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RTAs' Proliferation and Trade-Diversion Effects: Evidence of the "Spaghetti Bowl" Phenomenon

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Abstract:
This paper investigates the trade-diversion effects of regional trade agreements (RTAs), so-called “Spaghetti bowl” Phenomenon (SBP), in multilateral trade. The SBP is due to the proliferation of RTAs. Thus, I investigate the relationship between the number of RTAs concluded by a country and the additional trade value attributed to an RTA. Using bilateral trade data in a sample of 119 countries, from 1995 to 2012, my main finding reveals a negative trade-effect between them, confirming the existence of SBP multilateral trade. However, results could not conclude evidence of a negative effect of overlapping RTAs, involving the existence of SBP, within North-North, North-South or South-South trade. But, the additional trade value attributed to an RTA concluded with EU countries or US seems to confirm significantly a trade-diversion effect because of the number of RTAs signed by these countries.

Keywords:
Regional Trade Agreements, Spaghetti Bowl Phenomenon, Gravity equation, Trade diversion

Classification JEL: F11, F12, F15

1. Introduction

Regional Trade Agreements (RTAs)[1] are sweeping the multilateral trade system like wildfire while WTO talks advance at a glacial rate (Baldwin and Jaimovich, 2012). There has been renewed interest in RTAs in the two decades especially after the Doha round talks stalled. As Bhagwati (2008) noted, the regionalism is a threat to the multilatelalism. A "...major drawback of this free trade regime has been identified, which tends to proliferation of regionalism at the cost of dilution of multilateralism" (Pandey, 2006: 1)[2]. The most common theoretical explanation is that negotiators are frustrated attempting to achieve multilateral free trade. Thus, Nations are increasingly eager to negotiate bilaterally removing barriers because multilateralism talks are progressing so slowly (e.g. Krugman, 1993; Bhagwati, 2008).[3] Also, the multiple memberships of RTAs may generate duty-free market access and zero-tariffs on imports with many trading partners and can hence be an appealing alternative to national policy makers as a substitute to free trade (Schiff and Winters 2003: 75). Therefore, RTAs have become a ubiquitous feature of global trade.

Since 2001, the international trade is a drastic increase in RTAs across the world (see Fig. 1a). In general, the formation of RTAs between countries has evolved. For a long time, most RTAs were regional in focus with members being geographically close to

[1] In what follow, I take Regional Trade Agreements (RTAs) to mean any preferential access for members of such an agreement. Thus RTAs are used to encompass set of Free Trade Agreements (FTAs), Customs Unions (CUs), and Common Markets (CMs). In practice, there are some differences between these categories of RTAs. In a FTA group, countries enforce their own external trade restrictions. In a CU group, members adopt a common set of external trade restrictions (Grant ant Lambert, 2008). In a CM area, the movement of factors must be unrestricted and fiscal, monetary, and other economic policies must be harmonized between members (DeRosa, 1998).
Note that RTAs were conceived as an exception to Most Favored Nation (MFN) clause to cater to the specific needs of developing as well as developed countries (see Art. XXIV of General Agreement on Tariffs and Trade – GATT). According provisions on RTAs in GATT, the formation of a RTA commits members to eliminate restrictions on "subtantially" all trade.

[2] Pandey, Sanjay, Spaghetti Bowl Phenomenon and Crucification of Multilateralism: Task Ahead for WTO (December 10, 2006). Available at SSRN: http://ssrn.com/abstract=951392 or http://dx.doi.org/10.2139/ssrn.951392 (accessed on 8 august 2014).

[3] According to Baldwin and Jaimovich (2012), the Bilateralism/Regionalism phenomenon may also explained by idiosyncratic events (such as the US's opening of the US-Canada FTA talks in 1996, the breakup of the USSR in 1991, and the Asian Crisis of 1997) and by some institutional needs (such as democracy, transparency, and geopolitical stability).

each other (e.g. EU, NAFTA, ECOWAS, ASEAN, etc.). Nowadays, countries or regional blocs have signed or negociate RTAs with diverse and geographically distant partners (e.g. EPAs, CETA, TPP, TTIP).[4] The number of the second RTA-type is increasingly important. The number of RTAs (in force) notified to the World Trade Organization (WTO) increased from 40 in 1993 to 258 in 2013.[5] Nowadays, "the world faces the prospect of over 400 RTAs" (Grant and Lambert, 2008: 765). Baldwin and Jaimovich (2012) explain the multiplication of RTAs by contagion effet testing the hypothesis that the domino-like spread of regionalism is partly driven by 'defensive' RTAs.

[Figure 1 (here)]

Theorically the nature of an RTA is to promote trade and investment between members (see Fig. 1b). But, the formation of a RTA has different impact on partner states and third countries (trade creation and diversion effects). "On one hand, liberalization with certain trade partners generates positive effects as high-cost products in the home country can be substituted to low-cost products from the partner countries [trade creation effect]. One the other hand, as preferential integration is discriminatory, countries outside the agreement face higher tariffs than the member [trade diversion effect]" (Fergin, 2011: 6). The products from a non-member country will instead be imported from member countries that do not face tariffs, even though they are not the most efficient producers. According to Baldwin and Wyplosz (2009: 171), RTAs has generated a new inefficiency and this is

[4] Economic Partnership Agreements (EPAs) between European Union (EU) and Africa-Caribbean-Pacific (ACP) group; the Comprehensive Economic and Trade Agreement (CETA) between EU and Canada; the Trans-Pacific Partnership (TPP) is being negotiated between Brunei, Chile, New Zealand, Singapore, United States, Australia, Peru, Vietnam, Malaysia, Mexico, Canada and Japan (Taiwan, South Korea announced their interest in November 2013); Transatlantic Trade and Investment Partnership (T-TIP) is being negotiated between EU and United States.

