The Cost of Non-Europe Revisited

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Motivation

Why re-evaluate Costs of Non-Europe nearly 30 years after the Cecchini report ?

Confectionery	**2.97***
Railway	**3.03***
Aerospace	*3.07**
Metals transformation	3.18*
Paint and Ink	3.26*
Printing	3.39*
Motor vehicles-bodies	3.39*
Structural metal	3.52*
Pharmaceuticals	**3.61***
Graphic labs	*3.62**
Foundries	3.68*
Shipbuilding	**3.69***
Grain milling	3.82*
Dairy	3.92*
Metal containers	**3.95***
Food n.e.s.	4.12*
Used tyres	4.12*
Bread	4.19*
Distilling	4.21*
Pasta	**4.27***
Wine	**4.43***
Soft drinks	**4.58***
Clay	4.63*
Tobacco	4.64*
Beer	**4.66***
Concrete	4.68*
Cement	4.75*
Forging	4.78*
Poultry	4.83*
Wood-sawing	5.26*
Wooden containers	5.55*
Oil refining	5.58*
Carpentry	6.03*
Sugar	6.41*

Motivation

Why re-evaluate Costs of Non-Europe nearly 30 years after the Cecchini report ?

- Brexit, policy platforms in various EU member states proposing referenda on EU membership, global support for the EU falling... all question the European integration process

  $\Rightarrow$ What gains did the EU reap from *trade* integration since 1957 ? What would be the costs of going backwards ?

- On the academic front, tools to evaluate gains from trade have matured
  1. econometric analysis estimating trade creation / diversion
  2. computable general equilibrium
  3. structural gravity / exact hat algebra

Motivation

- Two very convenient properties of most popular trade models (Dekle et al., 2007 ; Arkolakis et al., 2012 ; Costinot and Rodriguez-Clare, 2014) :
  1. trade frictions are estimable in a simple way using structural gravity ;
  2. endowed with those frictions, it is easy to run counterfactuals using an Exact Hat Algebra approach (EHA) that imposes minimal data requirement.
- Gains From Trade (GFT) depend on two aggregate "sufficient statistics"
  - $\pi_{nn} = 1-$ import penetration ratio of country n, observed and counterfactual ;
  - $\epsilon < 0$: elasticity of trade wrt. to trade costs.
- Need to know what are the impacts of trade policy changes on all bilateral trade flows, to recalculate counterfactual π_{nn}.

What we do

1. Estimate the trade impact of the EU
   - differentiating various components of European integration : customs union, single market, Schengen area, euro area ;
   - separately for trade in goods and services.
2. Assess the performance of counterfactual exercises based on structural gravity in the case of the 2004/07 enlargements.
3. Compute counterfactual trade flows in 2 scenarios
   - a regular RTA replaces the EU ;
   - return to the WTO option under which MFN tariffs replace the EU.
4. Compute welfare gains from EU for all members.

What we don't do

Some limits to our calculations :

- estimate static gains from trade
  - dynamic gains are ambiguous : could foster or deter innovation.
- silent on cost/benefit of provision of public goods by the EU (e.g. external trade policy, competition policy, monetary policy, security...)
- ... or costs related to the heterogeneity of preferences between members (Spolaore et al., 2000).
- no account for FDI, immigration, net contribution to EU budget...

Outline of talk

1. Welfare and trade impacts of regional agreements
2. The trade Impact of the EU
3. Assessing the fit of counterfactuals based on structural gravity
4. Gains from EU trade integration

Welfare and trade impacts of regional agreements

Gravity as a tool

- To evaluate counterfactual trade flows, we need a good model for... factual trade flows :
  1. It should describe bilateral data patterns well ▸ GDP ▸ Distance
  2. It should be easy to fit in a general equilibrium analysis
  3. Ideally should be general in terms of micro-foundations

  $\Rightarrow$ Structural gravity fits those requirements.

- Leamer & Levinsohn : gravity models "have produced some of the clearest and most robust findings in economics."

Structural gravity

Most popular trade models feature bilateral trade as

$$X_{ni} = \frac{Y_i}{\Omega_i} \frac{X_n}{\Phi_n} \phi_{ni},$$

where $\phi_{ni} \equiv \tau_{ni}^{\epsilon}$, τ_{ni} being trade costs, $Y_i = \sum_n X_{ni}$ is the value of production, $X_n = \sum_i X_{ni}$ is the value of expenditure, and Ω_i and Φ_n are "multilateral resistance" terms defined as

$$\Phi_n = \sum_{\ell} \frac{\phi_{n\ell} Y_\ell}{\Omega_\ell} \quad \text{and} \quad \Omega_i = \sum_{\ell} \frac{\phi_{\ell i} X_\ell}{\Phi_\ell}.$$

▸ Microfoundations

2 measures of trade impact

Suppose $\ln \phi_{ni}$ includes RTA_{ni} dummy with coefficient β. What is the impact on trade of changing RTA_{ni} to RTA'_{ni} ?

Partial Trade Impact :

$$\text{PTI}_{ni} = \phi'_{ni}/\phi_{ni} = \exp[\beta(\text{RTA}'_{ni} - \text{RTA}_{ni})] \tag{1}$$

General Equilibrium Trade Impact :

$$\text{GETI}_{ni} = \frac{X'_{ni}}{X_{ni}} = \underbrace{\exp[\beta(\text{RTA}'_{ni} - \text{RTA}_{ni})]}_{\text{PTI}} \times \underbrace{\frac{\Omega_i \Phi_n}{\Omega'_i \Phi'_n}}_{\text{MR adj.}} \times \underbrace{\frac{Y'_i X'_n}{Y_i X_n}}_{\text{GDP adj.}} = \frac{\hat{Y}_i \hat{X}_n}{\hat{\Omega}_i \hat{\Phi}_n} \hat{\phi}_{ni} \tag{2}$$

GETI : GDP adj. algorithm

- Structural gravity also writes :

$$X_{ni,s} = \pi_{ni,s} X_{n,s} = \frac{(w_{i,s}^{\mu_s} P_{i,s}^{1-\mu_s} \tau_{ni,s})^{\varepsilon_s}}{\sum_\ell (w_{\ell,s}^{\mu_s} P_{\ell,s}^{1-\mu_s} \tau_{n\ell,s})^{\varepsilon_s}} X_{n,s}$$

  where μ_s the share of value added in output of sector s. As in Dekle et al. (2007), we assume that sector s consumes its own production as intermediate inputs (with cost $P_{\ell,s}$).

