The (Non-)Neutrality of Value Added Taxation

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The paper in a nutshell

Is the VAT neutral? Is it non-discriminatory?

- Neutrality: VAT does not influence trade flows.
- Non-discrimination: VAT applies uniformly to imports and domestic production of final goods.
- Structural (general equilibrium) gravity model.
  - ... aggregate imports (Neutrality).
  - ... internal trade relative to external trade (Discrimination).
  - ... overall welfare.
- Novel panel of VAT regime information covering more than 150 countries
- Main findings:
  - The VAT is not neutral.
  - The VAT is discriminatory.
  - The welfare effects are not marginal, but substantial; between 1.94 and 4.92% for the average European country.

Related literature & contribution

1. VAT reforms in public economics literature
   - Doyle Jr. and Samphantharak (2008), Chetty et al. (2009), Kosonen (2015), Benzarti et al. (2020); VAT reforms affect both prices and demand.
   - This paper: analyze the effect of VAT changes in a structural cross-country setting.
2. Analysis of the effects of the VAT and trade
   - Desai and Hines (2003), Keen and Syed (2006), Nicholson (2010), Benzarti and Tazhitdinova (2021); VAT appears to have no or only moderate effects on trade.
   - This paper: to the best of our knowledge, we are the first to use structural gravity and a global panel of consumption tax information to estimate the effects of the VAT on trade.
3. Analysis of non-discriminatory policy instruments
   - Yotov et al. (2016), Beverelli et al. (2018), Heid et al. (2021); develop the methodological tools for non-discriminatory trade policy analysis.
   - This paper: employs these methodologies in the context of the VAT.

The model I

- Armington model with n countries that may trade with each other. Each country produces a final good (and intermediate goods).
- Production $\rightarrow$ constant unit cost of c_i, public good improves the efficiency of production.
- Utility:

$$U_j\left(q_{ij}\right) = \left(\sum_{i=1}^{n} \alpha_i^{\frac{1-\sigma}{\sigma}} q_{ij}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}.$$

q_{ij}: consumption of good i in country j, that is, country j's final goods imports from country i, $\sigma, \sigma > 1$: elasticity of substitution, α_i: preference parameter for goods produced in country i, q_{jj}: country j's internal trade.

The model II

- Value-added taxation: does not affect intermediate goods trade.
- Trade cost:
  - Iceberg type, t_{ij} for trade from country i to country j.
  - t_{ij} includes markups which may differ across locations.
  - $t_{ii} = 1$.
- Consumer good prices:

$$\underbrace{c_i t_{ij}}_{\text{c.i.f. producer price } p_{ij}} \times \tau_j,$$

τ_j: country j's commodity tax rate, defined as 1 plus the VAT rate.

The model III

- Representative consumer maximizes utility s.t. the budget constraint $E_j = \sum_{i=1}^{n} p_{ij}\tau_j q_{ij} = \sum_{i=1}^{n} c_i t_{ij}\tau_j q_{ij}$.
- Expenditures: $E_j = w_j L_j + \phi_j T_j + \Pi_j - \mathcal{T}_j$
  - $w_j L_j$: factor income of the local factor of production,
  - T_j: VAT revenues of which a share $\phi_j, 0 \leq \phi_j \leq 1$, is redistributed to consumers,
  - Π_j: after-tax profits accruing to residents in country j,
  - $\mathcal{T}_j$: all other taxes such that $G_j = (1-\phi_j)T_j + \mathcal{T}_j$ gives the governmental budget constraint (and G_j determines A_j).
- Gravity:

$$X_{ij} = \frac{Y_i^C E_j}{Y^C} \left(\frac{t_{ij}}{Q_i P_j} \right)^{1-\sigma} \tau_j^{-\sigma},$$

where $P_j(Q_i)$ is the inward (outward) resistance term.

The model IV

- When is the VAT neutral such that it does not change external and internal trade? If:
  1. Producer prices do not change with the VAT.
  2. The VAT is returned completely to consumers.
- Intuition: No change in relative prices implies no change in relative consumption, and a complete return compensates completely for the consumer price increase.