[5] My data on RTAs comes from than the WTO database which lists only agreements (in force) that have been officially notified to the WTO: http://rtais.wto.org/UI/PublicAllRTAList.aspx (accessed on 07 July 2014). This WTO database does not include data regarding preferential trade arrangements (PTAs) notified. For last ones, see http://ptadb.wto.org/ptaList.aspx (accessed on 07 July 2014).
It exist another Trade Agreements Database developed by Hufbauer and Schott (2009) which lists agreements (notified or not to the WTO) from 1948 to 2007. Hufbauer-Schott database was updated by Baldwin and Jaimovich (2012): only 329 agreements of 570 agreements recorded in Hufbauer-Schott database were still force in 2007.

the trade diverting part. The main critic of preferential integration is that regional trading blocs limit global trade liberalization due to high external trade barriers (Fergin, 2011).

However, the proliferation of RTAs would create a so-called "Spaghetti bowl" phenomenon (SBP) in global trade (Bhagwati, 1995). The "Spagetti bowl" is a metaphor to illustrate the numerous and crisscrossing RTAs, where innumerable applicable tariff rates and a multiplicity of rules of origin (RoOs) must coexist. According to Bhagwati et al. (1998), this situation impose higher transaction to firms and distort trade and investment flows. That is the "Spaghetti bowl" phenomenon (SBP) which negatively impacts trade. In academic litterature, except Kimura et *al.* (2006) and Fergin (2011), the trade effect of "Spaghetti bowl" phenomenon (SBP) has no been seriously quantify. As pointed out Dai, Yotov and Zylkin (2014), trade-diversion effects of RTAs have not been throughly examined empirically. These autors found that RTAs divert trade away from non-member countries and even more so from internal trade in member countries.

Kimura et *al.* (2006) quatifyed the trade impact of "proliferation" of RTAs using cross-section data (for 2002/2003). Their findings determine significatively a trade creation effect for RTAs about 1.76 and 3.80 and a trade-diversion of RTAs like "Spagetti bowl" phenomenon estimated -0.76 to -1.39, depending to model specification. These results are likely overestimated. Their estimating model does not control for the 'gravitational un-constat'[6] and for self-selection into RTAs. Moreover, "the discussion about proper econometric specification of gravity model has shown that the conventional cross-section formulation without the inclusion of country-specific effects is misspecified and so introduces a bias in the assessment of the effects of RTAs" (Carrère, 2006: 224). For these reasons the findings of RTAs effect in Kimura et *al.* (2006) are likely to be unreliable because of estimation bias.

Fergin (2011) discusses the spaghetti bowl effect, which can be regarded as a potential negative transaction cost effect of RTA proliferation. Using also cross sectional

[6] That is what Anderson and van Wincoop (2003) refer to as the 'multilateral resistance', or Frankel and Wei (2008) qualify as 'remoteness'.

data covering intra-Africa bilateral trade flows for Africa's 53 countries, she conclude "any robust evidence for the hypothesis of a negative trade effect caused by the spaghetti bowl phenomenon on the RTA effect" Fergin (2011: 32).

In contrast to the cross-section gravity model used by these authors, I apply in this paper a panel gravity specification (modeling as ramdom effects) which includes country-time fixed effects. This panel specification controls for unobservable characteristics of each country-dyad. In sum, I investigate the trade-diversion effects of RTAs like a "Spaghetti bowl" phenomenon (SBP) with proper econometric specification of the gravity model following recent empirical discussions.

The remainder of the paper is set out as follow. Section 2 develops my estimating equation taking into account relevant empirical methods on RTA's trade effects. Section 3 discusses data used for estimations. My empirical results are reported in Section 4. Section 5 presents the concluding remarks.

2. Empirical modelling

To examine the relationship between proliferation of RTAs (so-called "Spaghetti Bowl" Phenomenon) and trade promotion, I adopt a typical gravity-type regression of the log-linearized form:

$$T_{ij}^{t} = \alpha + \beta_1 \log(GDP_i^t) + \beta_2 \log(GDP_j^t) + \eta \log(Dist_{ij}) + \sum_{h=1}^{n} \gamma_h X_{ijh}^{t} + \varepsilon_{ij}^{t} \qquad (1)$$

T_{ij}^{t} represents export values of country *i* to country *j* at time *t*. GDP_i^t and GDP_j^t denote respectively the Gross Domestic Product (GDP) in country *i* and *j* at time *t*. $\sum_{h=1}^{n} X_{ijh}^{t}$ is a set of other country-pair characteristics (e.g. contiguity, common language, GATT/WTO

membership, legal system, etc.) at time *t*. $Dist_{ij}$ is geographical distance between countries *i* and *j*. ε_{ij} is a disturbance term.