- Assuming $Y_i = w_i L_i$, with L_i constant,

$$\frac{\pi'_{ni,s}}{\pi_{ni,s}} = \hat{\pi}_{ni,s} = \frac{(\hat{Y}_{i,s}^{\mu_s} \hat{P}_{i,s}^{1-\mu_s} \hat{\tau}_{ni,s})^{\varepsilon_s}}{\sum_\ell \pi_{n\ell,s} (\hat{Y}_{\ell,s}^{\mu_s} \hat{P}_{\ell,s}^{1-\mu_s} \hat{\tau}_{n\ell,s})^{\varepsilon_s}}.$$

- Assuming trade deficits to be is exogenously given on a per capita basis, $X_n = w_n L_n (1 + d_n)$, so that $\hat{X}_n = \hat{w}_n = \hat{Y}_n$.
- Using the market clearing condition that $Y'_i = \sum_n \pi'_{ni} X'_n$, one can solve for the changes in production of each origin country.

$$\hat{Y}_{i,s} = \frac{1}{Y_{i,s}} \sum_n \hat{\pi}_{ni,s} \pi_{ni,s} \hat{Y}_{n,s} X_{n,s}$$

GETI/welfare 4-step program

1. Estimate a gravity equation, with dummy RTA_{ni} with coefficient β and the trade elasticity, ϵ, or use results from literature.

2. Calculate $PTI_{ni} = \hat{\phi}_{ni} = \exp(\beta)$ for the ni for whom $RTA_{ni} = 1$ and $\hat{\phi}_{ni} = 1$ for all other pairs.

3. Plug estimated $\hat{\phi}_{ni}$ (along with initial values of Y_i, X_n, and the π_{ni}) into $\hat{Y}_i$ eqn. Substitute the $\hat{\phi}_{ni}$ and $\hat{Y}_i^{\epsilon}$ into $\hat{\pi}_{ni}$ eqn $\Longrightarrow$ matrix of trade changes. Iterate using a dampening factor until $\hat{\pi}_{ni}$ stops changing.

4. Calculate GETI for each country pair $= \hat{\pi}_{ni}\hat{Y}_n$ and the welfare change (Costinot and Rodriguez-Clare, 2014) :

$$\hat{C}_n = \prod_s \left(\hat{\pi}_{nn,s}\right)^{-\eta_{n,s}/(\varepsilon_s \mu_s)}$$

(under perfect competition and Cobb-Douglas preferences), where μ_s equal 1-the share of intermediates in production of sector s and $\eta_{n,s}$ are preference parameters with $\sum_s \eta_{n,s} = 1$. Go

The trade impact of the EU : PTI and GETI

Gravity empirics

Structural gravity with panel data :

$$\ln X_{nit} = \underbrace{\ln Y_{it} - \ln \Omega_{it}}_{\text{Exporter} \times \text{ year FE}} + \underbrace{\ln X_{nt} - \ln \Phi_{nt}}_{\text{Importer} \times \text{ year FE}} + \underbrace{\ln \phi_{nit}}_{\text{Dyadic vars.}}$$

- ϕ_{nit} includes dummies for RTA membership and specific EU dimensions : customs union, single market (starting in 1992), Schengen agreement, euro area.
- Endogeneity of RTA membership : country pair fixed effects (Baier and Bergstrand, 2007).
- Zeroes : robustness with PPML (Santos Silva and Tenreyro, 2006).
- Data :
  1. trade in goods : IMF-DOTS over 1950-2012
  2. trade in services : Eurostat over 1992-2012

Partial trade impact

	(1)	(2)	(3)
Sample	Goods	Services	
Flow	Goods	Services	Goods
RTA	0.373^a	0.071^b	0.090^a
European Union	0.411^a	0.177^a	0.333^a
EU post 92	1.041^a		
Shengen	0.175^a	-0.027	-0.096^a
Both GATT	0.151^a	0.215	0.153
Shared Currency	0.341^a		
EuroZone 1999-2002	-0.365^a	0.051	0.046
EuroZone 2002-2009	-0.221^a		
EuroZone post 2009	0.062		
Observations	848879	35927	33822
R^2	0.859	0.965	0.972
Origin*time FE	Yes	Yes	Yes
Destination*time FE	Yes	Yes	Yes
Country pair FE	Yes	Yes	Yes

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

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Partial trade impact

- Trade in goods : large (partial) impact of the single market ($+183\% = \exp^{1.041} - 1$) compared to regular RTA ($+45\%$).
  - goes well beyond tariffs : preferential margin of 4.9% (WTO, 2011) would imply a $+28\%$ (partial) impact on bilateral trade with most common $\hat{\varepsilon}$: $(\exp^{0.049})^{5.03}$.
- Trade in services : EU impact two to three times larger than regular RTA (small sample bias, outlined in Limao, 2016).
- Positive impact on trade of the Schengen agreement.
- Insignificant impact on trade of the euro area post 2009.
- Remember that PTI differs from actual trade impact : GETI Go

PTI vs GETI : trade effect of EU integration (RTA scenario with intermediate inputs)

Sector	Goods			Goods		Tradable Services			Tradable Services	
Var.	Imports with/without EU			Import/ consumption		Imports with/without EU			Import/ consumption	
Origin State of the world	Total	EU	non EU	Total With EU	Total Without EU	Total	EU	non EU	Total With EU	Total Without EU
EU (mean)	130%	182%	85%	58%	47%	124%	146%	97%	17%	14%
EU (median)	131%	184%	85%	59%	44%	124%	145%	97%	13%	11%

▸ Details

Assessing the fit of counterfactuals based on structural gravity

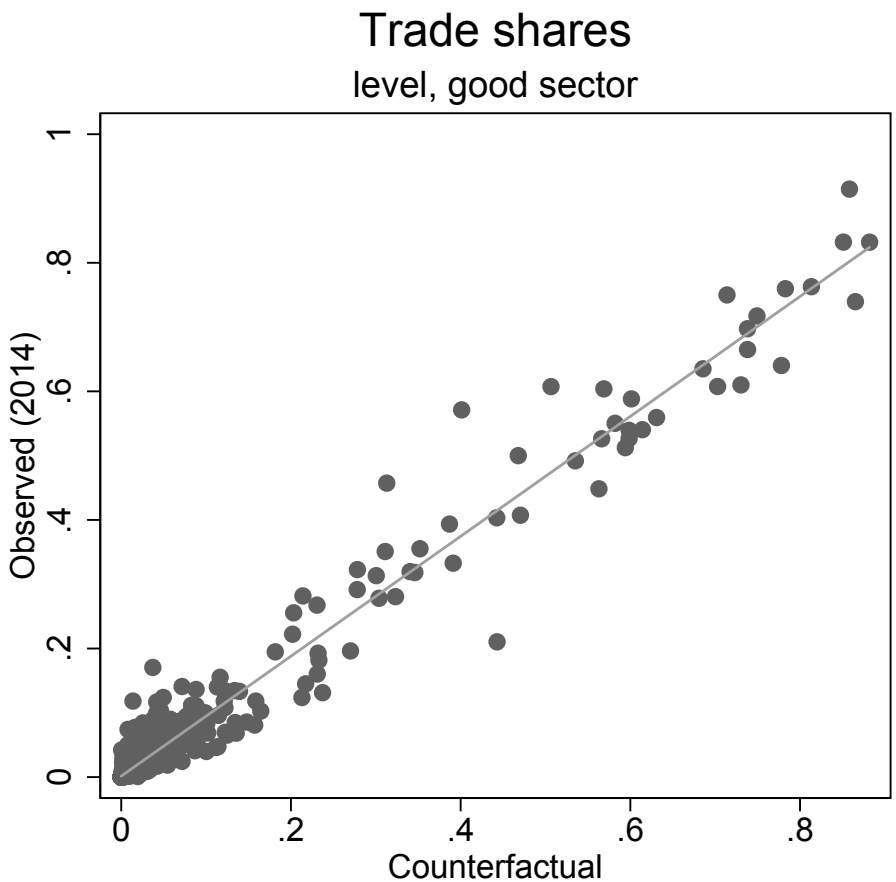
Fit of structural gravity : EU enlargement