Data

- Consumption tax regime data:
  1. Hand-collected FOR2738 panel
     - 228 countries from 2003-2020; 159 countries with VAT type consumption taxes
     - Sources: EY *Worldwide VAT, GST and Sales Tax Guides* and reports by the International Bureau for Fiscal Documentation (IBFD)
  2. Panel of the 28 (eventual) EU member countries from 1967-2020, collected from the EC report also used in Benzarti and Tazhitdinova, 2021
- Consumption goods trade based on the BEC classification system:
  1. UN's *Comtrade database* 1995-2019 for 28 (eventual) EU countries and 49 non-EU countries
  2. CEPII's *TradeProd database* 1980-2006 for 75 countries; includes internal trade flows

▸ Data description

The effect of the VAT on overall trade flows I

- Two step estimation:
  1. Standard gravity estimation using PPML.
  2. Estimated importer-time fixed effects $\hat{v}_{jt}$ are regressed on the standard VAT rate in country j in year t:

$$\hat{v}_{jt} = \beta \cdot VAT_{jt} + \psi_j + \chi_t + \epsilon_{jt}.$$

- χ_t controls for time-fixed effects.
- ψ_j captures country-fixed effects (time-invariant components of multilateral resistance and economic size).
- If the VAT were neutral, the coefficient of interest β should not be statistically insignificant.

The effect of the VAT on overall trade flows II

Table 1: Gravity Import-FE and VAT

VAT Data	EU		Global
Trade Data	Cmtrd ('95-'19)	TrdPrd ('80-'06)	Cmtrd ('03-'19)
	(1)	(2)	(3)
VAT %	-0.052**	-0.039**	-0.081***
	(0.020)	(0.016)	(0.016)
Num.Obs.	631	490	1103

Note: Standard errors are clustered at the country level and are reported in parentheses. All models were estimated with country and year fixed effects.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

- Columns (1)-(3) indicate a significant reduction in aggregate imports.

The effect of the VAT on overall trade flows III

- Extension: Control for idiosyncratic productivity shocks or changes in non-discriminatory trade policies (such as MFN tariffs); include *GDP*, unweighted average trade costs and tariffs (MLR) as covariates. ▸ Extension
- Exclude intra-national trade flows to check whether results are driven by internal trade. ▸ Estimates for external trade only
- Exploit reduced VAT rates (foodstuffs) to estimate a two-sector model to control for sector-time specific trends.

The effect of the VAT on overall trade flows IV

Table 2: Two-Sector Model

	TrdPrd & EU VAT, '80-'06	
	Import FE (1)	Import FE (2)
appl. VAT %	-0.031**	-0.016***
	(0.009)	(0.006)
Num.Obs.	888	866

Note: Shown are results from a linear fixed effects model. Standard errors are clustered at the country-sector level for model (1). For model (2) standard errors are calculated using three-way clustering at the country-sector, sector-year and country-year levels. Standard errors are reported in parentheses. All models were estimated with country-sector, sector-year and country-year fixed effects. The dependent variable is the importer-sector-time fixed effect from a two-sector gravity model estimated with PPML.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

- Conclusion: VAT is not neutral, both internal and external trade in final goods decrease substantially, at least by 3.05 %.

The effect of the VAT on internal trade I

- Interact VAT rate with a border indicator to distinguish between international and internal trade responses.

$$X_{ijt} = \exp(\beta_1 RTA_{ijt} + \beta_2 BORDER_{ij} * VAT_{jt} + \eta_{it} + \nu_{jt} + \xi_{ij} + \zeta_{ijt} + u_{ijt}),$$

  coefficient β_2: the *additional* impact of the VAT on imports from a foreign country compared to internal trade.
- TradeProd data set combined with EU VAT data set.
- Robust results for standard bilateral gravity controls instead of pair FE ▸ Standard Gravity

The effect of the VAT on internal trade II

Table 3: Discriminatory VAT

	(1)	(2)	(3)	(4)	(5)	(6)
	Pooled Sample		Non-Foods		Foodstuffs	
RTA	0.624***	0.532***	0.882***	0.578***	0.318***	0.444***
	(0.094)	(0.057)	(0.132)	(0.086)	(0.039)	(0.063)
Border X VAT (EU)	-0.034***	-0.111***	-0.054***	-0.079***	-0.018**	-0.152***
	(0.009)	(0.005)	(0.017)	(0.009)	(0.009)	(0.007)
Num.Obs.	67124	66762	37550	37295	29574	29467

Note: Shown are results from a gravity model estimated using PPML. Standard errors are clustered at the country-pair level and shown in parantheses. All models are estimated with importer-time and exporter-time fixed effects. Models (1), (3) and (5) include symmetric pair fixed effects. Models (2), (4) and (6) also include distance, contiguous border, common language and colony as covariates. All models also include border-year fixed effects
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The effect of the VAT on internal trade III

- Conclusion: VAT is discriminatory, internal relative to external trade in final goods increases substantially, by at least 5.4 %.
- How can we rationalize the empirical findings?

