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Abstract

This working paper presents a set of indicators to measure regional trade integration, with a special focus on the case of the European Union. We propose measures of openness, connectedness and integration which are tuned to evaluate not only how these components contribute to the advance of international integration but also to control for the potential threat that the proliferation of regional trade agreements may pose to trade globalization. Although this and related questions have been examined from several perspectives, the present article combines the virtues of using a network analysis approach and the possibility to explicitly quantify how regional trade agreements either intensify or thwart international trade integration. Results show that the process of international trade integration has intensified among EU members, whereas trade integration with non-members is advancing slowly. Our indicators provide a more complete view of the differing speeds of integration, which depends on the component of integration considered —either openness or connectedness.

Key words

European Union, geographic neutrality, trade agreement, trade integration, network analysis.

Resumen

Este documento de trabajo presenta una serie de indicadores para medir la integración comercial a nivel regional, en especial el caso de la Unión Europea. Se proponen medidas de apertura, conexión e integración, que son ajustadas para evaluar no sólo cómo estas componentes contribuyen al avance de la integración internacional sino también para controlar, por la amenaza potencial que supone, el cada vez mayor número de acuerdos comerciales para la globalización. Aunque este tipo de cuestiones han sido tratadas con anterioridad, este trabajo combina las virtudes de utilizar un enfoque de análisis de redes y la posibilidad de cuantificar explícitamente cómo los acuerdos comerciales regionales intensifican o amenazan la integración comercial internacional. Los resultados indican que el proceso de integración se ha intensificado entre los miembros de la UE, mientras que con los no miembros avanza lentamente. Estos indicadores proporcionan una visión más completa de las diferentes velocidades de integración, que depende de la componente de integración considerada, ya sea apertura o conexión.

Palabras clave

Unión Europea, neutralidad geográfica, acuerdo comercial, integración comercial, análisis de redes.

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1. Introduction

ACCORDING to the World Trade Organization (WTO), the surge in regional trade agreements (RTAs) has continued unabated since the early 1990s and, as of July 31, some 474 RTAs, counting goods and services notifications separately, had been notified to the General Agreement on Tariffs and Trade (GATT)/WTO[1]. Most of the agreements have been concluded in the past 15 to 20 years, and additional agreements are being negotiated[2]. However, there is no unanimous answer as to whether trade blocs increase or decrease the welfare of the world, and some authors even inquire about whether there is a positive impact on the member countries. Although in 1991, based on the view that regionalism was very likely to be good, Larry Summers proclaimed that countries should pursue trade openness via all type of tariff reduction (Estevadeordal et al. 2008), some prominent trade economists even judge trading arrangements as pernicious to the world trade system. However, in contrast to the glum views of, for instance, Bhagwati and Panagariya (1996) or Frankel et al. (1995), as to the welfare effects of preferential trade areas, Wonnacott (1996) takes a more positive stance, indicating that the effects of free trade agreements (FTA) would be better than previously thought because of scale economies, which would yield welfare increases even under trade diversion[3].

The World Bank (2005) provides a meta-analysis of the literature on the impact of RTAs on intra- and extra-regional trade. The analysis considers 17 research studies providing 362 estimates of the impact on the level of trade between partners. The World Bank's review contributes to the relatively long debate in the literature on international economics regarding the costs and benefits of RTAs, in terms of trade creation and trade diversion. The general trend in the literature is to differ in its conclusions as to the effects on trade of RTAs. As indicated by

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[1] Out of these, 351 RTAs were notified under Article XXIV of the GATT 1947 or GATT 1994; 31 under the Enabling Clause; and 92 under Article V of the GATT. At that same date, 283 agreements were in force.

[2] There are numerous forms of international economic integration agreements. As indicated by Vicard (2009), the canonical taxonomy of RTAs, initially introduced by Balassa (1961), considers regionalism as a gradual process towards economic union, through free trade area, customs union (CU) and common market. For ease of reference, we use the term "regional trade agreements" generically (Baier and Bergstrand 2009).

[3] For instance, although Mexico lost trade to the benefit of Canada (with relatively high costs) when Canada and the U.S. signed an FTA, it regained it when Mexico joined the agreement.

Cipollina and Salvatici (2010) some results show disconcerting variance, since the coefficients of the variable are not stable, with widely varying estimates across studies and some worrying rankings of trade-creating agreements (Cipollina and Salvatici 2010, p.64). The World Bank's review points in the same direction, since the mean value of these estimates is positive, but there is a high degree of variance around the mean. Baier and Bergstrand (2007) point out similar ideas, indicating that since 1962, when Jan Tinbergen found that the "average treatment effects" of RTAs on trade flows were economically insignificant, the results obtained have been mixed. As indicated by Baier and Bergstrand (2007), whereas Aitken (1973) or Brada and Méndez (1985) found the former European Economic Community (EEC) to have an economic and statistically significant effect on trade flows among members, Bergstrand (1995) and Frankel et al. (1995) found insignificant effects.