To measure the trade-effect attributed of RTAs, I intrduce in equation (1) a "RTA" dummy (RTA_{ij}^{t}) which is a binary variable taking unity if trading partners conclude, at time *t*, an RTA and zero otherwise. That is, the typical gravity equation is augmented by including interaction terms between the dummy for RTA membership as the following:

$$T_{ij}^{t} = \alpha + \beta_1 \log(GDP_i^t) + \beta_2 \log(GDP_j^t) + \eta \log(Dist_{ij}) + \lambda RTA_{ij}^{t} + \sum_{h=1}^{n} \gamma_h X_{ijh}^{t} + \varepsilon_{ij}^{t} \quad (2)$$

The trade-effect of RTA is examined on the coefficient λ for "RTA" dummy. The estimates of this coefficient of interest, from equation (2), are potentially contaminated by an endogeneity bias due to *self-selection* of countries. Countries choose their trading partners into RTAs (Baier and Bergstrand, 2007) as well as the form of the RTA (Vicard, 2009) according to economic and political factors. This causes a downward bias on estimates of effect of RTAs on trade, "...because a country pair that has more to gain from regional integration is more likely to create an RTA and to choose the appropriate nature of regional integration" (Shahid, 2011: 16). To deal for this endogeneity bias, literature suggests to use a panel data with county pair and country-and-time fixed effects (Heckman 2001; Wooldridge, 2002). But, this method does not allow investigating which kinds of country pairs gain more from RTA even if it yields consistent estimates (Vicard, 2011: 189). All country specific variables and time-invariant country-pair specific variables are dropped due to the inclusion of the latter fixed effects. For this reason Vicard (2011) suggests to introduce interaction variables between country-pair characteristics and the RTA membership dummy. The consistent gravity equation suggested by Vicard (2011) is

$$T_{ij}^{t} = \alpha + \lambda RTA_{ij}^{t} + \sum_{k=1}^{m} \gamma_k RTA_{ij}^{t} \cdot DV_{ijk}^{t} + FE_{i}^{t} + FE_{j}^{t} + FE_{ij} + \varepsilon_{ij}^{t} \quad (3)$$

FE_i^t and FE_j^t are country-and-year fixed effects, and FE_{ij} is bilateral-pair fixed effects. $RTA_{ij}^t \cdot DV_{ij}^t$ is a set of country-pair characteristics (DV_{ij}^t) interacted with RTA dummy.

Estimating equations

I define my gravity equation using country-and-year fixed effects, but not adding bilateral-pair fixed effects. This is unnecessary since the country-pair variables (distance, contiguity, common language, legal system, etc.) control for the idiosyncratic bilateral trade factors.[7] Thus, the equation (2) is rewritten adding country-and-year fixed effects (FE_i^t and FE_j^t). As pointed out by Baldwin (2006), the increase in the number of RTAs can be described as a spaghetti bowl of trade agreements. I introduce an interaction variable between the number of RTA concluded by each country and the RTA membership dummy to measure "Spaghetti bowl" phenomenon (SBP) effect on trade:

$$T_{ij}^{t} = \begin{pmatrix} \alpha + \eta \log(Dist_{ij}) + \lambda_1 RTA_{ij}^{t} + \lambda_2 RTA_{ij}^{t} \cdot \log(NUM_{ijt}^{RTA}) \\ + \sum_{h=1}^{n} \gamma_h X_{ijh}^{t} + FE_{i}^{t} + FE_{j}^{t} + \varepsilon_{ij}^{t} \end{pmatrix} \quad (4)$$

The variables GDP_i^t and GDP_j^t are dropped by introducing country-and-year fixed effects. The variable NUM_{ijt}^{RTA}, defined by $NUM_{it}^{RTA} \times NUM_{jt}^{RTA}$, denotes the product of number of RTA in force concluded by each trading country (exporter and importer) in dyad, at time *t*. The multiplicative-variable specified by $RTA_{ij}^t \cdot \log(NUM_{ijt}^{RTA})$ is defined as a proxy of the "Spaghetti bowl" phenomenon (SBP).[8] All other variables were

[7] Also, introducing bilateral-pair effects would entail additional regressors which due to the large dataset was not possible to compute.

[8] As suggested by one reviewer, in principle variable NUM_{ijt}^{RTA} can be also included linearly in the model because it is not controlled for by country fixed effects. I ran equation (4) including this variable but it did not produce robust results. I thank the reviewer for this point.

previously defined above. Regardless of the existence of the SBP, coefficient λ_1 of RTA should be positively estimated. And if a trade-effect of SBP exists, coefficient λ_2 is expected to be negative. Data and source for each variables used in my estimating equation (4) are described below in Table 1 at section 3. Using the variable NUM_{ijt}^{RTA}, Figure 2 gives an overview of the negative effect of RTAs' proliferation, so-called "Spaghetti bowl" phenomenon (SBP).

[Figure 2 (here)]

Literature suggests that in absence of correlation between explanatory variables and the bilateral trade, coefficients estimated by the Generalized Least Squares (GLS) estimator are consistent.[9] But, according to Baier and Bergstrand (2002: 5), "...the [RTA] dummy variables may be correlated with unobservable (omitted) variables that are correlated also with the decision to trade". In gravity equation, one of the source of endogeneity bias is potentially unobserved heterogeneity. The unobservable bilateral variables – included in the error term – influence simultaneously of variable of interest (RTA) and volume of trade. The best way to account for endogeneity due to omitted variable bias is to use fixed effects modeling (see Raimondi et al. 2012; De Benedictis and Taglioni, 2011; Martínez-Zarzoso et al. 2009; Baier and Bergstrand, 2007).[10] My estimating equation (4) includes the time varying multilateral resistance terms (country-and-time fixed effects – FE_i^t and FE_j^t).