Proposition

Internal trade in final goods increases relative to aggregate imports of final goods if the relative price change of p_{jj} is smaller than the sum of relative prices changes of p_{ij}, $i \neq j$, weighted by the import shares s_{ij}

- Pass-through of the VAT to consumers needs to be smaller for home firms than for foreign firms-
- Potential drivers of relative price change:
  - Absolute trade cost
  - Public good provision
  - Extensive margin response ▸ entry model

Welfare analysis I

- If the VAT is discriminatory, how large are the welfare effects?
- Employ ACR (Arkolakis et al, 2012); welfare effect of a change in expenditures on domestically produced final goods.
- Distinguish between the value of imports which is given before VAT in c.i.f. terms and expenditures which include the VAT.

Proposition

The welfare change due to a change in the VAT rate is given by

$$\widehat{W}_j = \widehat{E}_j \frac{\widehat{\lambda}_{jj}^{\frac{1}{1-\sigma}}}{\widehat{p}_{jj}\widehat{\tau}_j} = \left(\frac{\widehat{E}_j}{\widehat{\tau}_j}\right)^{\frac{\sigma}{\sigma-1}} \frac{\widehat{X}_{jj}^{\frac{1}{1-\sigma}}}{\widehat{p}_{jj}}.$$

Welfare analysis II

- As in ACR, only changes in domestic variables determine the welfare change. ▸ Details
- A positive change in internal trade $\widehat{X}_{jj}$ implies a welfare loss.
- Conservative estimate: 1 % VAT increase reduces aggregate trade by 3.1 %.
- Implication: expenditures decrease.
- External trade relative to internal trade declines by an *additional* 1.8 % or 5.4 % on average.
- Absolute change in internal/external trade depends on the ratio of external relative to aggregate trade (γ).
- Welfare effects are calculated for:
  1. Elasticity of substitution: $\sigma_1 = 3.8$, $\sigma_2 = 5.03$.
  2. $\beta_2 = -5.4\%$ or $\beta_2 = -7.9\%$.
  3. Average ratio of external to aggregate trade $\bar{\gamma} = 0.6734958$.
  4. Average VAT $\bar{\tau} = 1.1962683$.

▸ Calculation

Welfare analysis III

1. Welfare loss if increase in tax revenues is completely unproductive, for complete absorption ($\widehat{p}_{jj}\widehat{\tau}_j = 1$) to complete pass-through ($\widehat{p}_{jj} = 1$) of domestic prices.

Table 4: $1 - \widehat{W}_j$

	β_2	
	-0.018	-0.054
$\sigma_1 = 3.8$	2.71 - 3.52	3.57 - 4.37
$\sigma_2 = 5.03$	2.59 - 3.39	3.18 - 3.99

▸ Further welfare calculations

Conclusions

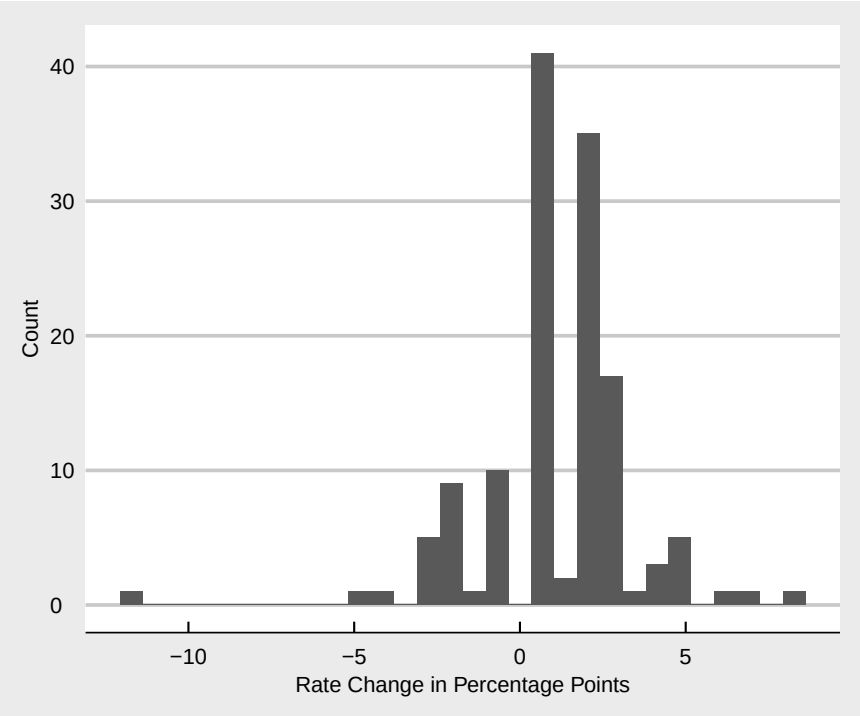
- The VAT is not neutral; semi-elasticity of aggregate imports at least -3.1 %.
- The VAT is discriminatory; international trade relative to internal trade decreases in the EU by 1.8 % or 5.4 %.
- Substantial welfare losses from VAT changes.
- Explanation: relative prices of importers and local producers of final goods change.
- Exploring the details of these responses requires a model which can explain the varying markup behavior of firms.