More recent contributions include Cipollina and Salvatici (2010), who participate in this literature debating about the welfare effects of RTAs, stressing the existence of "intellectual" support for the concern that the current pattern of regionalization is likely to be welfare reducing, as indicated in the above paragraphs. Ornelas (1995) also makes a contribution, indicating that although, as first suggested by Viner (1950), preferential trade agreements may generate trade diversion, it can also be shown that even purely trade creating FTAs can be harmful to the world trading system. Vicard (2009) fuels the debate, indicating that creating any kind of RTAs providing trade preferences to their member countries significantly increases bilateral trade, and that the average treatment effect of the members on bilateral trade does not significantly differ according to the depth of the agreements. According to the extensive review by Soloaga and Winters (2001), the effect of the "second wave" of regionalism is still an open question.

Some of the latest additions to this literature have provided consistent estimates of the effect of RTAs on bilateral trade by appropriately controlling for the endogeneity of membership in RTAs (Vicard 2011). As indicated by Egger et al. (2009), even though for decades the dominant paradigm in the quantification of the effects of RTAs has been that countries were randomly assigned to RTAs, recent contributions allowed for RTAs to be endogenous to trade in an econometric sense (Baier and Bergstrand 2002, 2004, 2007, 2009; Magee 2003, Egger et al. 2008). Results show that ignoring endogenous selection into RTAs is relatively harmful, since the impact of endogenous RTAs on members' relative to non-members' trade flows is more than 40 percentage points higher than in a model which assumes RTA membership to be exogenous. In the specific case of Baier and Bergstrand (2007), they find an average treatment effect of RTAs on bilateral trade close to 50%, increasing to virtually 100% after 10 years. Another relevant paper in this particular field is Carrère (2006), who uses a gravity model to assess ex-post RTAs, finding that they have generated a significant increase in trade between members, often at the expense of the rest of the world. Her results indicate that the predictions of the effects of RTAs in terms of trade creation and trade diversion are very different whether one uses a cross-section or a panel specification that controls for the unobservable characteristics of each pair of countries. In addition, as indicated by Vicard (2011), different RTAs may have different effects.

The literature devoted to examine this and related questions is already voluminous, and the flow of contributions is still remarkable. Forgetting the simplistic answer that countries form trade blocs because it is in their best interest to do so, a thorough analysis is called for to examine the issue from different perspectives, or to examine aspects of the issue disregarded so far. We deal with this and related issues from a different point of view which is not standard in the literature and has some interesting features. Building on Arribas et al. (2009, 2011), we consider a network approach to formulate indicators of international economic integration which take into account RTA membership as opposed to the indicators presented in Arribas et al. (2009) which did not. By comparing both sets of international economic integration — those taking into account RTA membership and those that do not — we will be able to assess from a very different perspective to those adopted by the literature, mostly based on gravity models[4], the impact of RTA formation on trade flows.

Adopting such a remarkably different point of view to what is common practice comes at the price of yielding results which are more difficult to compare with those obtained in previous studies. Therefore, the contributions are more difficult to assess. In contrast, some problems essential to previous approaches such as the issue of exogeneity — i.e., the fact that RTA dummies are not exogenous random variables, Baier and Bergstrand (2007) — are avoided. In addition, the adoption of a network approach is not entirely new in this field, as recent papers by Chaney (2011) and, to a lesser extent, Antràs (2010), among others, indicate.

The article is structured as follows. After this introductory section, section 2 presents the indicators of regional trade integration, and a detailed decomposition of their evolution is

[4] A notable exception is Baier and Bergstrand (2009).

introduced in section 3. Section 4 describes the data, and sections 5 and 6 provide some results. Finally, section 7 concludes.

2. European Integration and Trade Flows

OUR empirical identification of integration within Europe builds on Arribas et al. (2009, 2011), tuning them to the particular case of the European Union (EU) of 27 countries[5], although it could also be extended to other RTAs. These are indicators designed to measure international trade integration for all countries of a given sample, generally the world. In this application we focus on the particular case of the EU, whose level of economic integration has been analyzed from multiple perspectives, since the early studies of Jacquemin and Sapir (1988), Neven (1988), among others, until the more recent contributions focusing on derivative issues such as the increasing relevance of trade blocs (De Melo and Panagariya 1996).

