

# A re-evaluation of the impact of regional agreements on trade patterns

Lionel Fontagné\*

Thierry Mayer<sup>†</sup>

Soledad Zignago<sup>‡</sup>

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\*CEPII and Université de Paris I. Email: [lionel.fontagne@cepii.fr](mailto:lionel.fontagne@cepii.fr)

<sup>†</sup>CEPII, PSE, and CEPR. Email: [tmayer@univ-paris1.fr](mailto:tmayer@univ-paris1.fr)

<sup>‡</sup>CEPII and Université de Paris I. Email: [soledad.zignago@cepii.fr](mailto:soledad.zignago@cepii.fr)

## 1 Introduction

- Huge literature addressing influence of regional agreements on trade patterns using gravity equations to study bilateral volumes of trade.
- Back to the early seventies, soon after first application of gravity equation to international trade.
- Exceptional fit of simple linear (in logs) regressions involving core variables for which data are among the easiest to find.
- Every PTA examined looking for **positive deviations from the norm of trade given by gravity**.
- Three core variables: GDP, Population, Distance. One variable accounting for PTAs.

- **Three limitations.**
- **1- Unobserved characteristics** of the bilateral trade between two countries: adding covariates improves the fit. Various measures of countries' geographical, historical and cultural proximity.
- **2- Theoretical foundation** of the empirical gravity equation. Surveyed in Feenstra (2003).
- e.g. Need to take into account remoteness of trading partners = not only their bilateral distance, but also their location with respect to third countries.
- e.g. Non observable price indices, generally omitted.
- **3- Reference group** to which members of a PTA are compared. Potential endogeneity of the membership decision (Baier and Bergstrand, 2004).

- **Results** of this literature **exhibit disconcerting variance**: widely varying estimates and troubling ranking of trade creating agreements.
- **Our objective**: Assess the trade effects of regional arrangements with a threefold value added.
- 1- Rely on a new data set encompassing trade and production longitudinal data for a wide range of countries at the industry level.
- 2- Use a theory-based version of the gravity equation in order to address the misspecification issue (modelling structure of the border effects literature).
- 3- Try to use the right benchmark: Integrated economy. Compare international trade inside PTA with trade within countries.
- **Our framework**: Large set of countries, including developing ones, trade and production data, tariff data, time dimension, wide set of PTAs

## 2 Estimating the Impact of PTAs with Gravity estimates

- The basic evaluation of the impact of PTAs.

$$\ln M_{ij} = \alpha + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln d_{ij} + \beta_4 C_{ij} + \beta_5 EU_{ij} + \epsilon_{ij}, \quad (1)$$

- Dummy variable for PTA, the European Union in this example ( $UE_{ij}$ ), taking the value of one if  $i$  and  $j$  are both member countries.
- Exponential of the coefficient on this variable interpreted as the (positive ?) deviation from the trade norm due to the PTA.
- Frankel (1997): Typical estimate in 1990 = 0.5  $\rightarrow$  65% more ( $\exp(.5) = 1.65$ ) trade between 2 EU countries.
- Haveman and Hummels (1998): Coefficients at 0.585 in 1980, 0.825 in 1986 and 0.406 in 1989.
- Soloaga and Winters (2001): Coefficient starts at -1.78 in 1980 and is at -0.80 in 1996.

### 3 Problems with existing methods

- Measurement issues: regional agreement depth, distance, dating et detailing the impact... : **potentially mild problem.**
- Endogeneity: RTAs are not signed randomly at all...: **potentially serious problem.**
- Mis-specification (link with theory): **potentially severe problem** (Anderson and van Wincoop, 2004) .

⇒ We attempt to deal with all 3 issues.

- We start with an augmented gravity equation estimated on a panel of countries trading in industries.
- We develop a theoretical framework addressing the right benchmark of a perfectly integrated economy.
- We estimate this (border effects) equation.
- We address the endogeneity issue.

#### 4 Gravity plus sectoral panel data

- 105 importers declaring their imports from 135 exporters, hence mirror data to complete data set.
- Period covered: 1976-2000 (annual data).
- Instead of using GDPs, we rely on industry level data for production and consumption within 26 ISIC industries.
- In total, we rely on a  $135 \times 135 \times 26 \times 25$  potential trade flows, omitting zero values, due to computational constraints.
- Baier and Bergstrand (2004) rely on  $96 \times 95 \times 5$  potential observations minus the zero flows.
- Different dummies for different PTAs: expected differentiated impacts.
- Take into account tariffs at the HS6level.
- Other issue: constraining the elasticity of trade flows to production to 1.

