Estimating the impact of bilateral and multilateral trade agreements

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1 Introduction

Economic literature has demonstrated convincingly the positive effect of free trade agreements (FTA) (Baier and Bergstrand 2009) and of regional trade agreements (RTA) (Carrère 2006) on trade. The former estimates that a FTA approximately doubles two members' bilateral trade after 10 years, and the latter that RTAs resulted in an increase in intra-regional trade, but often coupled with reduction in imports from the rest of the world, an evidence of trade diversion.

Regional trade agreements aren't free[1] - there are coordination costs (Maur 2011) and there is also evidence that regional integration[2] is costly and yields few benefits in the poorest countries, unless accompanied by substantial unilateral trade liberalization (De Melo and Panagariya 1992). Therefore, a relevant question can be asked: is the impact of regional trade agreements substantially different from the impact of bilateral trade agreements (BTA)? This paper aims to use the gravity model to address this issue.

1. No pun intended.
2. Regional trade agreements and regional integration initiatives are different but related phenomena.

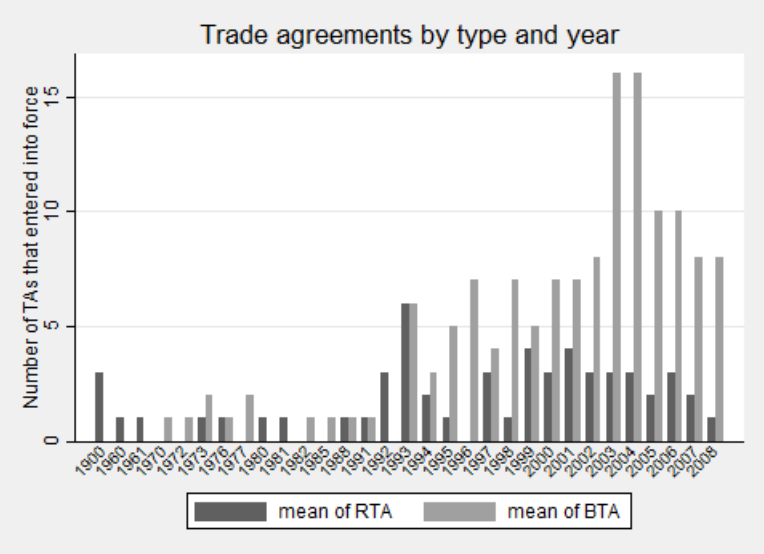

Figure 1: Number of BTA and RTAs that entered into force by year

This question becomes increasingly valid as the number of bilateral and multilateral trade agreements rose significantly over the course of the post-war era, and reached a peak in the late 1990s, as illustrated by Figure 1. It is clear that interest on these instruments is abundant. Thus, understanding their impact becomes ever more relevant.

2 The gravity model

The gravity model, today the workhorse of trade economists, were first developed by Tinbergen (1962), but the dearth of theoretical foundations kept mainstream economists distanced from them for a long time. Part of their current success comes from the fact that their explanatory power invited the thought of important theorists, who then discovered how many of the staple trade models could arrive at gravity-like specifications.

The simplest formulation of the gravity model has the following multiplicative form: $X_{ij} =$

$GS_iM_j\phi_{ij}$, where X_{ij} is the monetary value of exports from i to j, M_j denotes all importer-specific factors that make up the total importer's demand, S_i comprises exporter-specific factors that represent the total amount exporters are willing to supply, G is a "gravitational constant" (constant only in the cross-section) that does not depend on i and j and ϕ_{ij} is the ease of exporter i to the market j. (UNCTAD 2012).

It later became clear that the earlier estimations of this equation using exporting and importing country GDPs as a proxy for S_i and M_i was yielding wrong results. The seminal work by Anderson and van Wincoop (2001) developed the idea of *multilateral resistance terms* to reconcile gravity with the overwhelming evidence that trade costs vary over bilateral pairs. The basic framework underlying the post-Anderson and van Wincoop cross-sectional gravity equation is as follows:

$$lnX_{ij} = a_0 + a_1 lnY_i + a_2 lnY_j + a_3 lnt_{ij} + a_4 ln\Pi_i + a_5 lnP_j + \epsilon_{ij} \tag{1}$$

where Y are country GDPs, t_{ij} is the cost in j of importing a good from i, Π_i and P_j represent exporter and importer multilateral resistance terms.