According to our indicators, the basic notation stipulates that N is the total number of countries in our sample, X_{ij} is the trade volume between countries i and j (either exports or imports), and Y_i is country i's economic size (generally GDP). Additionally, our indicators use also information on the impact of distance, measured via θ, a non-negative parameter, and also on the distance between countries. This implies that our indicators will implicitly consider iceberg-type transportation costs (Samuelson 1954), as we shall see with more detail below.

The domestic demand would then be defined as:

$$D_i = Y_i - \sum_{j \in N} X_{ij} + \sum_{j \in N} X_{ji} \qquad (1)$$

In the infrequent case in which $D_j < 0$, then we would assume $D_j = 0$.

Since we are interested in measuring the *level* of economic integration for a particular group of countries, we will consider two partitions, namely, N_1 and N_2, of the total sample N so that $N = N_1 \cup N_2$. N_1 is the set of countries for which we are measuring the level of economic

[5] Our number of countries is actually lower because some new EU members have become states very recently.

integration —i.e., those countries which are members of the RTA— whereas N_2 is the set of countries outside the RTA under analysis[6]. The level of exports for each country in this specific group $(i \in N_1)$ is $X_i^{N_1} = \sum_{j \in N_1} X_{ij}$.

We also define the relative weight of the "rest of the world" (which in our case refers to those economies which are not members of the trade agreement, i.e., economies $N_2 \notin N_1$) with respect to the world economy, using the following expression:

$$b^{N_1} = \frac{\sum_{j \in N_2} D_j}{\sum_{j \in N} D_j} \tag{2}$$

which would correspond to the weight of the world outside (i.e., N_2) the trade agreement under analysis (i.e., N_1).

We construct a variant of the indicator (2) to control for the role of distance between the trading partners. Building on Arribas et al. (2011), the distance-corrected counterpart to (2) is:

$$b_{i,d}^{N_1} = \frac{\sum_{j \in N_2} D_j / d_{ij}^{\theta}}{\sum_{j \in N} D_j / d_{ij}^{\theta}} \tag{3}$$

As opposed to the indicator in (2), in this case $b_{i,d}^{N_1}$ varies across countries, i.e., the weight of the rest of the world for country *i* will depend on the distance between *i* and its trade partners. Although RTA members use to be geographically close, it is not infrequent the case in which some of them trade intensely with peripheral and close countries —such as, for instance, Spain with Morocco, or Finland with Russia.

We also define country *i*'s share with respect to the other members of the trade agreement, i.e., to countries in N_1, as follows:

$$a_i^{N_1} = \frac{D_i}{\sum_{j \in N_1} D_j} \tag{4}$$

[6] A future initiative will be to construct indicators in which we contemplate different regional trade agreements, and simultaneous membership to some of them.

Analogously to equation (3) we define the distance-corrected variant of a_i in expression (4), which follows:

$$a_{i,d}^{N_1} = \frac{D_i / d_{ii}^{\theta}}{\sum_{j \in N_1} D_j / d_{ij}^{\theta}} \tag{5}$$

Note that, since we are dividing both the numerator and the denominator by a distance parameter, its units of measurement will not affect the result. Therefore, the index will be robust to whether we use miles or kilometers, for instance. Expressions (2) and (5) are a way to introduce iceberg-type transportation costs (Samuelson 1954) in the analysis, since economies' relative size vary according to how far they are with respect to their trading partners (those who are members of the same trade agreement, i.e., $i \in N_1$).

The construction of our indexes needs the estimation of the distance effect, θ, along the period 1967-2006. To this end, we depart from the standard model by Anderson and van Wincoop (2003), which is obtained from a general equilibrium model on international trade. In this section we present the main developments, for a deeper analyzes we refer the reader to Anderson and van Wincoop (2003), or Feenstra (2004).

The theoretical form that is obtained from the general equilibrium model relates the trade between two countries i and j (X_{ij}) with the income of both countries (Y_i and Y_j), with the world income (y^w), with the bilateral trade cost (t_{ij}) and with the outgoing average costs (Π_i) and ingoing (P_j) respectively facing the country exporting and importing:

$$X_{ij} = Y_i \frac{Y_j}{y^w} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \tag{6}$$

The parameter $\sigma > 1$ is the elasticity of substitution between goods. The indexes Π_i and P_j can be expressed as follow,

$$\Pi_i^{1-\sigma} = \sum_{j \in N} P_j^{\sigma-1} \beta_j t_{ij}^{1-\sigma}$$
$$P_j^{1-\sigma} = \sum_{i \in N} \Pi_i^{\sigma-1} \beta_i t_{ij}^{1-\sigma}$$

where β_j is the ratio between the country j's income and the world's income, i.e., Y_j/y^w.

