Scale Economies in European Trade

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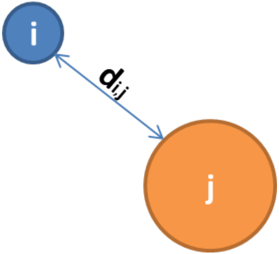
Introduction

Gravity models are one of the most successful framework for analyzing international trade flows.

They assume that bilateral trade flows are directly related to the size of origin and destination and inversely related to their distance (a proxy for trade costs).



They have been widely used for policy purposes, such as analyzing the effects of common currencies [Rose (2000)] or trade agreements [see Cipollina and Salvatici (2010) for a review] on trade flows.

Trade costs in Gravity Models

In gravity models, trade frictions come from the existence of region-pair specific "iceberg" trade cost: a fraction of every shipment melts during its transportation.

$\Rightarrow$ in order for 1 unit of goods or services to reach destination j from origin i, $t_{i,j} > 1$ units need to be shipped.

Trade costs are usually assumed to be **constant** between an origin and a destination: $t_{i,j}$ is *independent from the volume* of goods and services that are actually traded.

Anderson, Vesselovsky and Yotov (2016) are the first to depart from this assumption: they allow for economies of scale in trade flows and show that the data support this hypothesis (US-Canada trade).

My paper

In this paper, I will show that economies of scale in trade costs are strong in Europe as well.

Moreover, I will answer to the following questions:

Have the EU expansion played a role for the estimated scale elasticities?

Can I identify the determinants of scale economies in trade costs?

Preview of the results

Have the EU expansion played a role for the estimated scale elasticities?

On average, no. However, there is **cross-sectoral heterogeneity**.

Can I identify the determinants of scale economies in trade costs?

None of the product-level characteristics considered seems to play a role.

Country-level characteristics: the gain from additional volume doubles when exporting to the most **corrupted** countries.

Relationship to the Literature

This paper is related to

- the gravity literature [see Head and Mayer (2014) for a review]. In particular, I follow AYV (2016) and show that scale economies in trade costs are an empirical regularity in Europe as well
- studies on the effects of the EU [Beltramo (2010), Chen (2004), Nitsch (2000)] and of the Euro [Glick and Rose (2001), Frankel and Rose (2002)] on international trade flows
- analysis of the impact of institutions on international trade [Anderson and Marcoullier (2002), Dutt and Traca (2010), Thede and Gustafson (2012)]

Theoretical Framework

AYV (2016) develop three main equations:

1. a microfounded ▸ gravity equation for bilateral trade flow $X_{i,j,t}$
2. a specification where trade frictions are allowed to be a function of trade volumes $V_{i,j,t}$, according to a an **elasticity** ϕ, and also including the usual *iceberg* component $\tau_{i,j}$

$$t_{i,j,t} = \tau_{i,j}(\frac{r_{i,t}}{r_{j,t}})^{\rho_j} V_{i,j,t}^{\phi_{i,j}}$$

3. the definition of trade volumes

$$V_{i,j,t} = \frac{X_{i,j,t}}{t_{i,j,t}} \frac{r_{i,t}}{r_{j,t}}$$

$r_{i,t}$ and $r_{j,t}$ represent the appreciation of currencies i and j with respect to a base period.

Theoretical Framework

The main parameter of interest is the scale elasticity $\phi_{i,j}$:

$$\phi_{i,j} = \frac{\partial t_{i,j,t}}{\partial V_{i,j,t}} \frac{V_{i,j,t}}{t_{i,j,t}}$$

Crucially, scale economies are identified in relative terms with respect to internal ones.

In fact, it is assumed that

$$\phi_{i,j} = B_{i,j}\phi = \begin{cases} \phi & \text{if} \quad B_{i,j} = 1 \quad (i \text{ and } j \text{ are two separate countries}) \\ 0 & \text{if} \quad B_{i,j} = 0 \quad \text{(in case of internal trade)} \end{cases}$$

ϕ represents the scale elasticity (what I will be testing for):
- if $\phi > 0$, trade costs are increasing in trade volumes (D.R.S)
- if $\phi < 0$, trade costs are decreasing in trade volumes (I.R.S)
- if $\phi = 0$, trade costs are constant (i.e. the model nests the traditional one)

Scale elasticity

ϕ can be computed from the estimated structural coefficients of the gravity specification obtained from the three main equations:

$$X_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST_{i,j} + \delta CONTIGUITY_{i,j} + \zeta EXCH\_RATE_{i,j,t} + \beta_{BORDER} B_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,t}$$

See AYV's gravity equation

In fact

$$\alpha_1 = \gamma_1(1-\sigma)$$
$$\alpha_2 = \frac{\gamma_1(1-\sigma)}{1+\sigma\phi}$$

$$\Rightarrow \phi = \frac{1}{\sigma}\left(\frac{\alpha_1}{\alpha_2} - 1\right)$$

The Data

I constructed a comprehensive dataset for European bilateral flows and production figures (manufacturing) for the period 1980-2013 merging different sources :

What about the Euro?