3 A first look at the data

The data used for the analyses carried out in this paper was provided by Dr. Gordon Hanson. A bilateral trade agreement variable was included with information compiled by international trade lawyers Simon Lester and Kara Leitner[3]. I have parsed the list in Stata and generated an ISO-code database on bilateral trade agreements using this information.

3. Mr. Lester and Ms. Leitner have collected information about all bilateral and regional trade agreements notified to the WTO on their website http://www.worldtradelaw.net/databases/ftas.php

It is a panel data organized according to a year-dyad structure and it contains 1,204,671 observations for over 32,877 importer-exporter dyads[4], with 207 countries being represented both in the importer and in the exporter sides. A first look into log flow numbers for different categories of trade agreement status is as follows:

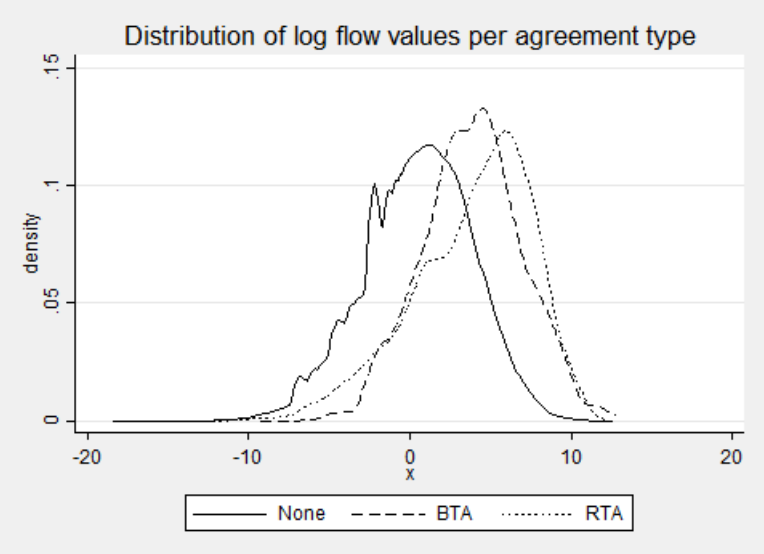

Figure 2: Log flow for the 3 different categories of trade agreement status

Figure 1 shows what we would expect: mean log flow increasing monotonically as trade agreement status changes from none to bilateral to RTA (if only so slightly in the last case). This is to be expected because countries who sign bilateral and regional trade agreements are generally countries who have a predisposition to trade anyways. So, Figure 1 should not be seen as evidence of any kind of impacts caused by these agreements.

4. If i and j are different countries, the number of 32,877 assumes that $Flow_{ijt}$ and $Flow_{jit}$ are two different dyads.

4 Measuring with gravity

4.1 The naive approach

It is possible to try to estimate the impact of trade agreements using cross-country data using this simple version of the gravity model, a version of the first model mentioned in section 2 and commonly estimated in papers before the 2000s (Head and Mayer 2013):

$$Flow_{ij} = \beta_0 (GDP_i)^{\beta_1} (GDP_j)^{\beta_2} (DIST_{ij})^{\beta_3} e^{\beta_4 (RTA_{ij}) + \beta_5 (BTA_{ij}) + \beta (X_{ij})} \tag{2}$$

Where $Flow_{ij}$ is the value trade from origin i to destination j, $DIST_{ij}$ is the distance from i to j, a proxy for "*the ease of exporter i to market j*", BTA and RTA are dummy variables indicating the dyad is in a bilateral trade agreement or regional trade agreements respectively, and βX_{ij} represents a series of control variables and their coefficients. The most commonly used are common border, common language, colonial history, common currency, but many others can be used. Table 1 shown below displays the results from this analysis.