## Data requirements

- “Trade and Production 1976-1999” database from the World Bank (Nicita and Olarreaga): developing and developed countries at the ISIC rev2 3-digit industry level. Database extended using more recent versions (up to 2000) of the UNIDO CD-ROM together with OECD STAN data for OECD members + New trade data compiled from COMTRADE. 135 countries. Available at <http://www.cepii.fr/anglaisgraph/bdd/TradeProd.htm>
- Relative prices: Price level of GDP expressed relative to the United States (PWT v.6.1).
- Internal and external distances uses city-level data in the calculation of the worldwide distance matrix (available at <http://www.cepii.fr/anglaisgraph/bdd/distances.htm>).
- “Bilateral affinity” variables = colonial link + common language + contiguity (from CEPII distances and geographical dataset) + common colonizer
- Tariffs: Disaggregated (HS6) bilateral data in the TRAINS database from UNCTAD (Jon Haveman version) converted to ISIC 3-digit (and MacMap Data to robustness checks).

Model : (select. var.)	Dependent Variable: Ln Imports (M)				
	(1)	(2)	(3)	(4)	(5)
Border	-5.28 <sup>a</sup> (0.02)	-5.31 <sup>a</sup> (0.02)		-4.85 <sup>a</sup> (0.05)	-5.20 <sup>a</sup> (0.02)
PTAs	0.94 <sup>a</sup> (0.01)				
EU		1.41 <sup>a</sup> (0.01)	1.36 <sup>a</sup> (0.01)	1.09 <sup>a</sup> (0.02)	0.53 <sup>a</sup> (0.01)
NAFTA		2.36 <sup>a</sup> (0.07)	2.34 <sup>a</sup> (0.07)	2.11 <sup>a</sup> (0.09)	0.72 <sup>a</sup> (0.08)
ASEAN		1.49 <sup>a</sup> (0.05)	1.46 <sup>a</sup> (0.05)	1.48 <sup>a</sup> (0.09)	1.14 <sup>a</sup> (0.06)
MERCOSUR		1.16 <sup>a</sup> (0.11)	1.16 <sup>a</sup> (0.11)	0.75 <sup>a</sup> (0.14)	0.96 <sup>a</sup> (0.12)
Andean Comm.		0.48 <sup>a</sup> (0.06)	0.48 <sup>a</sup> (0.06)	0.24 <sup>a</sup> (0.08)	1.06 <sup>a</sup> (0.07)
CACM		1.69 <sup>a</sup> (0.08)	1.67 <sup>a</sup> (0.08)	1.52 <sup>a</sup> (0.15)	2.63 <sup>a</sup> (0.09)
Ln(1+Tariff)				-2.79 <sup>a</sup> (0.05)	
N	1250552	1250552	1221579	245667	1250552
R <sup>2</sup>	0.531	0.533	0.487	0.559	0.272
DMCF	0.500	0.500	0.534	0.451	0.725

## 5 The right benchmark for integration

- *International* trade flows not sufficient to gauge international markets integration.
- One needs to consider not only international trade flows but also flows of goods *inside* each country and see how they compare.
- To do so, the gravity approach must be adapted (McCallum, 1995); Wei, 1996), in a more rigorous way than in the above estimation.
- Border effects are more informative: using a dummy variable for trade taking place inside a given PTA, how should we interpret a rise in the coefficient on this dummy variable?
- In contrast to Vinerian approach border effects methodology enables to **track a potential fall in the surplus of trade taking place inside countries**, and therefore separate trade creation from trade diversion effect.