Data description I

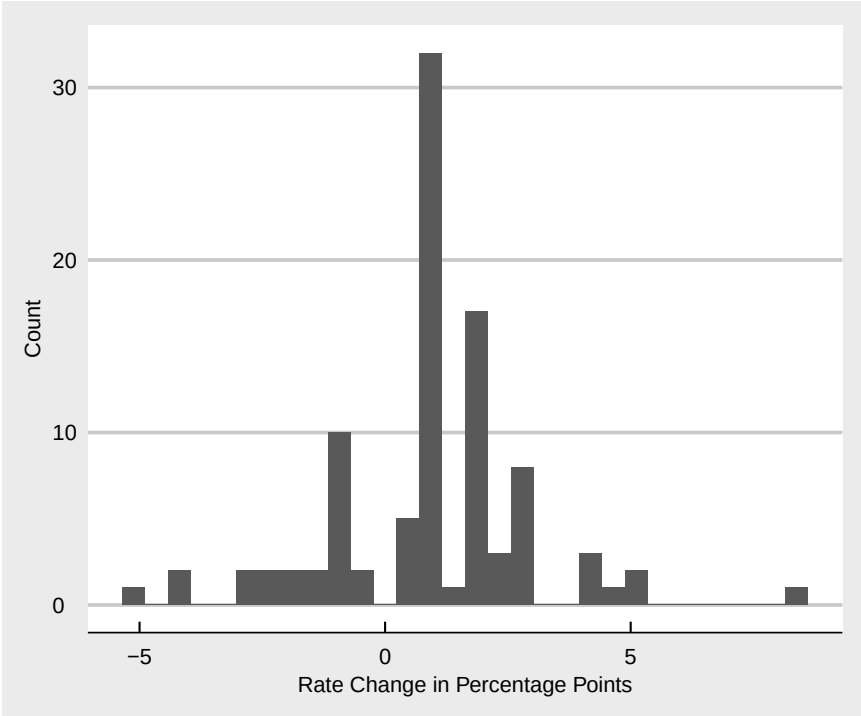
- Control Data:
  - RTA data from Egger and Larch, 2008
  - GDP data from Eurostat (EU panel) and the OECD (Global panel)
  - Average tariff data from the World Bank
  - Cost of insurance and freight data from CEPII's Trade Unit Values (TUV) data set

- Variation in the VAT rates:
  - EU: 135 VAT rate changes excluding initial introduction; 107 increases 28 decreases
  - Global: 96 rate changes (23 negative, 73 positive) for our main analysis (77 countries, 17 years)
  - 1.16 percentage points average rate change, 1 pp median change

