(f)js} - F_{f\ell(f)js} \right) \text{ where } \pi_{f\ell(f)js} = \left(\frac{p_{f\ell(f)js}}{\tau_{js}} - c_{fs} t_{\ell(f)js} \right) q_{f\ell(f)js}$$

denotes the operating profit in an active export market j, and $F_{f\ell(f)js}$ is the fixed cost of exporting to this market. $L_{f\ell(f)s}$ denotes the set of locations where this firm decides to sell. A firm f located in $\ell(f)$ will compete with rivals in country j's market only if the operating profit will cover the fixed cost.

In order to derive the first-order conditions, it is convenient to rewrite the operating profit as

$$\tilde{\pi}_{f\ell(f)js} = \tau_{js} \pi_{f\ell(f)js} = \left(p_{f\ell(f)js} - c_{fs} t_{\ell(f)js} \tau_{js} \right) q_{f\ell(f)js} \tag{A.1}$$

which does not change the first-order conditions for profit maximization. This allows us to use the markup over the tax-inclusive cost which we denote by $\tilde{\mu}_{f\ell(f)js}$ such that $p_{f\ell(f)js} = \tilde{\mu}_{f\ell(f)js} c_{fs} t_{\ell(f)js} \tau_{js}$. We now distinguish between two different competition modes, price competition, denoted by the superscript B for Bertrand, and quantity competition, denoted by the superscript C for Cournot. Consequently, any firm i will maximize operating profit (A.1) under Bertrand (Cournot) competition w.r.t. its price $p_{f\ell(f)js}$ (quantity $q_{f\ell(f)js}$) it will set (sell) in country j. The equilibrium markups are given by[22]

$$\tilde{\mu}_{f\ell(f)js}^{B} = \frac{\sigma_{js} - (\sigma_{js} - 1) s_{f\ell(f)js}^{B}}{(\sigma_{js} - 1)(1 - s_{f\ell(f)js}^{B})} \tag{A.2}$$

for price competition and

[22]For a derivation of markups in a general oligopoly model, see d'Aspremont and Dos Santos Ferreira (2016). Heid and Stähler (2024) prove existence and uniqueness of the Nash equilibrium.

$$\tilde{\mu}^{C}_{f\ell(f)js} = \frac{\sigma_{js}}{(\sigma_{js}-1)\left(1-s^{C}_{f\ell(f)js}\right)} \tag{A.3}$$

for quantity competition where

$$\begin{aligned} s^{A}_{f\ell(f)js} &= \frac{\left(\tilde{\mu}^{A}_{f\ell(f)js} c_{fs} t_{\ell(f)js} \tau_{js}\right)^{1-\sigma_{js}}}{\sum_{n\in M_{js}} \left(\tilde{\mu}^{A}_{n\ell(n)js} c_{nk} t_{\ell(n)js} \tau_{js}\right)^{1-\sigma_{js}}} \\ &= \frac{\left(\tilde{\mu}^{A}_{f\ell(f)js} c_{fs} t_{\ell(f)js}\right)^{1-\sigma_{js}}}{\sum_{n\in M_{js}} \left(\tilde{\mu}^{A}_{n\ell(n)js} c_{ns} t_{\ell(n)js}\right)^{1-\sigma_{js}}}, A \in \{B, C\} \end{aligned} \tag{A.4}$$

is the market share of firm f in country j.

Three comments are in order now. First, since the market shares depend on markups as well, both (A.2) and (A.3) is a system of equations which gives the markups of all firms of sector s that are active in country j. Second, both (A.2) and (A.3) converge to the markup of monopolistic competition if the market shares of all firms become very small. Third, we observe that τ_{js} drops out from (A.4) which means that any variation in τ_{js} does not change the system of equations that determine the markups $\tilde{\mu}_{f\ell(f)js}$.

Consequently, as long as the set of active firms remains unchanged, the markups over the tax-inclusive cost do not change, and thus also the relative prices do not change. What about the operating profit? We find that the maximized operating profit using the tax-inclusive markups is given by

$$\pi^{*}_{f\ell(f)js} = \frac{\left(\tilde{\mu}_{f\ell(f)js}-1\right) c_{fs} t_{\ell(f)js} \tau_{js}}{\tau_{js}} q^{*}_{f\ell(f)js} = \left(\tilde{\mu}_{f\ell(f)js}-1\right) c_{fk} t_{\ell(f)js} q^{*}_{f\ell(f)js}$$

where the equilibrium demand can be given as

$$q^{*}_{f\ell(f)js} = \frac{\alpha_{js} E_j \left(\tilde{\mu}_{f\ell(f)js} c_{fk} t_{\ell(f)js} \tau_{js}\right)^{-\sigma_{js}}}{\sum_{n\in M_{js}} \left(\tilde{\mu}_{n\ell(n)js} c_{ns} t_{\ell(n)js} \tau_{js}\right)^{1-\sigma_{js}}} = \frac{\alpha_{js} E_j}{\tau_{js}} \frac{\left(\tilde{\mu}_{f\ell(f)js} c_{fs} t_{\ell(f)js}\right)^{-\sigma_{js}}}{\sum_{n\in M_{js}} \left(\tilde{\mu}_{n\ell(n)js} c_{ns} t_{\ell(n)js}\right)^{1-\sigma_{js}}}.$$