Traditionally, the log-linearized form of gravity-type equation is estimated by Ordinary Least Square (OLS). However, Santos Silva and Tenreyro (2006) show that this method suffers two source of bias. It does not address problem of the multiplicative heteroskedasticity from the original non-linear model, and the logarithm-form excludes observations with zero trade. To deal with both problems, Santos Silva and Tenreyro

[9] However, variables as GDP or infrastructures may be correlated with bilateral specific effects (Carrère, 2006).

[10] Egger (2000) rejects the random effect gravity modeling, using either bilateral-pair or country-specific fixed effects.

(2006) suggest Poisson pseudo-maximum likelihood (PPML) estimator. They show that the PPML procedure yields consistent estimates in the presence of heteroskedasticity and accounts the problem of zero in bilateral trade.[11] Thus, I just comment PPML results as benchmark estimation. And, as proposed by Cameron et al. (2011), my all empirical estimations use a two-way clustering of errors at the country level to control for this issue (Baldwin and Jaimovich, 2012; Cameron et al., 2011).[12] Computing cluster-robust standard errors in estimations allowed accounting for correlation in the residuals over years within trade pairs.

In my case, I use the aggregated bilateral trade flows for all products. Thus, a first-stage selection correction is not needed. Therefore, the coefficients of the equation (4), transforming dependant variable in $\log(T_{ij}^{t})$, are typically estimated with Ordinary Least Squares (OLS). I report OLS results as a robustness check. Also, for robustness check, I present an alternative methodology that deals with the unobserved heterogeneity issue. I re-estimate equation (4) using first-differencing specification with country-year fixed effects to account for the time varying multilateral resistance terms. According literature, in panel data "...with two time periods, and when the error terms are equivalent to differencing the data around the mean" (Grant and Lambert, 2008: 770). Panel data modelling with fixed effects and first-differencing are not equivalent, when the number of time periods is more than two. The first case is source of potential presence of serially correlated error terms (Egger, 2002). Thus, Wooldridge (2002) notes that first-differencing should increase estimation efficiency. However, the first-differenced estimation drops the time-invariable variables (common border, common language, common legal, and common colonizer).

[11] An alternative method is the Heckman sample selection model (see Helpman, Melitz and Rubinstein, 2008). This method yields to include zero-trade observations in the estimation samples by assuming that positive and zero trade observations are drawn from different but related models. But "the main disadvantage of this approach is that it requires strong distributional assumptions in order to be consistent, whereas Poison is consistent under much weaker assumption" (Lejárraga et al., 2013: 119). Furthermore, the literature establishes that PPML estimator is equivalent to (weighted) non-linear least squares (see Cameron and Trivedi, 2009; and Winkelmann, 2003 for more details).

[12] The inference in dyadic regressions is problematic because observations in trade data are not independent (Fafchamps and Gubert, 2007).

3. Data analysis

My working data (balanced panel data) covers bilateral trade during the period 1995-2012 for a total of 119 trading partners (see Appendix for the countries list). Thus, I have potentially a total of 252'756 (119x118x18) observations representing 14'042 country-pair. The variable of trade (T_{ij}^{t}) represents exports from country *i* to partner *j* at time *t*. Data on bilateral trade (imports and exports in U.S dollars) comes from the United Nations Commodity Trade Statistics Database (COMTRADE). Distance measures (between countries) were from *Centre d'Étude Prospectives et d'Informations Internationales* (CEPII). Bilateral distances were calculated referencing by latitudes and longitudes of the largest urban agglomerations in terms of populations:

$Dist_{ij} = \sum_{g \in i}\left(\sum_{h \in j} \varpi_h d_{gh}\right)\varpi_g$, where d_{gh} is the distance between the two sub-regions $g \in i$ and $h \in j$ and ϖ_g and ϖ_h represent the economic activity share of the corresponding sub-region.

The dummy variables "*common border*", "*common legal*", "*common colonizer*" and "*common language*" were from CEPII. To account a potential impact of the economic crisis (in 2008/2009) on international trade flow, I introduce a dummy variable "*crisis*" in order to control for that in estimations. Also, I introduce another dummy variable "*GATT/WTO*" to control for trade-effect of WTO membership accession. Table 1 gives the details about sources and data construction of variables, and description statistics for the variables are presented in Table 2.

[Table 1 (here)]

My data on RTAs comes from WTO which lists only trade agreements that have been offically notified by Members.[13] Among these agreements, there are Free Trade agreements, Preferential Agreements (i.e. Trade Agreement among developing nations which allows tariffs to be preferential without going to zero), Costum Unions, and bilateral or multilateral consultative frameworks. To avoid linguistic infelicities, I refers to all of them as RTAs. The variable "RTA" is dummy variable refering to existence of a trade agreement between trading partners in dyad. My data accounts only RTAs in force. This gives a cumulative total of 247 RTAs notified and still in force over the period 1995-2012. According to my working sample, more than 32% of the considered RTAs involve European Union (EU) countries or United States (US), about 45% of RTAs were signed by trading countries in OECD group, and more than 40% involve a country of BRICS group.

[Table 2 (here)]

4. Resultats and Discussion

Table 3 provides results from the PPML and OLS estimations. The columns (1) et (2) of present the log-level panel results using equation (4), and the results from the two last columns (3 & 4) are robustness check. In all these results (columns 1 to 4), the coefficients for standard gravity variables are highly significant (at the 95% confidence level) and have the expected negative sign. International trade is negatively correlated with geographic distances between trading countries. Results also confirm that the economic crisis (2008/2009) had a negative impact on international trade. The coefficients for gravity dummy variables (GATT/WTO, common border, common language, common legal, and common colonizer) are positively estimated as expected.