- **Trade flows**:

  TradeProd: bilateral annual trade and production data for 26 industrial sectors (ISIC2 - 3digits) provided by CEPII- used for the period 1980 to 1995

  Eurostat databases for trade (*Comext*) and production (*Prodcom*): available at the product level - used for the period 1995 to 2013

More Info on Dataset Creation

- **Distances** are population-weighted and follow the CEPII notes by Mayer and Zignago (2006)

- **Exchange rate data**: World Bank website (annual frequency)

The estimated ϕ_s

Assuming $\sigma = 6.13$ and using the following formula $\hat{\phi} = \frac{1}{\sigma}(\frac{\hat{\alpha}_1}{\hat{\alpha}_2} - 1)$ (PPML estimator by Santos-Silva and Tenreyro (2006))

Sector	ϕ	S.E.
Aggregate	-0.073***	(0.004)
Food Products	-0.102***	(0.006)
Beverages	-0.01*	(0.006)
Tobacco[a]	-0.195***	(0.012)
Textiles	-0.045***	(0.008)
Wearing apparel[a]	-0.167***	(0.008)
Leatherpr	-0.034***	(0.006)
Footwear	-0.059***	(0.008)
WoodProd.	-0.108***	(0.005)
Furnit.	-0.084***	(0.004)
Paper&prod	-0.081***	(0.005)
Print&publ.	-0.101***	(0.006)
Ind.chem.	-0.069***	(0.007)
OtherChem.[a]	-0.102***	(0.003)

Sector	ϕ	S.E.
Petrol.ref.[a]	-0.156***	(0.007)
RubberProd.	-0.03***	(0.006)
PlasticProd.	-0.044***	(0.01)
Pottery	-0.017***	(0.006)
Glass&prod.	-0.018***	(0.005)
Non-metal.min.prod.	-0.03***	(0.007)
Iron&steel	-0.057***	(0.005)
Non-ferrMet	-0.06***	(0.008)
FabricMetPr	-0.038***	(0.008)
Machin	-0.017***	(0.005)
Machin,Electric	-0.055***	(0.005)
TransEquip	-0.014**	(0.007)
ProfessEquip	-0.162***	(0.017)

The average $\hat{\phi}$ is -0.073: a 10% increase in trade volumes corresponds to a 0.73% decrease in trade costs.

[a] possible mis-specification of the trade cost function, as suggested by the INTERNAL_DIST coefficient being positive

A simple trade cost function

My results show that per-unit trade costs t are decreasing in trade volumes, as the following trade cost function would imply

$$t = \frac{F}{v} + c$$

where F represents fixed trade costs (supported by micro-evidence, see Roberts and Tybout (1997)) and c represents variable trade costs.

Hence, the scale elasticity becomes

$$\phi = \frac{\partial t}{\partial v}\frac{v}{t} = -\frac{F}{F + vc}$$

if F is positive, ϕ will be negative.

The absolute value of ϕ is increasing in F and decreasing in v

$$\frac{\partial \phi}{\partial F} = -\frac{vc}{(F + vc)^2} \qquad \frac{\partial \phi}{\partial v} = \frac{cF}{(F + vc)^2}$$

Uniformity

So far, I assumed uniform scale coefficients, *i.e.* scale elasticities were allowed to vary only across sectors but were assumed to be the same for all country-pairs.

What if I depart from this assumption?