Examination of the estimated coefficients for the BTA and RTA dummies show that this strategy must be flawed: their values are inconsistent, and their statistical significance is inconsistent.

This happens because this specification is wrong in many levels. First of all, it does not take care of the multilateral trade resistance as exposed in section 2, committing the "Gold medal mistake" of the gravity model (UNCTAD 2012). It suffers from endogeneity derived from mostly two other sources: the omitted variable bias, since we can never be certain that all the control variables were included in the regression; selection bias, because (as

	1960	1970	1980	1990	2000
$\ln(GDP_i \times GDP_j)$	0.67	0.891	0.894	0.968	1.04
	(0.01)	(0.008)	(0.008)	(0.007)	(0.006)
lnDIST	-0.528	-0.867	-1.063	-1.153	-1.192
	(0.027)	(0.026)	(0.027)	(0.028)	(0.024)
common currency	0.934	1.382	0.721	1.065	0.161
	(0.132)	(0.164)	(0.208)	(0.193)	(0.142)
contiguous	0.174	0.266	0.05	0.516	0.94
	(0.105)	(0.106)	(0.113)	(0.106)	(0.1)
common language	0.418	0.65	0.503	0.71	0.809
	(0.061)	(0.058)	(0.057)	(0.056)	(0.048)
BTA	0.427	0.655	1.282	1.359	1.406
	(0.185)	(0.197)	(0.186)	(0.162)	(0.129)
RTA	1.205	1.152	0.864	0.583	0.943
	(0.108)	(0.155)	(0.113)	(0.097)	(0.064)
_cons	-6.072	-8.023	-7.229	-8.731	-10.308
	(0.295)	(0.266)	(0.278)	(0.276)	(0.224)
N	4858	9035	11596	14101	19997
R^2	0.52	0.579	0.574	0.598	0.635

Robust standard errors in parentheses

Table 1: Cross-sectional estimation of the naive gravity model

mentioned in section 3) countries that sign trade agreements arguably have an upfront different disposition towards trade when compared to countries that don't do so.

4.2 Understanding the measure of effect

It is important to understand what is the effect that we would like to measure in this paper. It is well known that not all bilateral and regional trade agreements are the same. Mercosur brought with it only but small changes in regional integration, but the European Community represented a radical overhaul of trade in the region. Thus, a good measure of the effect of trade agreements on trade flows would take into account the degree of trade liberalization in each agreement, but there is no quality data available to enable this measurement.

This paper tries to understand what are the partial effects of two mutually excludent endogenous binary variables (BTA, RTA) on a continuous endogenous variable, and this situation

can be studied by using the treatment effect approach (Angrist 2008). The average treatment effect is measured as $E[Y_{1i} - Y_{0i}]$. The fundamental measurement problem with the treatment effects approach is that once treatment is applied Y_{0i} becomes unobservable. This situation is handled by measuring using counterfactuals as a substitute for Y_{0i}.

Finally, according to Baier and Bergstrand (2007) the availability of panel data solves many of the problems caused by time-invariant heterogeneity in cross-sectional data, mainly due to the use of fixed effects. In the next section different specifications will be discussed and their results will be presented.

5 Estimating the impact of BTAs and RTAs

Table 2 below shows the results of the estimation of 5 different fixed-effects (FEs) specifications for the gravity model discussed in this paper: 1) year-level FEs; 2) year and dyad-level FEs; 3) year, importer and exporter FEs; 4) year, importer and exporter-time trend FEs; 5) year, importer and exporter-quadratic time trend FEs.