[Table 3 (here)]

[13] See Database on http://rtais.wto.org/UI/PublicAllRTAList.aspx (accessed on 07 July 2014).

As expected, the coefficients estimated for RTA dummy are positively significant (columns 1 & 2 in Table 3). Comparing the results in the two first columns show that the SBP variable is relevant for my regression model. The specification without the SBP variable seems cause an exaggeration of the coefficients of other explanatory variables, considering the specification with SBP. However, these results confirm that RTA formation increases trade values in general between Members. Even so, my regression result (in column 2) reveals significantly a negative coefficient on the multiplicative-variable $[RTA_{ij}*log(NUM_{ij}^{RTA})]$ defined as a proxy for measuring the "Spaghetti bowl" phenomenon (SBP).

Furthermore, the coefficients estimated in column (2) appear empirically to be robust and are consistent with the results of robustness check (columns 3 & 4).[14] This main finding confirms, as expected, the existence of a trade-diversion in international trade so-called SBP caused by the multiplication of RTAs around the world. Thus, signing other agreements with third countries by at least one of the members of trading-dyad having a RTA can on average to decrease trade in dyad. By referring to PPML-results in columns (1 & 2), the proliferation of RTAs across the world led to an average decrease of trade by 13%, all else constant. This negative effect of multiplication of RTAs reduces the magnitude of direct trade-creation effect of RTA. For my sample, the final impact of RTAs was, on average, a net trade-creation by 23% considering the direct effect of RTA formation (a trade-increase by 35.8%).

Otherwise, in models with log-transformed dependent variables, dummy variables can be interpreted as elasticity (Sorgho and Bruno, 2014; Giles, 1982).[15] For this interpretation, I considered estimates from log-transformed regression (column 3). Therefore, the coefficient for the variable SBP can be discussed as the effect of third RTAs signed by at least one of the parties on trade in a dyad having a RTA. Also, the

[14] The result of RTA trade-effect in column (2) is also significantly close to that found in the recent literature about RTAs' trade-creation (e.g. Magee, 2008; Baier and Berstrand, 2009; Vicard, 2011; Foster, Poeschl and Stehrer, 2011; Dai, Yotov and Zylkin, 2014).

[15] $\hat{\beta}$ is the estimated coefficient of the dummy variable of interest, then the estimated elasticity is $100\left[\exp\left(\hat{\beta}-0.5\,\mathrm{var}\left(\hat{\beta}\right)\right)-1\right]$, where $\mathrm{var}\left(\hat{\beta}\right)$ is the variance of the estimated coefficient .

coefficient for RTA dummy-variable can be interpreted as the gain of trade in a dyad having a RTA by comparing to a similar dyad without RTA, all else constant.

Therefore, according to the column (2) for specification including SBP variable, two RTA members on average traded 51.89% [=(exp(0.418)-1)*100] more than two otherwise similar non-RTA members, all else constant. My estimates suggest that the trade-effect of SBP was -0.166 from 1995 to 2012 (column 2). By a similar interpretation as before, when two trading countries have a RTA, third RTAs concluded by one of both countries decreased on average their trade by 18.06%, all else being equal. In doing so, the net effect of RTAs was an average increase of international trade by 33.83% considering that the negative trade-effect of the RTAs' proliferation around the world.

[Table 4 (here)]

Now I would like to know in which trading dyad the spaghetti bowl effect (SBP) is the most stringent. Table 4 reports the PPML-estimates from the equation (4) for different subsamples. First, I investigated SBP on trade within North countries (column 1), within South countries including BRICS countries (column 2), and between developed and developing countries (column 3). Secondly, I re-estimated the equation (4) considering the internal trade between developing countries and Rest of the World (column 4), between developed countries and Rest of the World (column 5), between BRICS group (Brazil, Russia, India, China, South-Africa) and Rest of the World (column 6), between OECD countries and Rest of the World (column 7), and the internal trade involving European Union countries or United States (US/EU) and Rest of the World (column 8). Finally, the last two columns report respectively results for estimations on internal trade between US/EU and developed countries (column 9), and internal trade between US/EU and OECD countries (column 10).

For the ten subsamples considered, I remark that estimates for the North-North trade (column 1), or for the trading-samples involving BRICS countries (column 6), OECD countries (column 7), and US/EU (columns 8 to 10), the coefficient on SBP trade-

effect is significantly negative. For example, the negative trade-effect of RTAs' multiplication, so-called SBP, has respectively represented an average reduction of trade by 9%, 7% and 4% for dyads US/EU and Rest of the World (RoW), US/EU and North countries, and US/EU and OECD. It has represented an average reduction by 8.5% for North-North countries. Contrariwise, the estimates of columns (2) and (4) suggest in particular that the multiplication of RTAs has respectively a positive effect on trade between developing countries and RoW, and on South-South trade. In short, the increase of the number of RTAs appears to be a trade-positive factor in South-South trade, while it involves a negative effect on North-North trade. I also note that the trade with developed countries (and RoW), and South (and North) reveals respectively a negative and positive sign of the coefficient of the interacted-variable ("SBP" trade-effect). But the coefficients are not statistically significant. It is possible that some countries possess a larger administrative capacity and institutional capital than others to minimize transaction costs due to multiple agreement membership.