Different dimensions can be considered:

- EU *vs* non-EU members
- Eurozone *vs* non-Eurozone members ▸ Go
- large *vs* small countries ▸ Go

EU Membership

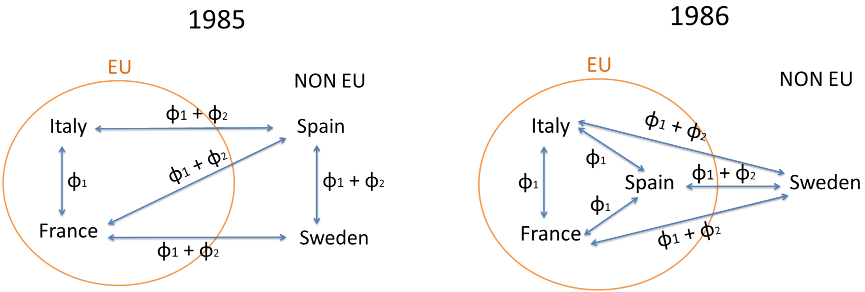
There could be differences in the scale elasticities implied by the expansion of the EU: EU members share a common set of rules and practices. Fixed trade costs should be lower when trading with a fellow EU member (at least their regulatory/institutional component) and/or trade volumes could be higher

$\rightarrow \phi$ **closer to zero for EU trade**

Name	Accession	Name	Accession
Belgium	Founder	Sweden	1-Jan-95
France	Founder	Cyprus	1-May-04
Germany	Founder	Czech Rep.	1-May-04
Italy	Founder	Estonia	1-May-04
Luxembourg	Founder	Hungary	1-May-04
Netherlands	Founder	Latvia	1-May-04
Denmark	1-Jan-73	Lithuania	1-May-04
Ireland	1-Jan-73	Malta	1-May-04
UK	1-Jan-73	Poland	1-May-04
Greece	1-Jan-81	Slovakia	1-May-04
Portugal	1-Jan-86	Slovenia	1-May-04
Spain	1-Jan-86	Bulgaria	1-Jan-07
Austria	1-Jan-95	Romania	1-Jan-07
Finland	1-Jan-95	Croatia	1-Jul-13

Go to full specification

EU elasticities: an example



Sector	ϕ_1	ϕ_2
Aggregate	**-0.083*** **	**0.002**
	(0.005)	**(0.003)**
Food Products	-0.126***	0.003
	(0.006)	(0.001)
Beverages	-0.02***	-0.036***
	(0.007)	(0.005)
Tobacco	-0.227***	-0.793
	(0.016)	(0.834)
Textiles	-0.064***	-0.016***
	(0.009)	(0.005)
Wearing apparel	-0.176***	-0.038**
	(0.009)	(0.015)
Leatherpr	-0.037***	-0.004
	(0.006)	(0.004)
Footwear	-0.104***	0.001
	(0.008)	(0.003)
WoodProd.	-0.097***	0.007
	(0.005)	(0.002)
Furnit.	-0.085***	0.022
	(0.005)	(0.002)
Paper&prod	-0.082***	0.006
	(0.005)	(0.002)
Print&publ.	-0.111***	0.004
	(0.007)	(0.002)
Ind.chem.	-0.085***	0.015
	(0.008)	(0.003)

Sector	ϕ_1	ϕ_2
OtherChem.	-0.108***	0.023
	(0.003)	(0.001)
Petrol.ref.	-0.13***	0.019
	(0.007)	(0.01)
RubberProd.	-0.035***	-0.01*
	(0.007)	(0.006)
PlasticProd.	-0.039***	-0.017**
	(0.012)	(0.008)
Pottery	-0.031***	-0.018***
	(0.006)	(0.005)
Glass&prod.	-0.021***	-0.01**
	(0.006)	(0.005)
Non-metal.min.prod.	-0.037***	-0.012**
	(0.007)	(0.005)
Iron&steel	-0.075***	0.002
	(0.006)	(0.003)
Non-ferrMet	-0.085***	0.01
	(0.01)	(0.004)
FabricMetPr	-0.034***	-0.013**
	(0.009)	(0.006)
Machin	-0.004	-0.035***
	(0.007)	(0.005)
Machin,Electric	-0.055***	-0.015***
	(0.006)	(0.004)
TransEquip	-0.012	-0.036***
	(0.009)	(0.007)
ProfessEquip	-0.174***	-0.076
	(0.017)	(0.075)

Aggregate trade: scale elasticities when crossing the EU border are not stronger.
For 11/26 sectors: the gain from additional volume is about 50% higher on average. All these sectors exhibit high average levels of the *weight-to-value* ratio, proxy for shipping costs (see Hummels, 2007).

Go to extra-Europe

Possible factors affecting Scale Elasticities

Scale elasticities arise because of fixed trade costs. We could expect them to differ according to

- product-specific characteristics (product homogeneity, technical barriers to trade...) Go
- country-specific characteristics (institutional variables)

My results show that the only the latter seem to play a role.

Corruption

The level of corruption has been proven to affect bilateral trade flows (see Anderson and Marcoullier (2002), Dutt and Traca (2010)).