Data description II



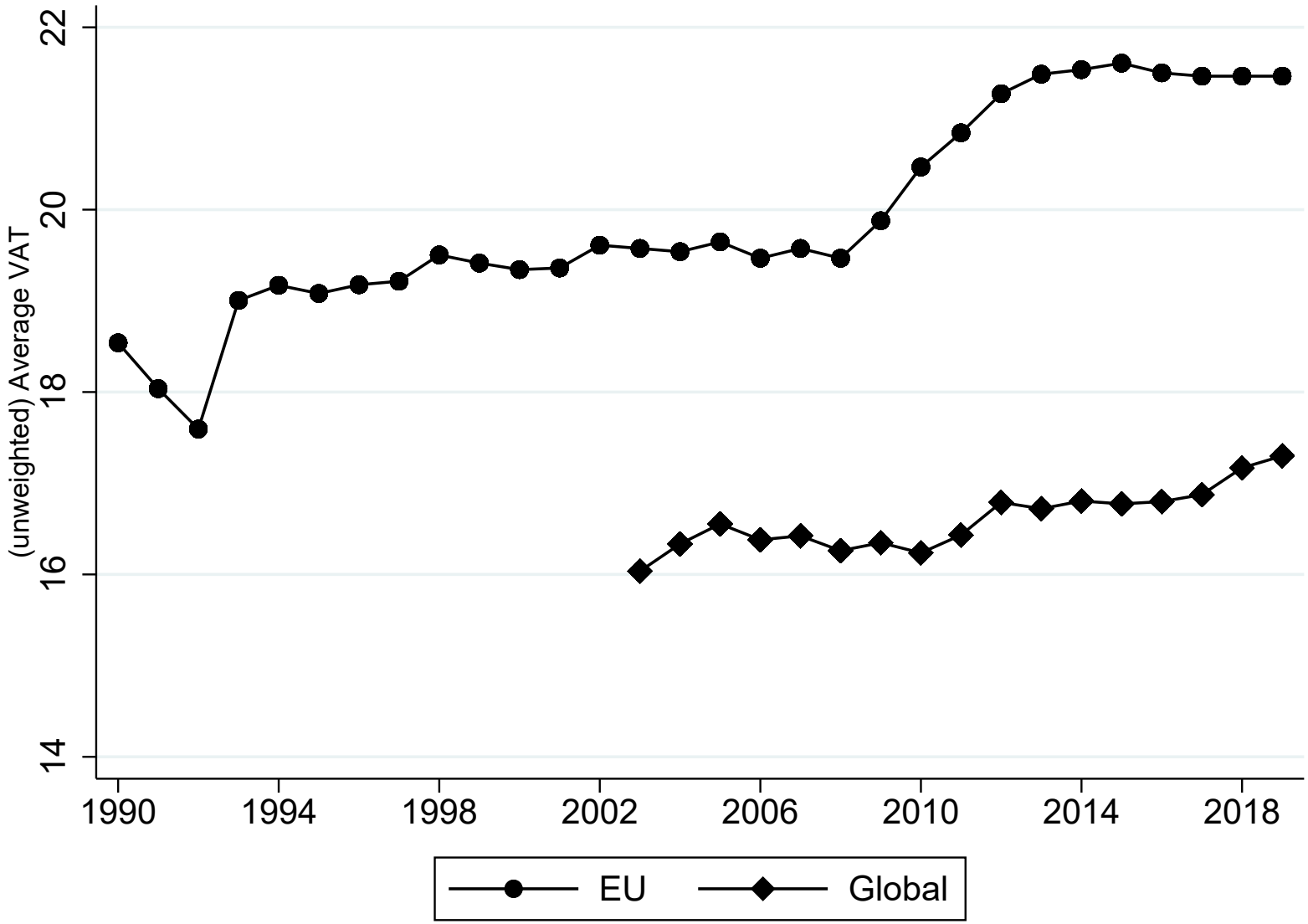
(a) Std. Rate Changes of Eventual EU Members



(b) Std. Rate Changes Global

Figure 1: Variation of VAT Rates

Data description III



Data description IV

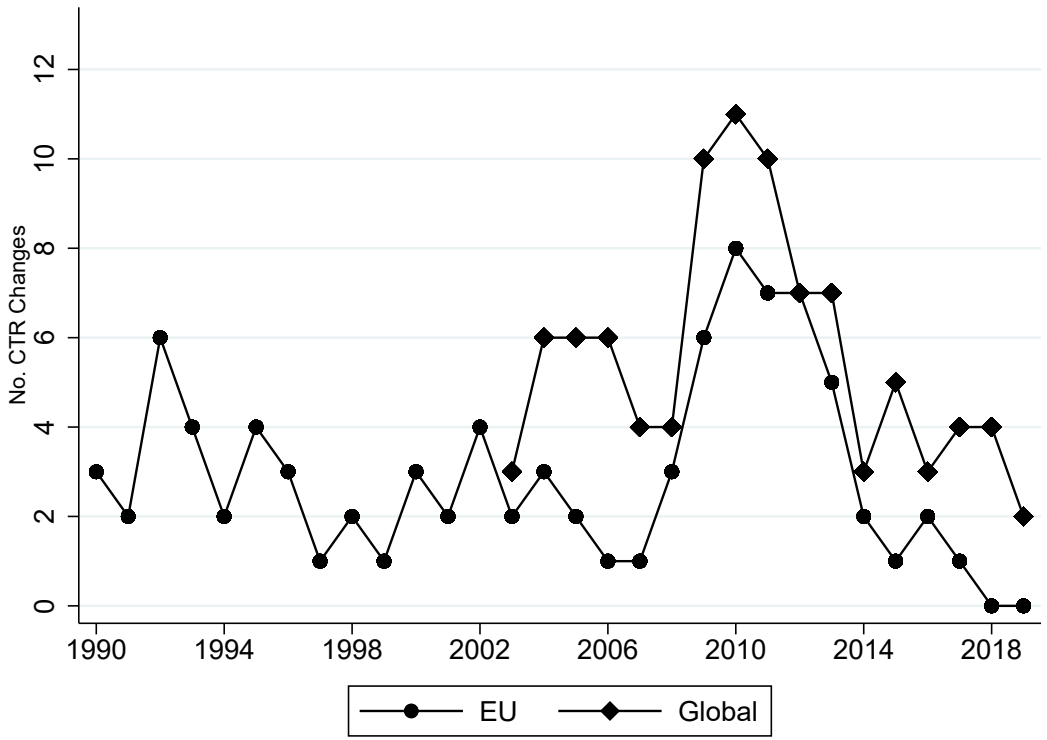


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Table 5: Gravity Import-FE and VAT with controls