Assessing the performance of counterfactuals based on structural gravity using the 2004/07 enlargements of the EU to 12 new members :

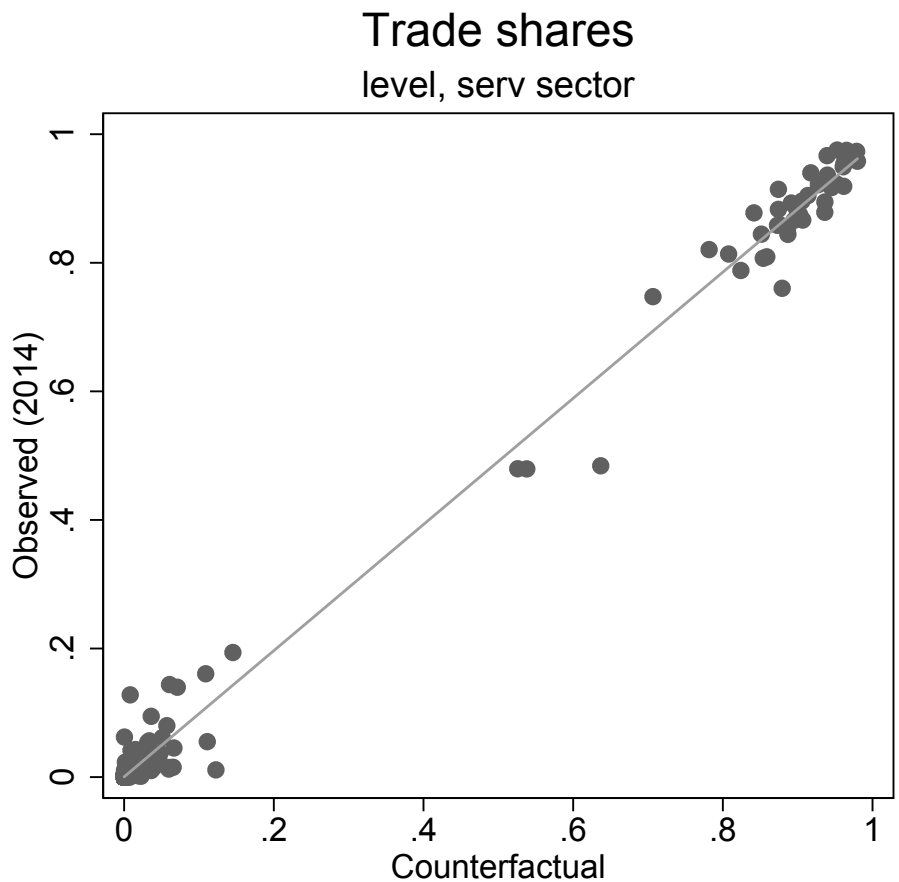
1. use pre-enlargement data for 2003
2. compute counterfactual trade flows for EU-27 instead of EU-15
   - using our estimates of PTI_{EU} from the first step
3. compare with actual data in 2014
   - trade share $\pi_{ni,s}$
   - share in total EU GDP : $\frac{Y_{i,s}}{\sum_{i,i\in EU27} Y_{i,s}}$

   in levels and in differences with respect to 2003.

Fit of structural gravity : EU enlargement

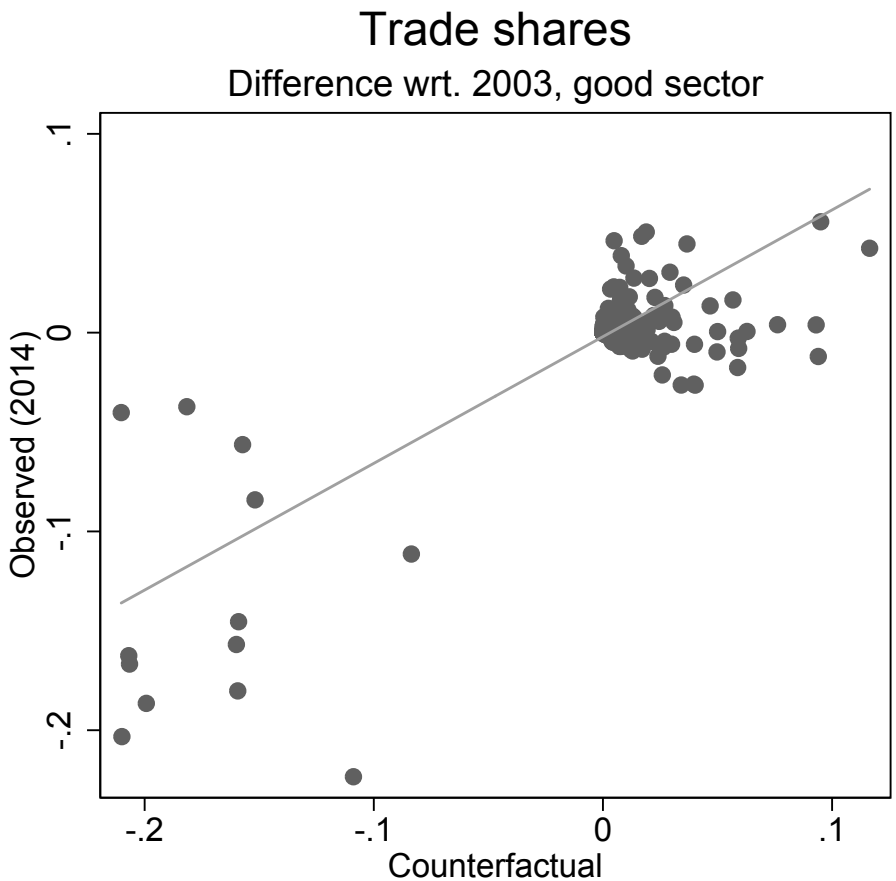


(a) Goods (R2=0.97)