I will test whether shipping goods to more "corrupted" destinations affected the scale elasticities using the following equation:

$$X^{k}_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST_{i,j} + \alpha_3 INTERNAT\_DIST_{i,j} \times CORRUP_{j,t} + \gamma CORRUP_{j,t} + \delta CONTIGUITY_{i,j} + \zeta EXCH\_RATE_{i,j,t} + \beta_{BORDER} B_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,k,t}$$

where $CORRUP_{j,t}$ is the *control of corruption* index from the WGI indicators, ranging from approximately -2.5 (weak) to 2.5 (strong) governance performance.

The most corrupted countries in the sample are Croatia and Latvia in 1996 (-0.642), whereas the least ones are Finland in 2000 and Denmark in 2006 (2.5).

Corruption - Results

Internal_dist	-1.164***
	(-16.81)
Internat_dist	-1.532***
	(-32.24)
$\text{Corrup}_{j,t} \times$ Internat_dist	0.0826***
	(-17.69)
N	2796
R2	0.99

The interaction with international distance is positive and significant (0.0826***): corruption depresses more trade on longer distances $\rightarrow$ scale elasticities are higher (in absolute value) the higher the importer's level of corruption.

Example: exporting to Romania in 2000 (*Corrup*= -0.477, highest in the regression subsample) entails a scale elasticity of **0.38%**, whereas exporting to Denmark in 2006 (*Corrup*=2.5) implies more than half the gain in terms of trade costs reduction: **0.16%**.

Corruption and EU membership

What about environmental regulations?

Many papers study the effects that environmental regulations may have on trade flows (see Cole and Elliott, 2003 and Jug and Mirza, 2005 among many others). If more stringent regulation affects the extensive margin (fixed cost) of trade and/or trade volumes, it could be affecting scale elasticities too.

How to measure environmental regulation in a **cross-country** study?

EPS index by Botta and Kozluk (2014)

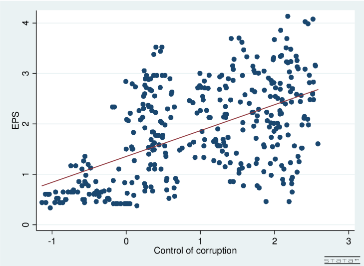
In order to use information for all countries in EPS database, I now use WIOD data (2013 release) on 14 manufacturing sectors - internal and international trade figures already available.

Results

At the bilateral level (collapsing the sectoral dimension), the higher the EPS of the importer the lower the scale elasticities, counterintuitive:

Internal_dist	-0.781***
	(-32.12)
Internat_dist	-0.849***
	(-32.24)
$EPS_{j,t} \times$ Internat_dist	0.018***
	(-11.09)
N	13,108
R2	0.99

But EPS is correlated with the institutional level:



Including "control of corruption" among the regressors the puzzling result (positive interaction) persists, even though economically small.

Internal_dist	-0.803***
	(-32.99)
Internat_dist	-0.859***
	(-53.82)
$EPS_{j,t} \times$ Internat_dist	0.005***
	(2.82)
$Corr_{j,t} \times$ Internat_dist	0.033***
	(-14.10)
N	10,672
R2	0.99

What if I pool all sectors and interact with a sector-specific pre-sample Environmental Dependence (ED) variable (similarly to Albrizio et. al (2014)[1].)

Internal_dist	-0.855***
	(-37.41)
Internat_dist	-1.076***
	(-79.88)
$EPS_{j,t} \times$ Internat_dist	0.059***
	(16.64)
$Corr_{j,t} \times$ Internat_dist	0.071***
	(-12.35)
$EPS_{j,t} \times$ Internat_dist $\times$ ED	-0.005***
	(-14.59)
$Corr_{j,t} \times$ Internat_dist $\times$ ED	0.000
	(0.89)
N	149,279
R2	0.99

Does this mean that environmental policy does not matter? No, it means that it does not matter for the **distance elasticity of trade** (whereas I proved that other institutional variables do).