(We omit the subscripts for sectors in the following)

- CES ( $\sigma$ ) demand structure + trade costs  $\tau_{ij}$  + bilateral preference  $a_{ij}$ .
- Krugman-type monopolistic competition.

$$m_{ij} = n_j p_{ij} c_{ij} = n_j p_j^{1-\sigma} \tau_{ij}^{1-\sigma} E_i P_i^{\sigma-1}, \quad (2)$$

Bilateral “relative” imports by country  $i$  from country  $j$  for a given industry:

$$\frac{m_{ij}}{m_{ii}} = \left( \frac{n_j}{n_i} \right) \left( \frac{p_j}{p_i} \right)^{1-\sigma} \left( \frac{a_{ij}}{a_{ii}} \right)^{\sigma-1} \left( \frac{\tau_{ij}}{\tau_{ii}} \right)^{\sigma-1}. \quad (3)$$

In this model:

$$\frac{n_j}{n_i} = \frac{v_j p_i}{v_i p_j}.$$

• Functional forms for trade costs ( $\tau_{ij}$ ) and preferences ( $a_{ij}$ ) have to be specified:

1. Trade costs function of distance and border related costs

$\tau_{ij} \equiv d_{ij}^\delta (1 + \text{brc}_{ij})$ , with

$$1 + \text{brc}_{ij} \equiv (1 + t_{ij}) (\exp[\eta E_{ij} + \theta \text{PTA}_{ij}])$$

( $\text{PTA}_{ij} = 1$  when both partners belong to a PTA and  $E_{ij}$  is the intercept).

2. Preferences = random component  $e_{ij}$ , + home bias  $\beta$  mitigated by common language, contiguity, etc. parameter  $\lambda$ .

$$a_{ij} \equiv \exp[e_{ij} - (\beta - \lambda L_{ij}) (E_{ij} + \text{PTA}_{ij})].$$

**Estimated equation** (sector and time indexes omitted):

1. Relative imports specification:

$$\begin{aligned} \ln \left( \frac{m_{ij}}{m_{ii}} \right) &= -(\sigma - 1)[\beta + \eta] + \ln \left( \frac{v_j}{v_i} \right) - \sigma \ln \left( \frac{p_j}{p_i} \right) \\ &\quad - (\sigma - 1) \ln(1 + t_{ij}) - (\sigma - 1) \delta \ln \left( \frac{d_{ij}}{d_{ii}} \right) + (\sigma - 1) \lambda L_{ij} \\ &\quad - (\sigma - 1)[\theta - \eta] \text{PTA}_{ij} + \epsilon_{ij}, \end{aligned} \quad (4)$$

- Constant of this regression  $(-(\sigma - 1)[\beta + \eta])$  gives the **border effect** of international trade for countries *that do not belong to a PTA*.
- Coefficient on  $\text{PTA}_{ij}$  gives the **additional volume of trade** generated by the agreement.

## How we proceed

- Column 6: a single dummy for all PTAs.
- Column 7: PTAs are disentangled.
- Column 8: information on bilateral tariffs added.
- Column 9: elasticity on the relative production constrained to 1 instead of the estimate around .75 in previous columns.
- Carefully notice why border effects are large. i) Border effect among countries that do not belong to a PTA. ii) Worldwide estimation, incorporating countries such as Tanzania and Pakistan, in addition to OECD members. iii) Individual border effects between each pair of countries are simply averaged in these pooled estimates, notwithstanding the economic size of the economic partners or the importance of the bilateral flow.

Model :(select. var.)	Dependent Variable: Ln Imports (M)			
	(6)	(7)	(8)	(9)
Border	-6.43 <sup>a</sup> (0.03)	-6.42 <sup>a</sup> (0.03)	-5.52 <sup>a</sup> (0.06)	-5.74 <sup>a</sup> (0.03)
PTAs	1.75 <sup>a</sup> (0.02)			
EU		2.57 <sup>a</sup>	1.88 <sup>a</sup>	2.38 <sup>a</sup>
NAFTA		(0.02)	(0.04)	(0.02)
ASEAN		2.54 <sup>a</sup>	1.99 <sup>a</sup>	2.29 <sup>a</sup>
MERCOSUR		(0.06)	(0.07)	(0.06)
Andean Comm.		2.00 <sup>a</sup>	1.81 <sup>a</sup>	1.97 <sup>a</sup>
		(0.08)	(0.15)	(0.08)
		1.02 <sup>a</sup>	0.43 <sup>a</sup>	1.01 <sup>a</sup>
		(0.07)	(0.10)	(0.08)
		0.24 <sup>a</sup>	-0.32 <sup>a</sup>	0.10
		(0.07)	(0.09)	(0.07)
		2.42 <sup>a</sup>	1.98 <sup>a</sup>	2.48 <sup>a</sup>
		(0.08)	(0.15)	(0.08)
Ln(1+Tariff)			-4.62 <sup>a</sup> (0.25)	
N	1311754	1311754	274761	1311754
R <sup>2</sup>	0.44	0.445	0.489	0.226
DMSE	2.716	2.702	2.607	2.804