5. Conclusion

This paper investigates empirical analysis on the spaghetti bowl phenomenon related to overlapping RTAs as pointed out by Bhagwati (1995). My empirical findings suggest a significantly negative relationship between the number of RTAs concluded by a country and the additional trade value attributed to a RTA conclusion. Trade with the EU or US seems to be particularly the most affected by this effect of spaghetti bowl. In sum, instead of promoting trade, the multiplication of RTAs might instead result trade diversion effects because of higher transaction costs due to a mass of overlapping rules.

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Figure 1. RTA formation and International Trade – from 1995 to 2012.

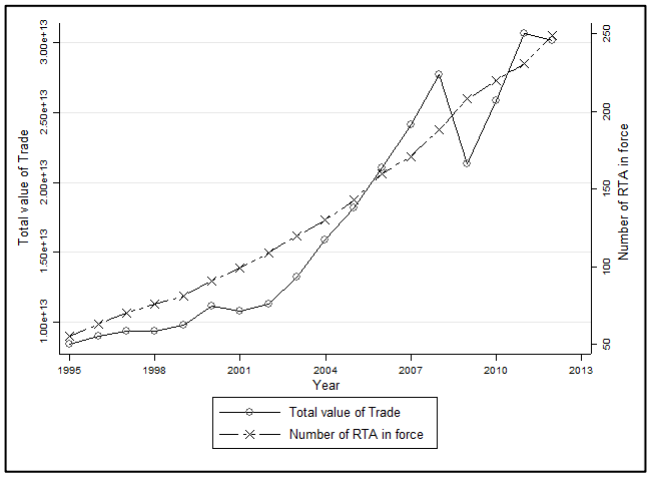

Fig. 1a.
Trade flows and Number of RTAs

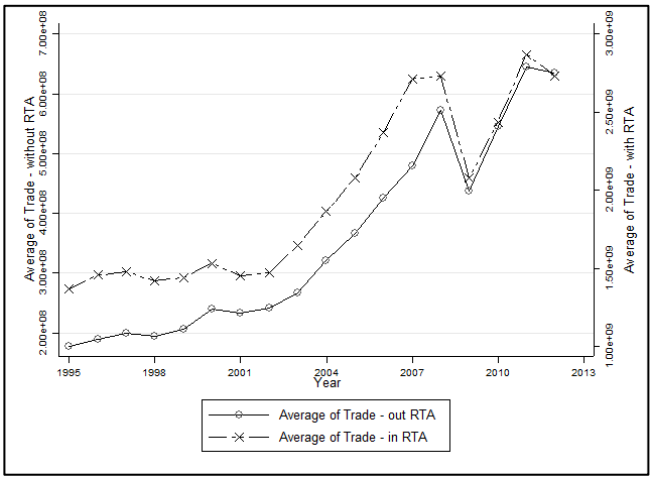

Fig. 1b.
Trade flows with and without a RTA

Figure 2. Overview of "Spaghetti bowl" Phenomenon (SBP) in multilateral trade.

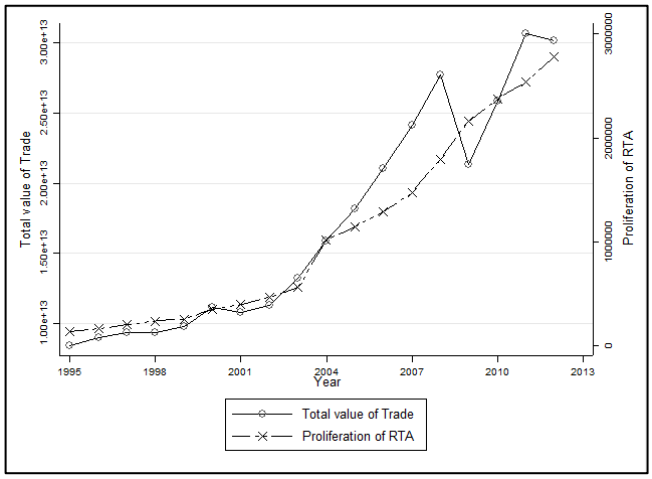

Fig. 2a.

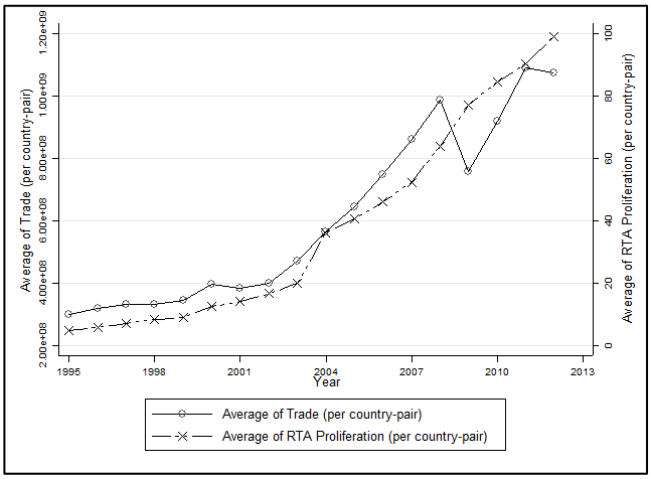

Fig. 2a.

Table 1. Variables descriptions and data sources.