Using $q^{*}_{f\ell(f)js}$ allows us to write the maximized operating profit as a function of the market share and of the tax-inclusive markup since

$$\pi^*_{f\ell(f)js} = \frac{\tilde{\mu}_{f\ell(f)js} - 1}{\tilde{\mu}_{f\ell(f)js}} \frac{\alpha_{js} E_j}{\tau_{js}} \frac{\left(\tilde{\mu}_{f\ell(i)js} c_{fk} t_{\ell(f)js}\right)^{1-\sigma_{js}}}{\sum_{n \in M_{js}} \left(\tilde{\mu}_{n\ell(n)js} c_{ns} t_{\ell(n)js}\right)^{1-\sigma_{js}}} \tag{A.5}$$
$$= \frac{s_{f\ell(f)js} \alpha_{js} E_j}{\tau_{js}} \left(1 - \frac{1}{\tilde{\mu}_{f\ell(f)js}}\right).$$

Expression (A.5) shows that the maximized operating profit increases with both the market share and the tax-inclusive markup. Furthermore, we observe that the VAT rate decreases the maximized operating profit by the factor $1/\tau_{jk}$. In order to compare the maximized operating profits across different firms, we first find that the markup increases with the market share for both price and quantity competition since

$$\frac{\partial \tilde{\mu}^B_{f\ell(f)js}}{\partial s^B_{f\ell(f)js}} = \frac{1}{(\sigma_{js} - 1)\left(1 - s^B_{f\ell(f)js}\right)} > 0, \frac{\partial \tilde{\mu}^C_{f\ell(f)js}}{\partial s^C_{f\ell(f)js}} = \frac{\sigma_{js}}{(\sigma_{js} - 1)\left(1 - s^C_{f\ell(f)js}\right)} > 0.$$

Consequently, if $s_{f\ell(f)js} > s_{n\ell(n)js}$ holds in equilibrium, also $\tilde{\mu}_{\ell(f)js} > \tilde{\mu}_{n\ell(n)js}$ must hold. Let $\gamma_{f\ell(f)js} = c_{fk} t_{\ell(f)js}$ denote the variable cost of firm f. We find for the relative market shares that

$$\frac{s_{f\ell(f)js}}{s_{n\ell(n)js}} = \left(\frac{\tilde{\mu}_{n\ell(n)js} \gamma_{n\ell(n)js}}{\tilde{\mu}_{f\ell(f)js} \gamma_{f\ell(f)js}}\right)^{\sigma_{js}-1}$$

which requires that $\tilde{\mu}_{n\ell(n)js} \gamma_{\ell(n)js} > \tilde{\mu}_{f\ell(f)js} \gamma_{\ell(f)js}$ must hold at the same time if $s_{f\ell(f)js} > s_{n\ell(n)js}$. Since $\tilde{\mu}_{\ell(f)js} > \tilde{\mu}_{n\ell(n)js}$, a larger market share and a larger markup must also imply a smaller variable cost such that $\gamma_{f\ell(f)js} < \gamma_{n\ell(n)js}$. Thus, low-cost (high-cost) firms have a larger (smaller) markup and market share and therefore a larger (smaller) maximized operating profit.

A.2 Extensive margin effect

We estimate the following equation:

$$log(N_{jt}) = \alpha + \beta VAT_{jt} + \delta g_{jt} + \psi_j + \chi_t + \epsilon_{jt}, \tag{A.6}$$

where N_{jt} represents either the number of importing firms into country j or the number of domestic firms in year t. ψ_j and χ_t represent country and year fixed effects, respectively. To account for changes in the underlying economic circumstances we also control for GDP growth in percent (g_{jt}). Looking at column (1) of Table A.1, we observe that

a one percentage point increase in the VAT rate results on average in a 2.13 percent reduction in the number of importing firms into country j. For the average European country this implies an exit of 2,422 importing firms, even larger than in our event study approach. Columns (2) and (3) indicate that the response is predominantly driven by non-EU importers. Column (4) shows no significant effect for domestic wholesalers and retailers.

Table A.1: Extensive Margin Response

	(1) All Importers	(2) EU Importers	(3) Non-EU Importers	(4) Domestic Firms
Variables				
VAT %	-2.13***	-2.01	-1.61*	0.122
	(0.68)	(1.37)	(0.81)	(0.245)
GDP growth (annual %)	0.003	-0.002	0.003	0.001
	(0.004)	(0.006)	(0.003)	(0.001)
Fixed effects				
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	211	209	211	195

Note: Standard errors are clustered at the country level and shown in parentheses.
r Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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