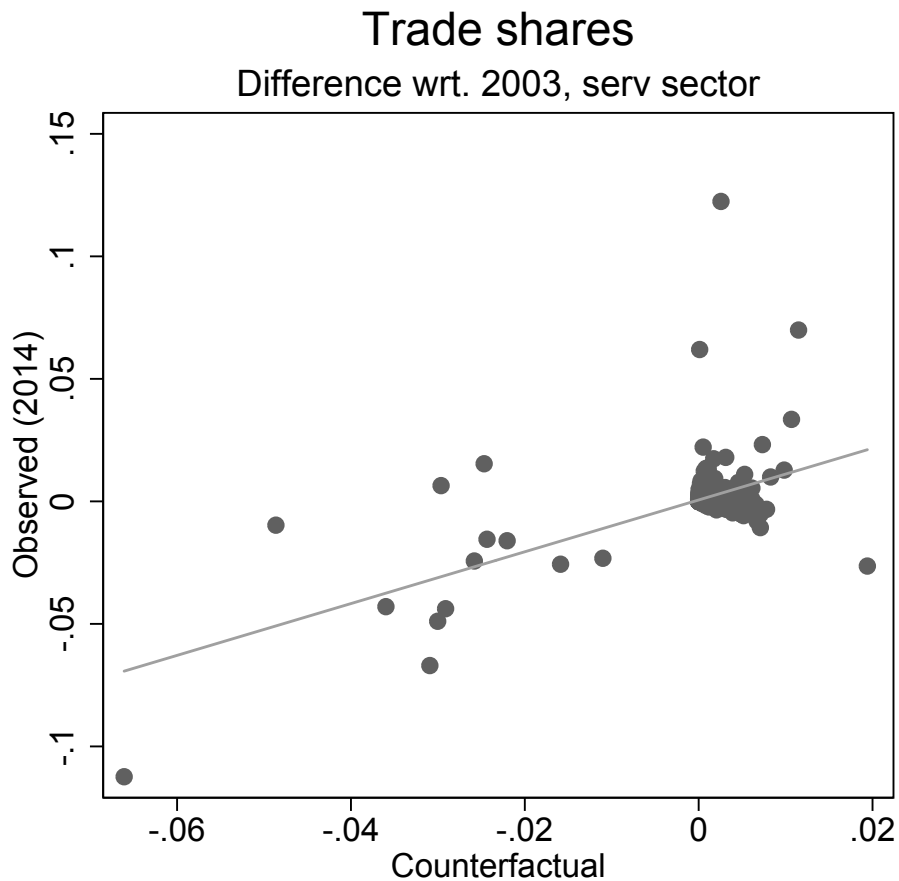


(b) Tradable services (R2=0.99)

Fit of structural gravity : EU enlargement



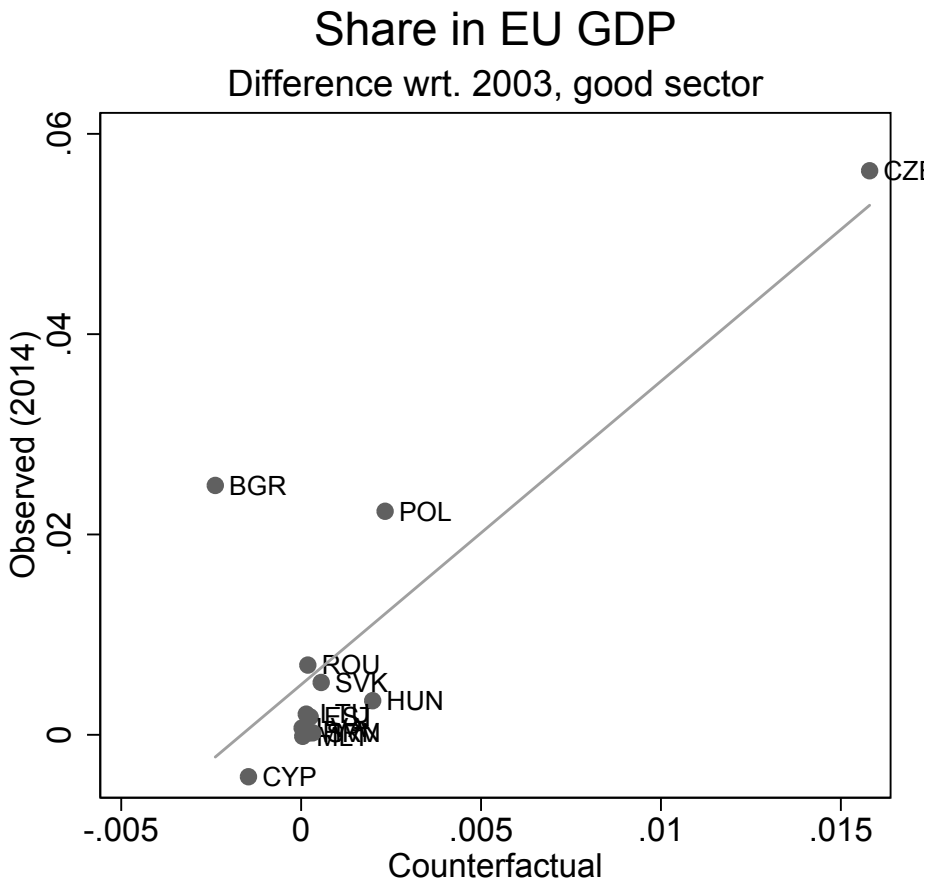
(a) Goods (R2=0.63)



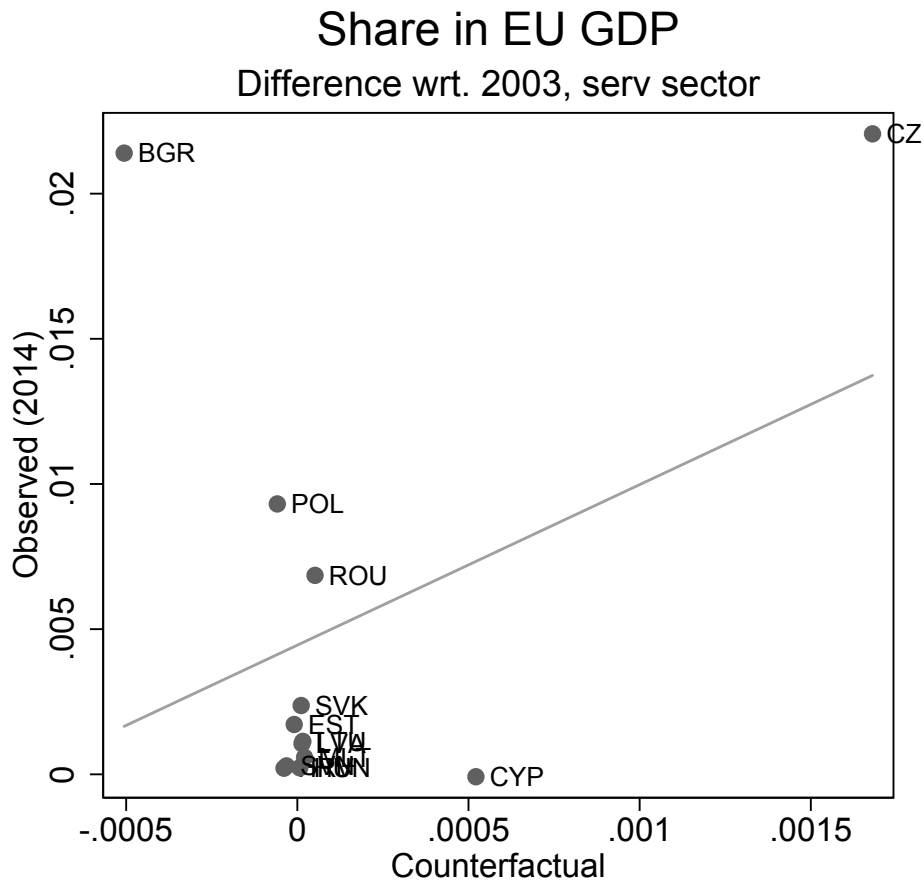
(b) Tradable services (R2=0.33)

Note : sample restricted to EU pairs including at least one new member.