[1] I constructed the ED ranking according to each sector's CO_2 emissions intensity per unit of value added using WIOD I/O and WIOD Environmental data in 1995 for a benchmark country, USA

Conclusions

In this paper, I show that

- trade costs are a decreasing function of trade volumes in bilateral-sectoral European trade: on average, an increase in volumes by 10% is associated with a decrease in costs by 0.73%
- the estimated scale elasticities are not influenced by the EU expansion on average. However, for some sectors they are 50% higher when trading with a non-EU members (consistent with having higher fixed costs and/or lower volumes)
- scale elasticities do not systematically vary according to different product-level characteristics that I considered...
- ...but vary instead according to country-level institutional variables such as the level of corruption

Moving forward

- estimate sector specific CES elasticities
- exploit data on transportation modes
- compare manufacturing and services (WIOD)

Appendix

Anderson and van Wincoop (2003) show that the trade flow between i and j in sector k ($X^k_{i,j}$) can be expressed as

$$X^k_{i,j} = Y^k s^k_i b^k_j \left(\frac{t^k_{i,j}}{\Pi^k_i P^k_j}\right)^{1-\sigma_k}$$

where

- Y^k is the total of world shipments
- s^k_i is the share of world shipment coming from origin i ($s^k_{i,t} = \frac{Y^k_i}{Y^k}$)
- b^k_j is the share of world shipment arriving to destination j from all possible origins ($b^k_j = \frac{E^k_j}{Y^k}$)
- $t^k_{i,j}$ represents the bilateral iceberg trade cost: for each unit shipped, only $\frac{1}{t^k_{i,j}}$ reaches the destination
- Π^k_i and P^k_j represent respectively the outward and the inward multilateral resistance terms

Back to Theoretical Specification

Estimation allowing for economies (diseconomies) of scale

Using the expressions for $X_{i,j,t}$, $V_{i,j}$ and $t_{i,j}$ is possible to write the following gravity equation:

$$X_{i,j,t} = (cx_{i,t}m_{j,t})^{\frac{1+\phi_{i,j}}{1+\sigma\phi_{i,j}}}(\tau_{i,j})^{\frac{1-\sigma}{1+\sigma\phi_{i,j}}}(\frac{r_{i,t}}{r_{j,t}})^{\frac{(\rho-\phi_{i,j})(1-\sigma)}{1+\sigma\phi_{i,j}}}$$

which can be taken to the data as follows:

$$X_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST_{i,j} + \delta CONTIGUITY_{i,j} + \zeta EXCH\_RATE_{i,j,t} + \beta_{BORDER} B_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,t}$$

where the coefficients depend on the structural parameters of the model.
In particular,

$$\alpha_1 = \gamma_1(1-\sigma) \qquad \alpha_2 = \frac{\gamma_1(1-\sigma)}{1+\sigma\phi}$$

Back to Theoretical Specification

Economies of scale in trade costs

Why could there be economies (diseconomies) of scale in trade costs?

- $\phi > 0$ (trade costs increasing in trade volumes) $\Rightarrow$ **congestion story**

Assume there is only one port, the increase in trade volume increases the trade friction simply because it takes more time for the shipment to arrive to destination [Anderson and Bandiera (2006)]

- $\phi < 0$ (trade costs decreasing in trade volumes) $\Rightarrow$ **fixed cost story**

There may be fixed trade costs, whose unitary impact gets lower the higher the amount of goods shipped [Melitz (2003), Chaney (2008, 2014), Arkolakis (2010)]

Back to Estimating Equation

Results

$$X_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST_{i,j} + \delta CONTIGUITY_{i,j} + \zeta EXCH\_RATE_{i,j,t} + \beta_{BORDER} B_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,t}$$

	(1) Food Products	(2) Beverages	(3) Tobacco	(4) Textiles	(5) Wearing apparel	(6) Leather pr	(7) est7
Internal_dist	-0.476***	-1.538***	0.829***	-0.823***	0.237***	-1.126***	-0.928***
	(-6.37)	(-18.54)	(4.14)	(-10.10)	(3.03)	(-15.23)	(-10.99)
International_Dist_	-1.674***	-1.661***	-2.244***	-1.206***	-1.371***	-1.473***	-1.577***
	(-32.50)	(-23.82)	(-16.79)	(-23.83)	(-23.07)	(-25.92)	(-24.38)
Border	4.290***	-1.562***	14.09***	0.328	7.424***	0.682**	1.529**
	(10.31)	(-3.95)	(9.07)	(0.90)	(14.26)	(1.98)	(2.51)
Contig	0.310***	-0.242***	-0.243**	0.258***	0.256***	0.0386	0.214***
	(5.70)	(-3.36)	(-1.99)	(3.99)	(3.85)	(0.65)	(4.14)
N	9548	8650	5262	9692	9451	8824	7762
R2	1.0e+00	1.0e+00	1.0e+00	9.7e-01	9.6e-01	9.9e-01	9.9e-01

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results (2)