	(1)	(2)	(3)	(4)	(5)
lnY	0.927	0.681	0.657	0.517	0.444
	(0.001)	(0.004)	(0.005)	(0.007)	(0.008)
lnd	-1.086	(omitted)	-1.403	-1.405	-1.417
	(0.004)		(0.004)	(0.004)	(0.004)
RTA	1.132	0.499	0.658	0.568	0.558
	(0.013)	(0.01)	(0.022)	(0.02)	(0.02)
BTA	1.24	(omitted)	0.801	0.873	0.858
	(0.024)		(0.013)	(0.014)	(0.014)
N	624145	624145	624145	624145	624145
r2_a	0.593	0.825	0.671	0.691	0.696

Robust standard errors in parentheses

Table 2: Coefficients and standard errors estimated for 5 different fixed effects specifications

The following sectons comprise the discussion of each specification. The basic model will be

the roughly the same one as laid out in equation (2), but without the controlling covariates such as common language or common border - the fixed-effects estimation takes care of the heterogeneity that these covariates accounted for.

5.1 Year fixed effects (1)

Year-level fixed effects erase any unobserved heterogeneity due to global economic fluctuations. The counterfactual for the BTA (RTA) variables can be interpreted as being dyads with similar gravity characteristics but without a BTA (RTA). It is important to notice that the counterfactual for BTA are all dyads without a BTA, including those that have a RTA, and vice-versa. The estimated coefficients and their standard errors are presented in the column (1) of table 2.

Figure 3 below shows the result of a robustness check that was carried out using this specification. 25% of the data was randomly excluded and the regression estimated again. This was done 200 times and the distribution of estimators that resulted from this procedure is as follows:

The distribution is very narrow, and the means are equal to the coefficients estimated down to the second decimal digit. Therefore, it is possible to conclude that this estimation is in fact robust. It is also clear in the graph that the RTA coefficient can be estimated much more precisely, given the larger number of dyads.

Yet, year fixed effects do not offer good estimators for one main reason: they do not take care of the most important unobserved issue which are the Anderson and van Wincoop multilateral resistance terms. If those terms change across the years (as they should, per the theory), they will still influence the estimators, because year-level fixed effects only

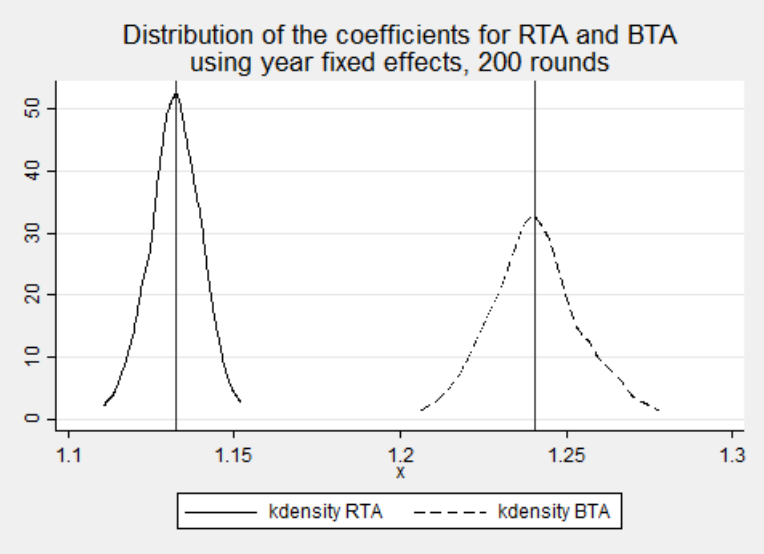

Figure 3: Robustness check for BTA and RTA estimators with year-level fixed effects

cancel the effect of time-invariant unobservables.

5.2 Year, dyad fixed effects (2)

The introduction of dyad-level fixed effects also changes the counterfactual being considered in the analysis of the treatment. In this case, the counterfactual is the same dyad, before being assigned treatment. This is also why the coefficient could not be estimated for bilateral trade agreements - given that these are assigned a treatment status per dyad for all the time available, this variation is discarded by the dyad-level fixed effects (the same result can be observed in the dyad-fixed distance term). Therefore, this specification is not useful for the purposes of this paper.