Fit of structural gravity : EU enlargement



(a) Goods (R2=0.67)



(b) Tradable services (R2=0.13)

Note : sample restricted to new EU members

Gains from EU trade integration

Trade-related welfare effects of EU membership

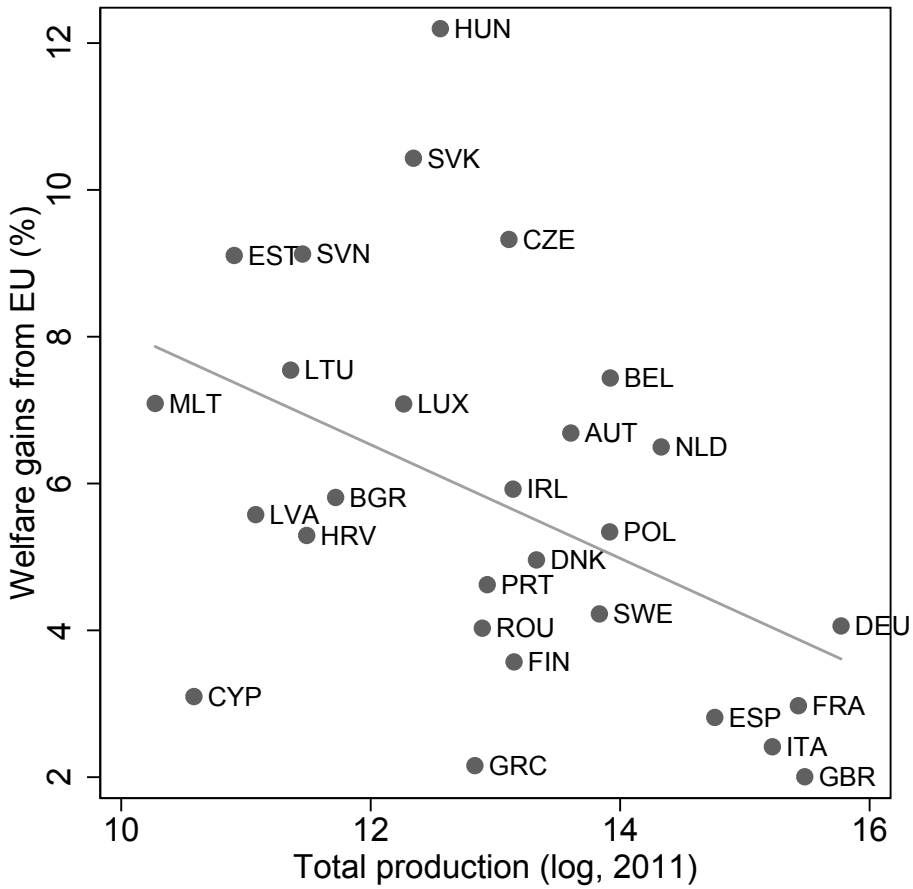
- Use WIOD data for 2014 (square goods and services trade and production data) :
  - 43 countries (incl. all EU countries)
  - 3 broad sectors : goods, tradable services and non-tradable services
- Partial trade impacts from the first-step gravity equation :
  - $\text{PTI}_{EU} = 1.216$ (EU post+1992 + Schengen, i.e. +237%)
  - $\text{PTI}_{RTA} = 0.373$
- Use $\epsilon = -5.03$ in GETI and welfare (Head and Mayer, 2014).
- Use $\mu = 0.321$ for goods and $\mu = 0.548$ for tradable services (ratio of value added to gross production).

Trade-related welfare effects of EU membership

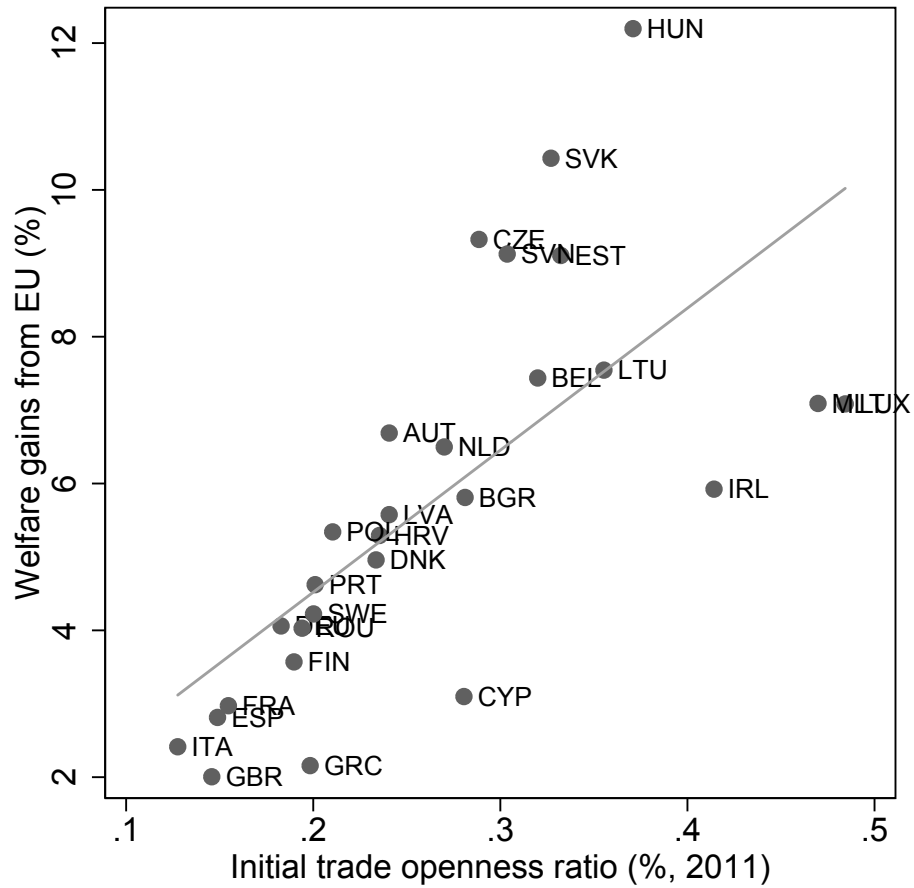
Counterfactual Assumption	(1) to RTA without intermediates	(2) to MFN without intermediates	(3) to RTA with intermediates	(4) to MFN with intermediates
EU (weighted mean)	1,3%	1,7%	3,9%	5,0%
EU (mean)	2,0%	2,6%	5,8%	7,5%
DEU	1,4%	1,8%	4,1%	5,2%
ESP	0,9%	1,2%	2,8%	3,6%
FRA	1,0%	1,3%	3,0%	3,8%
GBR	0,7%	0,9%	2,0%	2,6%
ITA	0,8%	1,0%	2,4%	3,0%
NLD	2,3%	3,0%	6,5%	8,5%
BEL	2,7%	3,4%	7,4%	9,7%
GRC	0,7%	0,9%	2,2%	2,7%
POL	1,8%	2,3%	5,3%	6,7%
CZE	3,1%	4,0%	9,3%	12,1%
ROU	1,3%	1,7%	4,0%	5,1%
SVK	3,4%	4,5%	10,4%	13,7%

▸ Details

Trade-related welfare effects of EU membership



(a) Size and welfare gains



(b) Openness and welfare gains

Note : Welfare gains under an RTA scenario with intermediate goods.