VAT Data	EU		World	
Trade Data	Cmtrd ('95-'19)	TrdPrd ('80-'06)	Cmtrd ('03-'19)	TrdPrd ('03-'06)
	(1)	(2)	(3)	(4)
VAT %	-0.041*	-0.056**	-0.054***	-0.038*
	(0.022)	(0.020)	(0.018)	(0.021)
GDP	0.000	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Trade Costs (import)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Tariffs			-0.005	-0.009
			(0.031)	(0.009)
Num.Obs.	499	154	644	175

Note: Shown are results from a linear fixed effects model. Standard errors are clustered at the country level and are reported in parentheses. All models were estimated with country and year fixed effects. The dependent variable are importer-time fixed effects from a gravity model estimated with PPML.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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Estimates for external trade only I

Table 6: Import FE with Controls and without Internal Trade

VAT Data	EU	World
Trade Data	TrdPrd '80-'06	TrdPrd '03-'06
	(1)	(2)
VAT %	-0.057***	-0.038**
	(0.016)	(0.015)
GDP	0.000*	0.000**
	(0.000)	(0.000)
Trade Costs (import)	0.000	0.000
	(0.000)	(0.000)
Tariffs		-0.016
		(0.012)
Num.Obs.	154	175

Note: Standard errors are clustered at the country level and are reported in parentheses. All models were estimated with country and year fixed effects. The dependent variable are importer-time fixed effects from a gravity model estimated with PPML on data excluding internal trade flows.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Estimates for external trade only II

Table 7: Two-Sector Model without Internal Trade

	TrdPrd & EU VAT, '80-'06	
	Import FE (1)	Import FE (2)
appl. VAT %	-0.016*	-0.016**
	(0.008)	(0.006)
Num.Obs.	866	866

Note: Standard errors are clustered at the country-sector level for model (1). For model (2) standard errors are calculated using three-way clustering at the country-sector, sector-year and country-year levels. Standard errors are reported in parentheses. All models were estimated with country-sector, sector-year and country-year fixed effects. The dependent variable are importer-sector-time fixed effects from a two-sector gravity model estimated with PPML on data excluding internal trade flows.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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The effect of the VAT on internal trade I

Table 8: Discriminatory VAT

	(1)	(2)
RTA	0.882***	0.578***
	(0.209)	(0.127)
Border X VAT (EU)	-0.054**	-0.079***
	(0.026)	(0.028)
Log Distance		-0.361***
		(0.084)
Contiguous Border		0.232*
		(0.122)
Common Language		0.762***
		(0.091)
Colony		0.222**
		(0.102)
Num.Obs.	37550	37295

Note: Shown are results from a gravity model estimated using PPML. Standard errors are clustered at the country-pair level and shown in parantheses. Both models are estimated with importer-time and exporter-time fixed effects. Model (1) also includes symmetric pair fixed effects. Both models also include border-year fixed effects.
Significance levels: *$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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Welfare effects

Totally differentiating the price index yields

$$d \ln P_j = \sum_{i=1}^{n} \lambda_{ij} d \ln p_{ij} + d \ln \tau_j.$$

Since $\lambda_{ij} = (p_{ij}\tau_j / P_j)^{1-\sigma}$, $\lambda_{kj}/\lambda_{ij} = (p_{kj}/p_{ij})^{1-\sigma}$. Taking logs and differentiating:

$$d \ln p_{ij} = d \ln p_{jj} + \frac{d \ln \lambda_{ij} - d \ln \lambda_{jj}}{1 - \sigma},$$

Welfare effects

$$d \ln P_j = \sum_{i=1}^{n} \lambda_{ij} \left[d \ln p_{jj} + \frac{d \ln \lambda_{ij} - d \ln \lambda_{jj}}{1 - \sigma} \right] + d \ln \tau_j$$
$$= \frac{d \ln \lambda_{jj}}{\sigma - 1} + d \ln p_{jj} + d \ln \tau_j.$$

Define $d \ln \Lambda_j = d \ln \lambda_{jj} + (\sigma - 1)[d \ln p_{jj} + d \ln \tau_j]$. Differential equation:

$$\frac{dP_j}{P_j} = \frac{d\Lambda_j}{(\sigma - 1)\Lambda_j} \Leftrightarrow \frac{dP_j}{d\Lambda_j} = \frac{P_j}{(\sigma - 1)\Lambda_j},$$

solution $P_j = C\Lambda^{\frac{1}{\sigma - 1}}$.