## Results (2):

- Huge differences across PTAs.
- Trade creation of the EU matched by the one of the NAFTA, but larger than Mercosur or ASEAN.
- Tariffs variable erodes trade creation impacts.
- Constraining elasticity of relative production to unity strongly reduces the BE.
- Elasticity of tariff makes sense: implied price elasticity around 5.6. in line with Hanson (2005).
- Can be used to estimate a tariff equivalent of the BE.
- The tariff equivalent of crossing a border outside a PTA is  $\exp(5.52/4.62) - 1 = 230\%$ , while it amounts to  $\exp((5.52 - 1.88)/4.62) - 1 = 120\%$  within the EU.

## 6 Are PTAs exogenous?

- Effects of PTAs may depend on determinants that are unobservable to the econometrician.
- A large part of the trade effects of PTAs may be due to unobservable characteristics of countries entering in such agreements (e.g.: bilateral trust).
- Imposes the use of dyads (fixed effects by pairs of partners).
- Purge the coefficient on PTAs from bilateral fixed characteristics of countries that affect both PTAs and trade flows.
- How we proceed: i) OLS versus RE or FE in the three first columns authorizing for a single PTA variable. ii) OLS versus RE or FE in the three last columns differentiating among PTAs.

Model : (select. var.)	Dependent Variable: Ln Rel. Imports					
	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	RE	FE	OLS	RE	FE
Border	-6.43 <sup>a</sup> (0.03)			-6.42 <sup>a</sup> (0.03)		
PTAs	1.75 <sup>a</sup> (0.02)	0.88 <sup>a</sup> (0.01)	0.87 <sup>a</sup> (0.01)			
EU				2.57 <sup>a</sup> (0.02)	0.80 <sup>a</sup> (0.02)	0.76 <sup>a</sup> (0.02)
NAFTA				2.54 <sup>a</sup> (0.06)	1.32 <sup>a</sup> (0.08)	1.31 <sup>a</sup> (0.08)
ASEAN				2.00 <sup>a</sup> (0.08)	1.05 <sup>a</sup> (0.06)	1.03 <sup>a</sup> (0.06)
MERCOSUR				1.02 <sup>a</sup> (0.07)	1.29 <sup>a</sup> (0.15)	1.29 <sup>a</sup> (0.15)
Andean Comm.				0.24 <sup>a</sup> (0.07)	1.40 <sup>a</sup> (0.07)	1.41 <sup>a</sup> (0.07)
CACM				2.42 <sup>a</sup> (0.08)	0.69 <sup>a</sup> (0.09)	0.65 <sup>a</sup> (0.09)
N	1311754	1311754	1321917	1311754	1311754	1321917
R <sup>2</sup>	0.44	0.	0.182	0.445	0.	0.181
RMSE	2.716	.	2.286	2.703	.	2.287

### **Results (3):**

- *A large part of the trade effects of PTAs are due to unobservable characteristics of countries entering in such agreements.*
- Instead of considering that on average trade is 5.7 times larger within a PTA, we find only a 2.4 increase when controlling for such unobservable country-pairs characteristics
- In the EU case, the difference is particularly striking. Neglecting the bilateral fixed (or random) effects would lead to overestimate trade effects by a factor of around 3.
- Hence, a large part of PTA membership's trade effects are simply artefacts.
- This is because EU countries share the characteristics of countries intensively trading among themselves that they have formed the Common market and subsequently the Single market.
- The trade effects of the NAFTA, for instance, are much larger than the ones observed in Europe when such characteristics of member countries of the arrangement are taken into account.

## 7 Conclusion

- We have tried to depart from the literature on PTAs using limited data and missing theoretical foundations.
- We have used a large panel of trade and production data at the industry level.
- We have compared the traditional gravity equation with a theoretically founded one.
- We have introduced detailed tariff information.
- Level of integration appears more limited in the EU than expected given the depth of integration.
- The depth of agreements does not match the magnitude of trade impacts.
- One possible explanation is the endogenous nature of PTAs, particularly striking in the EU case.
- More work needed: Zero flows - Propensity matching - Update data base.