	(1) Footwear	(2) Wood prod.	(3) Furnit.	(4) Paper&prod	(5) Print&publ.	(6) Ind.chem.
Internal_dist	-0.361***	-0.813***	-0.595***	-0.483***	-0.862***	-0.538***
	(-6.05)	(-11.56)	(-10.62)	(-5.98)	(-9.74)	(-11.52)
International_Dist_	-1.492***	-1.988***	-1.375***	-1.689***	-1.677***	-1.928***
	(-33.81)	(-31.82)	(-36.77)	(-25.61)	(-42.39)	(-55.28)
Exch. rate	0.236	0.454	0.341	0.0942	-0.251	-0.00506
	(0.00)	(0.00)	(0.00)	(0.00)	(-0.00)	(-0.00)
Border	3.823***	4.957***	2.507***	3.844***	4.042***	6.477***
	(13.62)	(12.64)	(8.73)	(8.98)	(8.08)	(22.10)
Contig	0.602***	0.194***	0.365***	0.485***	0.122***	-0.192***
	(10.59)	(3.24)	(8.24)	(6.71)	(2.84)	(-4.85)
N	8917	8724	9019	9013	9502	9209
R2	9.9e-01	1.0e+00	9.9e-01	1.0e+00	9.6e-01	1.0e+00

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results (3)

	(1) Other chem.	(2) Rubber prod.	(3) Petrol.ref.	(4) Plastic prod.	(5) Pottery	(6) Glass & prod.
Internal_dist	0.289***	-1.115***	-0.937***	-1.493***	-1.559***	-1.462***
	(2.89)	(-17.54)	(-9.15)	(-16.17)	(-22.01)	(-13.98)
International_Dist_	-2.113***	-1.407***	-1.350***	-1.692***	-1.789***	-1.832***
	(-25.19)	(-22.85)	(-20.46)	(-21.59)	(-35.01)	(-26.76)
Exch. rate	0.524	-0.194	0.0386	-0.0654	0.122	-0.0273
	(0.00)	(-0.00)	(0.00)	(-0.00)	(0.00)	(-0.00)
Border	11.26***	0.234	0.453	-0.669	0.101	0.113
	(20.83)	(0.57)	(0.80)	(-1.49)	(0.25)	(0.24)
Contig	-0.0507	0.190***	0.399***	0.157**	0.198***	0.169**
	(-0.74)	(3.48)	(4.99)	(2.09)	(3.76)	(1.99)
N	4409	9113	9196	8039	8727	9000
R2	1.0e+00	9.8e-01	9.7e-01	1.0e+00	9.8e-01	9.9e-01

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results (4)

	(1) Iron & steel	(2) Non-ferr met	(3) Fabric met pr	(4) Machin	(5) Machin, electric	(6) Trans Equip	(7) Profess Equip
Internal_dist	-0.854***	-0.927***	-1.166***	-1.197***	-0.778***	-1.314***	0.208
	(-14.17)	(-9.30)	(-13.02)	(-20.86)	(-15.84)	(-17.00)	(1.12)
International_Dist_	-1.415***	-1.608***	-1.584***	-1.357***	-1.272***	-1.459***	-1.529***
	(-29.31)	(-33.32)	(-29.08)	(-39.25)	(-30.71)	(-28.95)	(-22.82)
Exch. rate	0.0614	0.0285	-0.00124	-0.170	-0.0904	-0.300	-0.00257
	(0.00)	(0.00)	(-0.00)	(-0.00)	(-0.00)	(-0.00)	(-0.00)
Border	1.173***	2.719***	0.693	-0.244	1.023***	-0.208	9.843***
	(3.55)	(4.95)	(1.33)	(-0.85)	(3.64)	(-0.52)	(8.53)
Contig	0.301***	0.193***	0.376***	-0.00847	0.0434	0.219***	-0.0494
	(6.16)	(3.61)	(4.73)	(-0.23)	(1.00)	(4.61)	(-0.82)
N	7940	8364	9533	9749	9631	9264	9079
R2	1.0e+00	9.7e-01	9.7e-01	9.9e-01	9.9e-01	9.8e-01	8.6e-01

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Large vs Small countries

I consider country size with respect to either their GDP or their population (being time-varying, I ranked destination countries according to their average over the sample-period for these variables).