Variable	Description	Source
T_{ij}^{t}	Value of exports from country *i* to partner *j* at year *t*.	WITS-COMTRADE
$Dist_{ij}$	Great circle distance between the main cities of country *i* and its partner *j*.	CEPII
Common border	Dummy variable equal to 1 for countries that share a common land border, and 0 otherwise.	CEPII
Common language	Dummy variable that values 1 when countries *i* and *j* share the same official language, and 0 otherwise.	CEPII
GATT/WTO	Dummy variable equal to 1 if both trading countries *i* and *j* are GATT/WTO' Members at year *t*.	WTO
RTA	Dummy variable equal to 1 if both trading countries *i* and *j* share a same RTA membership at year *t*.	WTO
NUM_{ijt}^{RTA}	The product of number of RTA concluded by each trading country (exporter and importer) in dyad, at year *t*.	-
Crisis 2008/09	Dummy variable that values 1 for the years 2008 or 2009, and 0 otherwise.	-
Common legal	Dummy variable equal to 1 for countries sharing a common legal origin (namely UK, French, German, or Socialist), and 0 otherwise.	CEPII
Common colonizer	Dummy variable equal to 1 for countries that were colonized by the same Power and 0 otherwise.	CEPII

Table 2. Description statistics.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
T_{ij}^{t}	252756	$5.35e^{+08}$	$4.91e^{+09}$	0	$3.52e^{+11}$
$Dist_{ij}$	252756	7182.056	4280.143	114.637	19648.45
Common border	252756	0.024	0.153	0	1
Common language	252756	0.112	0.315	0	1
GATT/WTO	252756	0.706	0.456	0	1
RTA	252756	0.198	0.399	0	1
RTA number per country	252756	7.342	9.395	0	39
Crisis 2008/09	252756	0.111	0.314	0	1
Common legal	252756	0.314	0.464	0	1
Common colonizer	252756	0.072	0.259	0	1

Table 3. Estimation Results and Evidence of "Spaghetti bowl" Phenomenon

	(1) PPML	(2) PPML	(3) OLS	(4) First-difference
Log distance	-1.179***	-1.078***	-1.437***	–
	(0.034)	(0.033)	(0.031)	
Common border	0.756***	0.875***	0.681***	–
	(0.123)	(0.108)	(0.125)	
Common language	0.701***	0.699***	0.625***	–
	(0.047)	(0.046)	(0.063)	
GATT/WTO	0.052	0.046	0.061	–
	(0.067)	(0.069)	(0.153)	
Δ GATT/WTO	–	–	–	0.114*
				(0.082)
RTA	0.382***	0.358***	0.418***	–
	(0.029)	(0.036)	(0.091)	
Δ *RTA*	–	–	–	0.531***
				(0.166)
SBP	–	-0.128***	-0.166***	–
		(0.018)	(0.019)	
Δ *SBP*	–	–	–	-0.191*
				(0.166)
Crisis 08/09	-0.453**	-0.422**	-0.505**	–
	(0.147)	(0.116)	(0.223)	
Δ Crisis 08/09	–	–	–	-0.496*
				(0.282)
Common legal	0.388***	0.319***	0.390***	–
	(0.031)	(0.029)	(0.040)	
Common colonizer	0.683***	0.635***	0.704***	–
	(0.082)	(0.062)	(0.084)	
Fixed Effects	Yes	Yes	Yes	Yes
R^2	0.830	0.841	0.832	0.524
Observations	252'756	252'756	176'399	176'399
Clusters	14'042	14'042	12'784	12'784

Notes: Cluster-robust standard errors reported in parentheses, pooled data by country-pair (importer-exporter). Coefficients with * indicate significance at the 10% level, ** indicate significance at the 5% level, and *** indicate significance at the 1% level. The variables with Δ are reported for first-differenced estimation.

Table 4. Log-Level Gravity Equation – PPML Results for Various Samples with Panel Data, 1995-2012.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(N↔N)	(S↔S)	(S↔N)	(S↔RoW)	(N↔RoW)	(BRICS↔RoW)	(OECD↔RoW)	(US/EU↔RoW)	(US/EU↔N)	(US/EU↔OECD)
Log distance	-0.975***	-1.328***	-1.093***	-0.832***	-1.082***	-1.004***	-1.187***	-1.241***	-1.022***	-1.143***
	(0.076)	(0.046)	(0.052)	(0.028)	(0.036)	(0.079)	(0.062)	(0.061)	(0.067)	(0.082)
Common border	0.161**	0.890***	0.688***	0.974***	0.143*	1.082***	0.242*	0.157**	0.186	0.119
	(0.074)	(0.138)	(0.184)	(0.083)	(0.101)	(0.194)	(0.181)	(0.061)	(0.189)	(0.165)
Common language	0.085***	0.432***	0.369***	0.394***	0.229***	0.562***	0.328***	0.331***	0.255***	0.289***
	(0.017)	(0.088)	(0.094)	(0.065)	(0.080)	(0.129)	(0.082)	(0.093)	(0.084)	(0.087)
GATT/WTO	0.046	0.193**	1.086***	0.142**	0.813***	0.748***	0.074**	0.631***	0.089	0.038
	(0.094)	(0.079)	(0.269)	(0.063)	(0.121)	(0.083)	(0.032)	(0.126)	(0.246)	(0.805)
"RTA" trade-effect	0.330***	0.463***	0.139*	0.158*	0.029	0.146*	0.118*	0.259***	0.156**	0.279***
	(0.081)	(0.072)	(0.119)	(0.143)	(0.072)	(0.119)	(0.074)	(0.072)	(0.062)	(0.089)
"SBP" trade-effect	-0.085***	0.069*	0.113	0.096*	-0.014	-0.064**	-0.075*	-0.093***	-0.071*	-0.039**
	(0.019)	(0.049)	(0.223)	(0.062)	(0.015)	(0.031)	(0.045)	(0.015)	(0.022)	(0.016)
Crisis 2008/09	-1.032***	-0.468	-0.692*	-0.893*	-0.939***	-0.787	-0.862	-1.113**	-1.612**	-0.699***
	(0.316)	(0.766)	(0.496)	(0.805)	(0.203)	(1.168)	(1.047)	(0.561)	(0.675)	(0.086)
Common legal	0.416***	0.201***	0.560***	0.230***	0.600***	0.381***	0.643***	0.651***	0.572***	0.642***
	(0.054)	(0.050)	(0.049)	(0.034)	(0.051)	(0.086)	(0.048)	(0.048)	(0.050)	(0.055)
Common colonizer	0.587	0.894***	-0.131	0.258***	0.111	0.141	0.446	0.805***	0.363**	1.106***
	(0.470)	(0.083)	(0.178)	(0.049)	(0.167)	(0.166)	(0.310)	(0.153)	(0.180)	(0.275)
R^2	0.821	0.693	0.804	0.621	0.829	0.842	0.835	0.806	0.857	0.831
Observations	16'740	77'984	81'975	10'891	98'415	15'342	89'903	86'590	75'167	68'579
Clusters	930	6'624	5'230	810	6'160	1'120	5'956	5'462	4'662	4'470