Welfare effects

$$\widehat{W}_j = \frac{W_j^1}{W_j^0} = \frac{E_j^1}{E_j^0}\frac{P_j^0}{P_j^1} = \widehat{E}_j \widehat{\Lambda}_j^{\frac{1}{1-\sigma}}.$$

$\Lambda_j = \lambda_{jj}(p_{jj}\tau_j)^{\sigma-1}$. $\lambda_{jj} = \tau_j X_{jj}/E_j$:

$$d\ln\Lambda_j = d\ln X_{jj} - d\ln E_j + (\sigma-1)d\ln p_{jj} + \sigma d\ln\tau_j,$$

$$\Lambda_j = \frac{X_{jj}}{E_j} p_{jj}^{\sigma-1}\tau_j^{\sigma}.$$

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Welfare results: Calculations I

- Change in the VAT: $\hat{\tau} = 1.2062683/1.1962683 = 1.00836$
- Change in expenditure: $\widehat{E}_j = 1.00836 \times 0.9695 = 0.977604$.
- Change of internal trade in terms of γ: $\gamma\widehat{X}_{ij} + (1-\gamma)\widehat{X}_{jj} = \gamma(1+\beta_2)\widehat{X}_{jj} + (1-\gamma)\widehat{X}_{jj} = \widehat{X}_{ij}\left[1+\gamma\beta_2\right] = 1 - 0.0305 = 0.9695$ must hold for the average European country
- Implication: $\widehat{X}_{jj} = 0.9695/(1+\gamma\beta_2)$ where $\beta_2 = -5.4\%$ or $\beta_2 = -7.9\%$.

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A simple entry model I

- Perfect competition model of trade with n countries, each country i hosts N_i firms, and each firm is able to sell one unit (or none) in each country.
- Each firm draws its unit cost realization from a distribution $F(\cdot)$ that has positive support between 0 and $\bar{c}$.
- Focus on sales in country j, iceberg trade cost of size t_{ij}
- Implication: a firm located in country i sells a unit in country j if its cost realization is less or equal to $p_{ij}/(\tau_j t_{ij})$.
- In equilibrium, each firm correctly anticipates demand and supply for each variety i sold in country j to clear such that

$$q_{ij} = \frac{E_j p_{ij}^{-\sigma}}{\sum_{k=1}^{n} p_{kj}^{1-\sigma}} = \min\left[F\left(\frac{p_{ij}}{\tau_j t_{ij}}\right), 1\right] N_i \tag{1}$$

holds where we have set $\alpha_i = 1$ w.l.o.g.

A simple entry model II

- LHS: demand for variety i in country j, RHS: supply that is the fraction of firms serving country j times the number of firms located in country i.
- For $k \neq i$:

$$\frac{\partial q_{ij}}{\partial p_{ij}} = -\frac{q_{ij}}{p_{ij}}\left(\sigma - (\sigma-1)\frac{p_{ij}q_{ij}}{E_j}\right) = -\frac{q_{ij}}{p_{ij}}\left(\sigma - (\sigma-1)s_{ij}\right) < 0 \text{ and}$$

$$\frac{\partial q_{ij}}{\partial p_{ik}} = \frac{q_{ij}}{p_{ij}}(\sigma-1)\frac{p_{kj}q_{kj}}{E_j} = \frac{q_{ij}}{p_{ij}}(\sigma-1)s_{kj} > 0,$$

where s_{ij} denotes the market share of country i in country j.

A simple entry model III

- Let

$$z_{ij} = F\left(\frac{p_{ij}}{\tau_j t_{ij}}\right) N_i$$

denote supply in case that $\min\left[F\left(p_{ij}/\left(\tau_j t_{ij}\right)\right), 1\right] < 1$.

- Then:

$$\frac{\partial z_{ij}}{\partial p_{ij}} = \frac{f\left(p_{ij}/\left(\tau_j t_{ij}\right)\right)}{\tau_j t_{ij}} N_i > 0, \frac{\partial z_{ij}}{\partial p_{ik}} = 0 \textbf{ and}$$
$$\frac{\partial z_{ij}}{\partial \tau_j} = -\frac{f\left(p_{ij}/\left(\tau_j t_{ij}\right)\right) p_{ij}}{\tau_j^2 t_{ij}} N_i < 0.$$

- Assumption 1: all producers in the domestic country j serve their own country because $p_{jj}/\tau_j < \bar{c} \Leftrightarrow F\left(p_{jj}/\tau_j\right) = 1$.