The model will be modified as follows

$$X^k_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST\_large_{i,j} + \alpha_3 INTERNAT\_DIST\_SMALL_{i,j} + \delta_1 CONTIG\_large_{i,j} + \delta_2 CONTIG\_SMALL_{i,j} + \zeta_1 EXCH\_RATE\_large_{i,j,t} + \zeta_2 EXCH\_RATE\_SMALL_{i,j,t} + \beta_{BORDERB} B\_large_{i,j} \; \beta_{BORDERS} B\_SMALL_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,t}$$

and therefore I will be able to back out the following parameters

$$\phi_{large} = \frac{1}{\sigma}(\frac{\alpha_1}{\alpha_2} - 1) \qquad \phi_{SMALL} = \frac{1}{\sigma}(\frac{\alpha_1}{\alpha_3} - 1)$$

Large vs Small countries

Country size could imply differences in the scale elasticities: larger destination countries should exhibit lower scale elasticities (in absolute value) because:

- trade volumes v are larger towards larger destinations $\rightarrow$ scale elasticity closer to zero

In search-models a' Chaney (2014), more likely to find a buyer in larger countries. The creation of contacts involves only the extensive margin of trade

- in my setting, F lower towards larger destination markets $\rightarrow$ scale elasticity closer to zero

Large vs Small countries - Results

Criterion	ϕ_{LARGE}	ϕ_{SMALL}
Population	-0.075***	-0.090***
	(0.006)	(0.005)
GDP	-0.086***	-0.095***
	(0.005)	(0.004)
N	13029	13017
R2	0.99	0.99

As expected, the coefficients are closer to zero for larger destinations.

Sector by sector, I do not find significant differences, so I decided to keep uniformity for the remainder of the paper.

Back to Uniformity

I consider a different expression for trade costs:

$$t_{i,j,t} = \tau_{i,j}(\frac{r_{i,t}}{r_{j,t}})^{\rho_j} V^{\phi_{i,j,t}}$$

The scale elasticity coefficient is now time varying: $\phi_{i,j,t}$ equals

$$\begin{cases} 0 & \text{if } \mathrm{B}_{i,j} = 0 \ \ \text{(internal trade)} \\ \phi_1 & \text{if } i \text{ and } j \text{ are both in the EU at time } t \\ \phi_1 + \phi_2 & \text{if } i \text{ and } j \text{ are not both in the EU at time } t \end{cases}$$

It is possible to back out the scale elasticities ϕ_1 and ϕ_2 using the expressions for the estimated coefficients.

$$\phi_{i,j,t} = B_{i,j}[\phi_1 + \phi_2 U_{i,j,t}]$$

where $U_{i,j,t}$ takes value 1 if i and j are separated by a non-EU border at time t, i.e. if at least one of the two is not a member of the European Union at time t.

$$X^k_{i,j,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST\_EU_{i,j,t} + \alpha_3 INTERNAT\_DIST\_NONEU_{i,j,t} + \delta_1 CONTIGUITY\_EU_{i,j} + \delta_2 CONTIGUITY\_NONEU_{i,j} + \zeta_1 EXCH\_RATE\_EU_{i,j,t} + \zeta_2 EXCH\_RATE\_NONEU_{i,j,t} + \beta_{BORDER} B_{i,j}(U_{i,j,t} = 0) + \beta_{BORDERNONEU} B_{i,j}(U_{i,j,t} = 1) + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,t}$$

where:

$$\alpha_1 = \gamma_1(1-\sigma) \qquad \alpha_2 = \frac{\gamma_1(1-\sigma)}{1+\sigma\phi_1} \qquad \alpha_3 = \frac{\gamma_1(1-\sigma)}{1+\sigma(\phi_1+\phi_2)}$$

If α_2 and α_3 are statistically different
$\Rightarrow$ ϕ_2 is statistically different from zero
$\Rightarrow$ economies of scale are different when at least one of the trade partners is not a member of the EU.

In particular, we will have that $\phi_2 < 0$ if $|\alpha_2| < |\alpha_3|$.

Back to EU elasticities

Product Homogeneity

Proximity and cultural links affect bilateral trade to an higher extent for differentiated goods as opposed to homogeneous goods, whose quality and characteristics are more subject to asymmetric information issues (Rauch 1999).

This could be in place for scale elasticities, too. I checked for this hypothesis by pooling the data (at the product-level, from 1996 onwards) and estimating the following:

$$
\begin{aligned}
X^k_{i,j,k,t} = exp[\alpha_0 + \alpha_1 INTERNAL\_DIST_{i,i} + \alpha_2 INTERNAT\_DIST_{i,j} + \\
\alpha_3 (INTERNAT\_DIST_{i,j} \times DEGREE\_HOMOG_k) + \\
\delta CONTIGUITY_{i,j} + \zeta EXCH\_RATE_{i,j,t} + \beta_{BORDER} B_{i,j} + \theta_{j,t} + \eta_{i,t}] + \varepsilon_{i,j,k,t}
\end{aligned}
$$

The data do not support my hypothesis. The relevance of other product-level variables (*weight to value ratio*, technical barriers to trade) was also rejected by the data using the same methodology.