Notes: Cluster-robust standard errors reported in parentheses, pooled data by country pair (importer-exporter). Coefficients with * indicate significance at the 10% level, ** indicate significance at the 5% level, and *** indicate significance at the 1% level.

Appendix. Countries in the sample, number of RTAs in 2012.

ISO	Countries	RTAs	ISO	Countries	RTAs
ALB	Albania	4	FRA	France	39
ARE	United Arab Emirates	2	GAB	Gabon	0
ARG	Argentina	4	GBR	Great Britain & N. Ireland	38
ARM	Armenia	9	GEO	Georgia	8
AUS	Australia	8	GHA	Ghana	2
AUT	Austria	36	GIN	Guinea	2
AZE	Azerbaijan	5	GNB	Guinea-Bissau	1
BDI	Burundi	3	GRC	Greece	37
BEL	Belgium	39	GTM	Guatemala	7
BEN	Benin	3	HND	Honduras	7
BFA	Burkina Faso	2	HRV	Croatia	2
BGD	Bangladesh	5	HTI	Haiti	1
BGR	Bulgaria	34	HUN	Hungary	34
BHR	Bahrain	3	IDN	Indonesia	7
BLR	Belarus	7	IND	India	14
BLZ	Belize	2	IRL	Ireland	38
BOL	Bolivia	3	IRN	Iran	2
BRA	Brazil	5	ISL	Iceland	25
CAF	Central African Republic	1	ISR	Israel	7
CAN	Canada	8	ITA	Italy	39
CHE	Switzerland	28	JAM	Jamaica	2
CHL	Chile	24	JOR	Jordan	7
CHN	China	10	JPN	Japan	13
CIV	Ivory Coast	3	KAZ	Kazakhstan	11
COL	Colombia	11	KEN	Kenya	3
CRI	Costa Rica	7	KGZ	Kyrgyz Republic	10
CYP	Cyprus	34	KHM	Cambodia	6
CZE	Czech Republic	34	KWT	Kuwait	2
DEU	Germany	39	LBR	Liberia	1
DNK	Denmark	39	LKA	Sri Lanka	6
DOM	Dominican Republic	3	LTU	Lithuania	34
DZA	Algeria	2	LUX	Luxembourg	39
EGY	Egypt	7	LVA	Latvia	34
ESP	Spain	36	MAR	Morocco	6
EST	Estonia	34	MDG	Madagascar	2
ETH	Ethiopia	1	MEX	Mexico	13
FIN	Finland	35	MKD	Macedonia	6
MLI	Mali	2	SVN	Slovenia	34

MLT	Malta	34	SWE	Sweden	35
MYS	Malaysia	12	SYR	Syrian Arab Republic	3
NER	Niger	2	TCD	Chad	1
NGA	Nigeria	2	TGO	Togo	2
NIC	Nicaragua	8	THA	Thailand	11
NLD	Netherlands	39	TKM	Turkmenistan	6
NOR	Norway	24	TTO	Trinidad and Tobago	3
NZL	New Zealand	6	TUN	Tunisia	6
PAK	Pakistan	8	TUR	Turkey	17
PAN	Panama	11	TZA	Tanzania	5
PER	Peru	16	UGA	Uganda	3
PHL	Philippines	9	UKR	Ukraine	16
POL	Poland	34	URY	Uruguay	5
PRK	Korea	2	USA	United States of America	14
PRT	Portugal	37	UZB	Uzbekistan	5
PRY	Paraguay	4	VEN	Venezuela	4
RUS	Russian Federation	17	VNM	Viet Nam	8
SEN	Senegal	2	YEM	Yemen	1
SGP	Singapore	19	ZAF	South Africa	4
SLV	El Salvador	9	ZMB	Zambia	2
SVK	Slovakia	34	ZWE	Zimbabwe	4