A simple entry model IV

- All foreign producers, however, select themselves into exporters and non-exporters because $F\left(p_{ij}/(\tau_j t_{ij})\right) < 1$.
- Assumption 2: all foreign countries are symmetric, p_j, q_j, s_j denote the equilibrium price, demand and market share, respectively, of domestic producers, and p_i, q_i, s_i denote the symmetric foreign prices, demands and market shares, respectively.
- Change of the relative c.i.f. price p_j/p_i with a marginal increase in the VAT rate τ_j. Total differentiation yields

A simple entry model V

$$\overbrace{\frac{\partial q_j}{\partial p_j}}^{a_{jj}} \frac{dp_j}{d\tau_j} + \overbrace{(n-1)\frac{\partial q_j}{\partial p_i}}^{a_{ji}} \frac{dp_i}{d\tau_j} = 0,$$

$$\underbrace{\frac{\partial q_i}{\partial p_j}}_{a_{ij}} \frac{dp_j}{d\tau_j} + \underbrace{\left((n-1)\frac{\partial q_i}{\partial p_i} - \frac{\partial z_i}{\partial p_i}\right)}_{a_{ii}} \frac{dp_i}{d\tau_j} = -\underbrace{\frac{\partial z_i}{\partial \tau_j}}_{a_\tau},$$

where $a_\tau < 0$ and

A simple entry model VI

$$
\begin{aligned}
a_{jj} &= -\frac{q_j}{p_j}\left(\sigma - (\sigma-1)s_j\right) < 0, \\
a_{ji} &= (n-1)\left(\frac{q_j}{p_j}(\sigma-1)s_i\right) > 0, \\
a_{ij} &= \frac{q_i}{p_i}(\sigma-1)s_j > 0, \\
a_{ii} &= (n-1)\left(-\frac{q_i}{p_i}\left(\sigma - (\sigma-1)s_i - \frac{f\left(p_i/(\tau_j t_i)\right)}{\tau_j t_i}N_i\right)\right) \\
&< -(n-1)\left(\frac{q_i}{p_i}\left(\sigma - (\sigma-1)s_i\right)\right) < 0.
\end{aligned}
$$

A simple entry model VII

- The changes are given by $dp_j/d\tau_j = a_{ji}a_\tau/\det(A)$ and $dp_i/d\tau_j = -a_{jj}a_\tau/\det(A)$ where

$$\begin{aligned}\det(A) &= a_{jj}a_{ii} - a_{ji}a_{ij} \\ &> \frac{(n-1)\sigma q_i q_j\left(\sigma - (\sigma-1)s_i - (\sigma-1)s_j\right)}{p_i p_j} > 0\end{aligned}$$

because $g(\sigma) \equiv \sigma - (\sigma-1)s_i - (\sigma-1)s_j$ implies $g(1) = 1$ and $g'(\sigma)1 - s_i - s_j \geq 0$ as $s_i + s_j \leq 1$.

A simple entry model VIII

- The relative c.i.f. price change is given by

$$\frac{dp_j}{dp_i} = -\frac{a_{ji}}{a_{jj}} = \frac{(n-1)(\sigma-1)s_i}{\sigma-(\sigma-1)s_j} = \frac{(\sigma-1)\left(1-s_j\right)}{\sigma-(\sigma-1)s_j}$$
$$= 1 - \frac{1}{\sigma-(\sigma-1)s_j} < 1$$

  because $(n-1)s_i = 1 - s_j$.

- Shows that the c.i.f. price change is smaller for domestic producers than for foreign producers, implying an increase in relative demand for the domestically produced good.

back

Further welfare calculations I

2 Welfare loss if increase in tax revenues is completely unproductive, for complete absorption ($\widehat{p}_{jj}\widehat{\tau}_j = 1$) to complete pass-through ($\widehat{p}_{jj} = 1$) of domestic prices if $\widehat{E}_j = 1$.

Table 9: $1 - \widehat{W}_j$

	β_2	
	-0.018	-0.054
$\sigma_1 = 3.8$	0.435 - 1.26	1.31 - 2.13
$\sigma_2 = 5.03$	0.302 - 1.13	0.915 - 1.74

Further welfare calculations II

3. A 1% VAT increase raises public good provision (G_j) and increases productivity (A_j). By how much must the domestic price decrease to keep welfare constant?

Table 10: $1 - \widehat{p}_{jj}$ in % for $\widehat{W}_j = 1$

	β_2	
	-0.018	-0.054
$\sigma_1 = 3.8$	3.52	4.37
$\sigma_2 = 5.03$	3.39	3.99

Further welfare calculations III

4 A 1% VAT compensates for an income/corporate tax reform. By how much must income increase to keep welfare constant? (for complete absorption ($\widehat{p}_{jj}\widehat{\tau}_j = 1$) to complete pass-through ($\widehat{p}_{jj} = 1$) of domestic prices)

Table 11: $\widehat{Y}_{jj}$ in % for $\widehat{W}_j = 1$

	β_2	
	-0.018	-0.054
$\sigma_1 = 3.8$	2.05 - 2.68	2.72 - 3.35
$\sigma_2 = 5.03$	2.12 - 2.8	2.63 - 3.31

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