5.3 Year, importer and exporter fixed effects (3)

Up until this point, the estimated coefficients have been quite unstable. We believe that this is due to two main issues: first, the presence of multilateral resistance terms already mentioned; second, selection bias - assignment of treatment is not random, countries self-select into trade agreements because they think they are useful.

In this specification we try to address both issues by ruling out the influence both of the global economic issues (crises, inflation) and of country-specific issues at both the importer and the exporter levels. The counterfactual will now be given at the country level: for each country trading with a partner within the scope of a BTA (RTA), the counterfactual is a partner with a similar gravity score outside the scope of a BTA (RTA), controlling for global economic fluctuations.

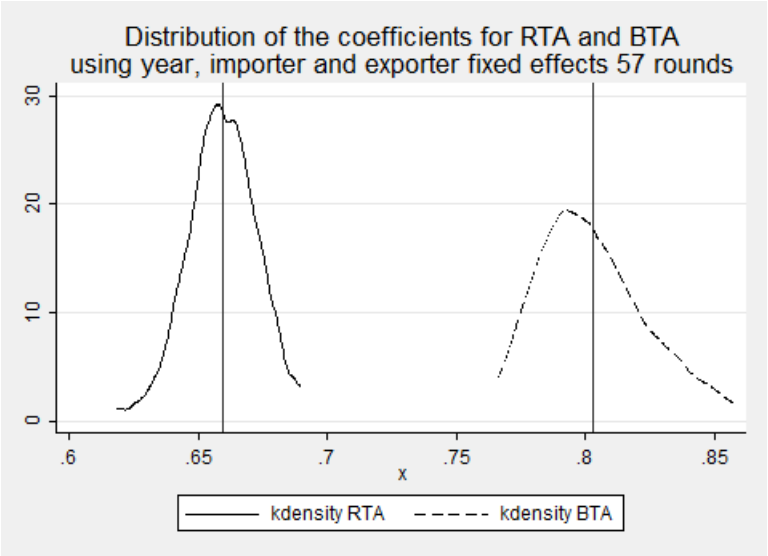

Figure 4: Robustness check for BTA and RTA estimators with year , importer and exporter-level fixed effects

The results are now more stable and in line with what is suggested by the literature. A

robustness check was carried out also in this specification. 50% of the data was randomly excluded and the coefficients were estimated again. The coefficients resulting from this method were plotted in figure 4. The method could only be repeated 57 times because this specification is much more computationally cumbersome than the one discussed in 5.1.[5]. This number of rounds is not yet enough for the works of the Law of Large Numbers, and therefore, the curves - especially the one for BTA, which is less precisely estimated - are skewed, but their means match the estimated coefficients up to the third decimal point.

5.4 Year, importer, exporter, and time-trend FEs (4) and (5)

As can be seen in table 2, the coefficients become much more consistent after the addition of importer and exporter time trends in the analysis. The inclusion of linear and quadratic time trend fixed effects changes the counterfactual analyzed: the results observed now will be due to deviations in the importer and exporter-specific time trend.

6 Discussion and policy implications

The results presented in this paper suggest that the gains of signing a bilateral trade agreement are higher than the gains of signing a multilateral trade agreement. The overall results are consistent to what has been found in the literature: Baier and Bergstrand (2007) find an estimated average treatment effect of 0.685 log points, a figure between our RTA and BTA coefficients in estimations (3), (4), and (5).

This conclusion goes in line with the data: Figure 1 shows that many more BTAs were

5. Each regression takes 450 seconds for half the dataset; the specification in 5.1. took only 20 seconds for 75% of the dataset

concluded over the 2000s than RTAs. Therefore, the main policy issue that these results suggest is that it is economically better to sign bilateral trade agreements than multilateral trade agreements.

Some important questions remain after this analysis, chiefly amongst them the issue of whether trade is *created* by signing trade agreements or *diverted* from the countries that are not part of a specific agreement.

Some econometric issues also remain. Even though the use of different fixed effects specifications help to address the problem related to the non-randomness of treatment assignment, the use of a matching estimator such as it was conducted in Baier and Bergstrand 2009 can help establish better counterfactuals.

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