Trade openness computed as total exports over production.

Accounting for Brexit reduces gains from the EU

Counterfactual Assumption	(1) to RTA with intermediates Baseline	(2) to RTA with intermediates Brexit	(3) Difference (2)-(1)
EU (mean)	5,8%	5,5%	-0,3%
IRL	5,9%	3,5%	-2,5%
MLT	7,1%	5,7%	-1,3%
LUX	7,1%	5,8%	-1,3%
BEL	7,4%	6,8%	-0,7%
NLD	6,5%	6,0%	-0,5%
DNK	5,0%	4,6%	-0,4%
DEU	4,1%	3,7%	-0,4%
LTU	7,5%	7,2%	-0,3%
CYP	3,1%	2,8%	-0,3%
POL	5,3%	5,0%	-0,3%
SWE	4,2%	3,9%	-0,3%
SVK	10,4%	10,1%	-0,3%
PRT	4,6%	4,3%	-0,3%
ESP	2,8%	2,5%	-0,3%
FRA	3,0%	2,8%	-0,2%

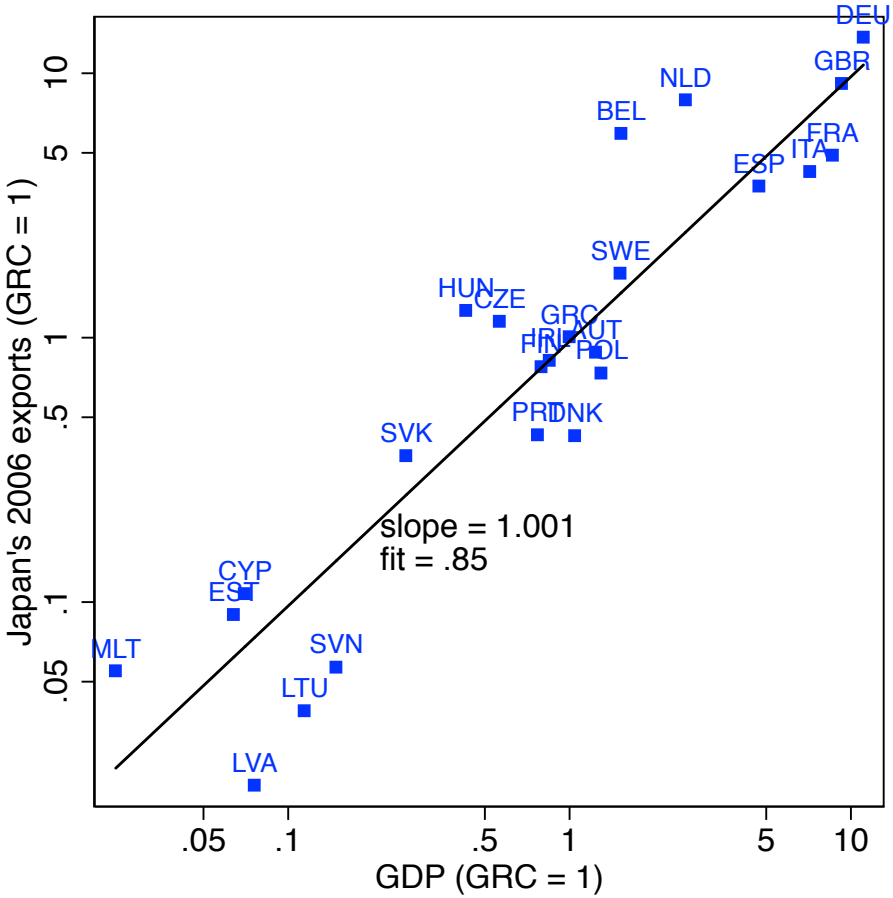
Conclusion

- Quantification of gains from trade integration based on structural gravity
  - common to large class of quantitative trade models ;
  - imposing minimal data requirement.
- Structural gravity can predict the past fairly well (EU enlargement over 2003-2014).
- Sizeable estimated gains from EU integration
  - weighted gains between 1.3 to 5.0% ;
  - depends on the counterfactual : regular RTA vs WTO rules ;
  - allowing for intermediate consumption magnifies gains from trade ;
  - wide variation across member countries : larger gains for smaller, more open economies.
  - Potential domino effects from Brexit
  - Prospective UK agreements with USA, Canada, Australia do very little to compensate Brexit (even all together would increase UK welfare by 0.45%, when Brexit loss is 2.5% under same scenario).