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What about the Euro?

In the baseline, I estimate scale elasticities over the 1980-2013 period independently from the introduction of the Euro.

Frankel and Rose (2002) among many others show that the introduction of a common currency has significant effects on trade and income. This could alter the meaning of my estimates.

However,

- analyzing the whole sample allows me to consider the full EU expansion, up until the last accession of Croatia in 2013
- including the whole sample in the regressions does not alter the magnitude of the results (S.E. estimated over the 1980-2001 period are not significantly different than the one estimated over the whole sample)
- Eurozone specific S.E. are, on average, 0.94% when exporting to a Eurozone member and 0.79% when exporting to a EU member not in the Eurozone. Sector by sector, differences are not economically significant and have opposite signs.

Back to Data

Back to Uniformity

Extra European countries

Sector	χ_1	χ_2
Aggregate	-0.079***	-0.021***
	(0.005)	(0.004)
Food Products	-0.11***	-0.003
	(0.006)	(0.002)
Tobacco	-0.193***	-0.098*
	(0.012)	(0.055)
Textiles	-0.044***	0.029
	(0.007)	(0.016)
Wearing apparel	-0.146***	-0.004
	(0.007)	(0.009)
Leatherpr	-0.024***	21.254
	(0.005)	(434.768)
Footwear	-0.028***	0.217
	(0.009)	(0.239)
WoodProd.	-0.103***	0.022
	(0.004)	(0.009)
Furnit.	-0.084***	0.032
	(0.004)	(0.015)
Paper&prod	-0.083***	0.044
	(0.005)	(0.015)
Print&publ.	-0.109***	-0.009***
	(0.005)	(0.003)
Ind.chem.	-0.077***	-0.018***
	(0.008)	(0.003)

Sector	χ_1	χ_2
OtherChem.	-0.106***	-0.005**
	(0.003)	(0.002)
Petrol.ref.	-0.157***	0.003
	(0.007)	(0.002)
RubberProd.	-0.041***	0.081
	(0.007)	(0.048)
PlasticProd.	-0.055***	-0.016
	(0.011)	(0.011)
Pottery	-0.018***	-0.039***
	(0.006)	(0.009)
Glass&prod.	-0.024***	-0.011
	(0.005)	(0.012)
Non-metal.min.prod.	-0.026***	0.109
	(0.006)	(0.052)
Iron&steel	-0.06***	-0.015**
	(0.005)	(0.007)
FabricMetPr	-0.041***	-0.021***
	(0.008)	(0.007)
Machin	-0.02***	-0.051***
	(0.006)	(0.005)
Machin,Electric	-0.064***	-0.04***
	(0.005)	(0.004)
TransEquip	-0.024***	-0.066***
	(0.007)	(0.006)
ProfessEquip	-0.22***	0.03
	(0.027)	(0.012)

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Notes on Dataset Creation

Tradeprod: ISIC2, 3digits
Prodcom: Nace Rev.2 classification
Comext: CN code → converted to CPA code using the RAMON Tables → Nace Rev.2 classification

I created a conversion table linking Nace Rev.2 to ISIC2, 3digits using the United Nations Statistics Division tables as follows:

Nace Rev.2 → Isic Rev.4 → Isic Rev. 3.1 → ISIC2, 3digits

When two entries were included in Comext data, I kept the importers figure.

TradeProd data is in thousands of dollars. Prodcom data (in thousands of ECU) and Comext data (in Euro) were converted in dollars using the currency conversion tables provided by the Eurostat and the OANDA database (oanda.com) on historical currency rates.

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Corruption and EU membership

	(1)	(2)
Internal_dist	-1.164***	-1.141***
	(-16.81)	(-16.26)
Internat_dist	-1.532***	-1.515***
	(-32.24)	(-31.42)
$\text{Corruption}_{j,t} \times$ Internat_dist	0.0826***	
	(-17.69)	
$\text{Corruption}_{j,t} \times$ Internat_dist $\times$ BothEU		0.0819***
		(17.59)
$\text{Corrup}_{j,t} \times$ Internat_dist $\times$ (1-BothEU)		0.0616***
		(8.05)
N	2796	2796
R2	0.99	0.99

Corruption matters independently on the EU membership of the trade partners (Column (2)). The estimates of the interaction coefficients are statistically different when both countries are EU members ($BothEU = 1$) or not ($BothEU = 0$), but the estimated ϕ are economically the same.