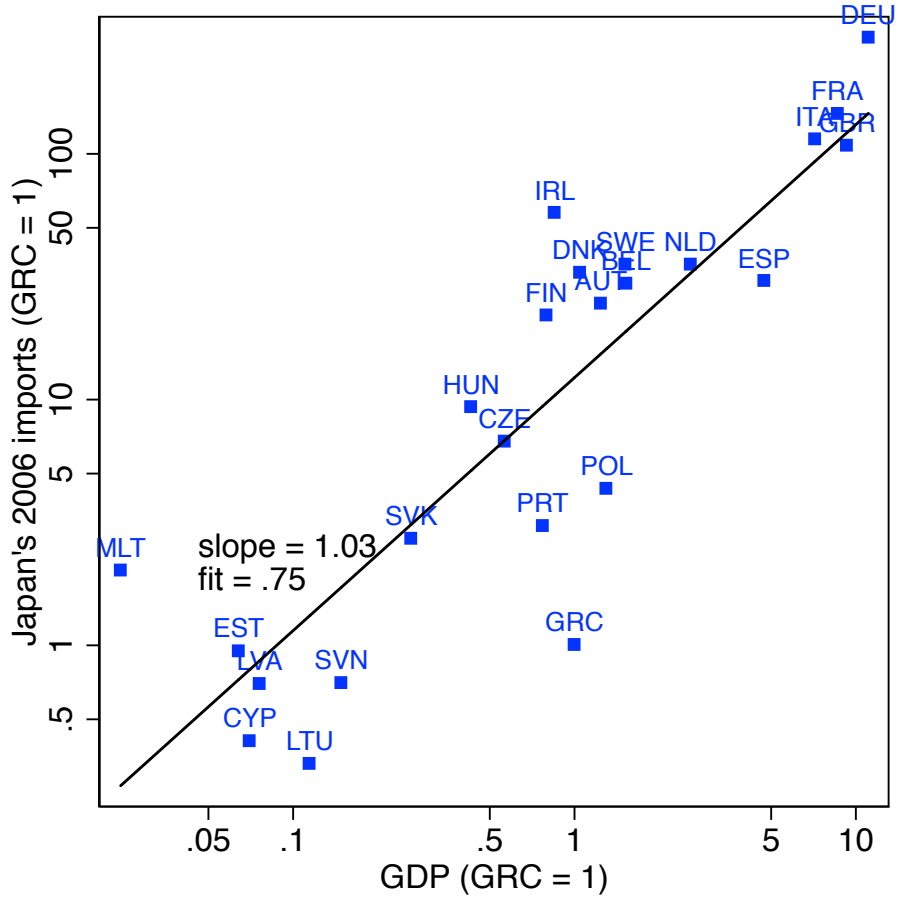
Appendix

Japan's EU trade is GDP-proportionate

(a) exports, 2006



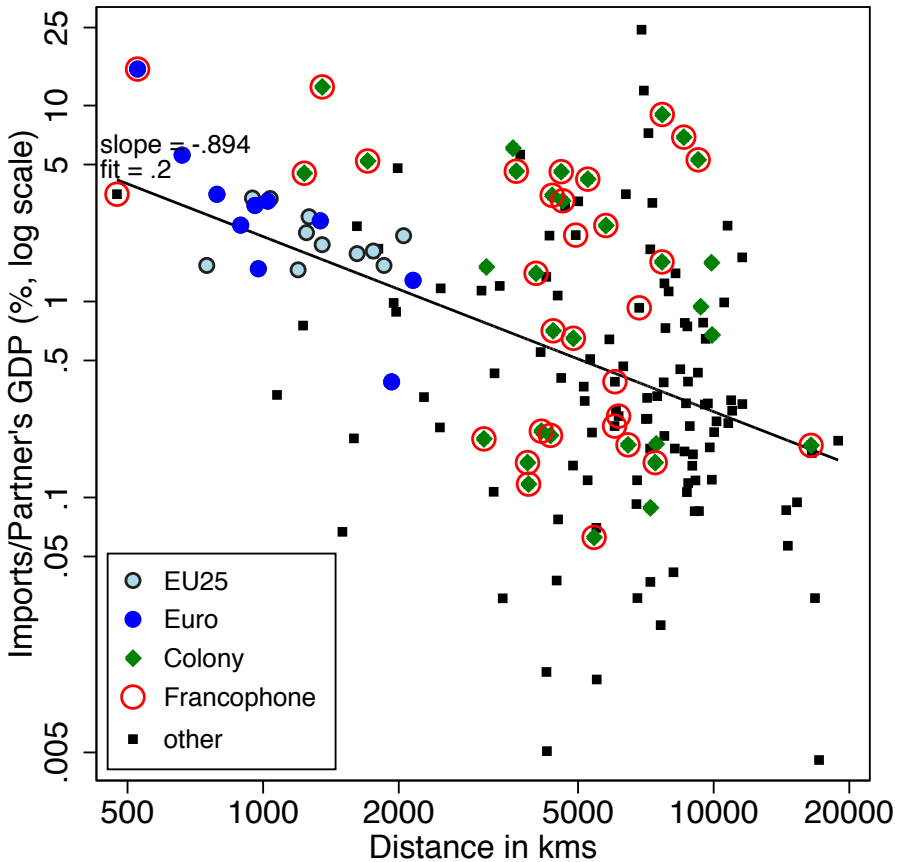
(b) imports, 2006



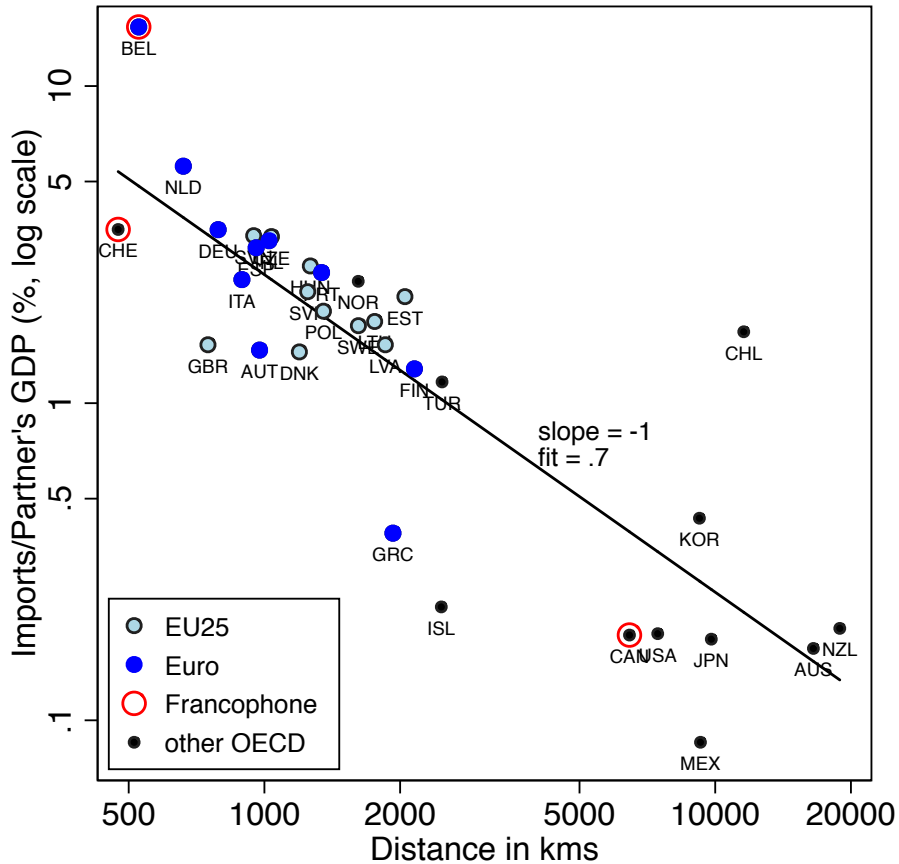
Back

France's trade-distance relationship for goods

(a) All origins



(b) OECD + EU25 orig.



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Microfoundations for structural models

	S_i Exp.	M_n Imp.	ϕ_{ni} Bilat.	ϵ Tr. elas.
CES NPD (AvW03)	$A_i^{-\epsilon} w_i^{\epsilon}$	X_n/Φ_n	τ_{ni}^{ϵ}	$1-\sigma$
CES MC (K80)	$N_i w_i^{\epsilon}$	X_n/Φ_n	τ_{ni}^{ϵ}	$1-\sigma$
Het. consumers (AdPT92)	$A_i^{-\epsilon} N_i w_i^{\epsilon}$	X_n/Φ_n	$\tau_{ni}^{\epsilon} a_{ni}^{-\epsilon}$	$-\theta$
Het. inds. (EK02)	$T_i w_i^{\beta\epsilon} \Phi_i^{1-\beta}$	X_n/Φ_n	τ_{ni}^{ϵ}	$-\theta$
Het. firms CES (M03,Ch.08)	$N_i \bar{\alpha}_i^{\epsilon} w_i^{\epsilon-\mu\left[\frac{\theta}{\sigma-1}-1\right]}$	X_n/Φ_n	$\tau_{ni}^{\epsilon} \xi_{ni}^{\frac{\theta}{\sigma-1}-1}$	$-\theta$
Het. firms "log-concave" (ACDR15)	$N_i \bar{\alpha}_i^{\epsilon} w_i^{\epsilon}$	X_n/Φ_n	τ_{ni}^{ϵ}	$-\theta$

Some models (Het. firms linear-MO08) do not obey structural gravity, but still are estimable with identical econometrics.

Back

Computing welfare gains

In a multi-sector framework with tradable intermediate goods, welfare changes associated to a change in trade costs write (Arkolakis and Rodrigues-Clare, 2014) :

$$\hat{C}_n = \prod_{s,k} \left(\hat{\pi}_{nn,k} \left(\frac{\hat{e}_{n,k}}{\hat{v}_n}^{\eta_k} \frac{\hat{r}_{n,k}}{\hat{v}_j} \right)^{-\delta_k} \right)^{-\beta_{n,s}\tilde{a}_{n,sk}/\varepsilon_k}$$

where $a_{n,ss}$ are the elements of an adjusted Leontief inverse matrix of input-output linkages $(I - \tilde{A}_n)^{-1}$.

Under perfect competition and Cobb-Douglas preferences, it simplifies to :

$$\hat{C}_n = \prod_{s,k} (\hat{\pi}_{nn,s})^{-\beta_{n,s}a_{n,ss}/\varepsilon_s} .$$

Further assuming that intermediate inputs are sourced from the sector itself only ($\alpha_{n,ss'} = 0$ if $s \neq s'$), A_n is diagonal with elements that are technology parameter $\alpha_{n,ss}$, and $a_{n,s} = 1/\mu_s$.

Without intermediate goods, it reduces to :

$$\hat{C}_n = \prod_{s} (\hat{\pi}_{nn,s})^{-\beta_{n,s}/\varepsilon_s}$$

Back

PTI vs GETI : RTA scenario with intermediate inputs

Back

Sector	Goods			Goods		Tradable Services			Tradable Services	
Var.	Imports with/without EU			Import/ consumption		Imports with/without EU			Import/ consumption	
Origin	Total	EU	non EU	Total	Total	Total	EU	non EU	Total	Total
State of the world				With EU	Without EU				With EU	Without EU
EU (mean)	130%	182%	85%	58%	47%	124%	146%	97%	17%	14%
EU (median)	131%	184%	85%	59%	44%	124%	145%	97%	13%	11%
AUT	142%	177%	84%	60%	44%	126%	144%	95%	13%	11%
BEL	135%	191%	90%	72%	59%	121%	144%	97%	24%	20%
BGR	124%	183%	85%	55%	45%	130%	148%	98%	11%	9%
CYP	95%	141%	64%	68%	63%	130%	152%	102%	18%	14%
CZE	151%	196%	92%	61%	44%	121%	137%	92%	14%	11%
DEU	138%	195%	93%	46%	35%	118%	140%	95%	11%	9%
DNK	133%	178%	84%	59%	46%	116%	145%	96%	19%	17%
ESP	132%	206%	95%	39%	31%	125%	146%	96%	6%	5%
EST	127%	172%	80%	71%	58%	131%	143%	95%	16%	12%
FIN	136%	192%	90%	44%	33%	113%	138%	91%	13%	12%
FRA	129%	185%	87%	47%	37%	123%	149%	99%	8%	7%
GBR	114%	175%	83%	47%	40%	125%	152%	101%	8%	6%
GRC	109%	176%	82%	46%	40%	115%	141%	94%	10%	8%
HRV	130%	172%	82%	54%	42%	122%	143%	95%	12%	10%
HUN	142%	186%	88%	69%	53%	127%	146%	97%	21%	17%
IRL	127%	188%	84%	79%	68%	108%	144%	97%	52%	48%
ITA	138%	204%	96%	33%	25%	119%	140%	94%	6%	5%
LTU	122%	190%	89%	68%	59%	118%	148%	100%	19%	16%
LUX	119%	145%	70%	84%	74%	115%	140%	93%	52%	46%
LVA	124%	169%	79%	64%	53%	132%	148%	99%	11%	8%
MLT	110%	164%	75%	72%	64%	123%	133%	90%	52%	43%
NLD	134%	205%	96%	67%	55%	124%	159%	105%	19%	16%
POL	144%	198%	93%	43%	31%	136%	162%	107%	10%	8%
PRT	131%	176%	81%	49%	37%	126%	142%	94%	8%	6%
ROU	130%	179%	85%	39%	30%	137%	159%	105%	9%	6%
SVK	139%	189%	91%	65%	51%	141%	158%	104%	12%	8%
SVN	140%	187%	88%	68%	53%	126%	148%	98%	14%	11%
SWE	135%	182%	86%	51%	38%	120%	144%	96%	16%	13%

Trade related welfare effects of EU membership

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Counterfactual Assumption	(1) to RTA without intermediates	(2) to MFN without intermediates	(3) to RTA with intermediates	(4) to MFN with intermediates
AUT	2,2%	2,9%	6,7%	8,8%
BEL	2,7%	3,4%	7,4%	9,7%
BGR	1,9%	2,5%	5,8%	7,5%
CYP	1,1%	1,5%	3,1%	4,0%
CZE	3,1%	4,0%	9,3%	12,1%
DEU	1,4%	1,8%	4,1%	5,2%
DNK	1,7%	2,2%	5,0%	6,4%
ESP	0,9%	1,2%	2,8%	3,6%
EST	3,1%	4,0%	9,1%	11,9%
FIN	1,2%	1,6%	3,6%	4,6%
FRA	1,0%	1,3%	3,0%	3,8%
GBR	0,7%	0,9%	2,0%	2,6%
GRC	0,7%	0,9%	2,2%	2,7%
HRV	1,8%	2,3%	5,3%	6,9%
HUN	4,1%	5,3%	12,2%	16,2%
IRL	2,3%	3,1%	5,9%	7,7%
ITA	0,8%	1,0%	2,4%	3,0%
LTU	2,5%	3,3%	7,5%	9,8%
LUX	3,0%	4,0%	7,1%	9,5%
LVA	1,9%	2,4%	5,6%	7,2%
MLT	3,2%	4,2%	7,1%	9,5%
NLD	2,3%	3,0%	6,5%	8,5%
POL	1,8%	2,3%	5,3%	6,7%
PRT	1,5%	1,9%	4,6%	5,8%
ROU	1,3%	1,7%	4,0%	5,1%
SVK	3,4%	4,5%	10,4%	13,7%
SVN	3,1%	4,0%	9,1%	12,0%
SWE	1,5%	1,9%	4,2%	5,4%
EU (weighted mean)	1,3%	1,7%	3,9%	5,0%
EU (mean)	2,0%	2,6%	5,8%	7,5%