We assume that,

$$t_{ij} = d_{ij}^{\theta} e^{\delta b_{ij} + wL_{ij}} \tag{7}$$

is the function of trade cost, where d_{ij} is the bilateral distance, b_{ij} is existence of a common border and L_{ij} the existence of a common language (being the last two dichotomous variables).

The empirical equation to be estimated by the Tobit's procedure is the following:

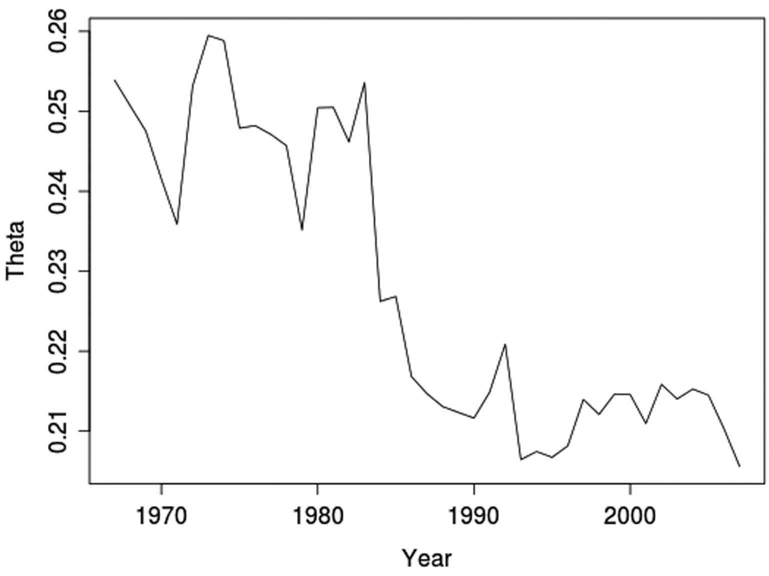
$$\ln(X_{ij}) = \theta(1-\sigma)\ln(d_{ij}) + \delta(1-\sigma)b_{ij} + \omega(1-\sigma)L_{ij} + \sum_i \mu_i \Pi_i + \sum_j \eta_j P_j + \varepsilon_{ij} \tag{8}$$

Thus, Π_i and P_j are two set of country-specific dichotomous variables that control the flow from country *i* to country *j*. On the other hand, θ, δ, ω, μ and η are the parameters to be estimated and L_{ij} is the residual term, that is assumed to be i.i.d. The terms Y_i, Y_j and y^w, present in the theoretical form of the equation (6), are included in the variables Π_i and P_j.

The estimation process does not allow to identify the distance effect, θ, given that this value is always multiplying the term $(1-\sigma)$. To identify the distance effect we follow the recommendation by Anderson and van Wincoop (2004), that replaced by a likelihood value of substitution elasticity between goods, taking this parameter from specific literature on that subject. The parameter ranges from 5 to 9. In our case, we decide to set $\sigma = 7$ according to the work by Imbs and Mejean (2009).

Thus, the distance effect, θ, is obtained for every year dividing the estimated parameter of the variable $\ln(d_{ij})$ (see equation 8) by $(1-\sigma)$, where $\sigma = 7$. The evolution of the θ parameter for the countries in our sample is shown in figure 1.

FIGURE 1: Estimated values for the distance (θ) parameter, 1967-2007



2.1. Degree of trade openness

Our first *de facto* indicator of trade integration in a regional trade agreement is the degree of trade openness. As indicated by some authors such as Pritchett (1996) or Baldwin (1989), the trade literature has grown up proposing and evaluating alternative measures to capture the concept of trade openness (see Proudman et al., 1997, for a survey). We will use which is perhaps the most popular of these approaches, based on *ex post* measures such as export shares —although it has some shortcomings derived from endogeneity in growth regressions and related contexts. In contrast, *outcome-based* approaches evaluate the gap between the actual outcome and what the outcome would have been without trade barriers, using trade intensity (Leamer 1988) or price distortion Pritchett (1996) measures, whereas the *incidence-based* approach attempts to measure openness by direct observation of trade restrictions such as average tariff rates, non-tariff barriers, black market exchange rates, central planning or state monopolies in major exports, which allow to classify economies as "open" or "closed". Both the outcome-based and incidence-based approaches are also subject to criticism— for instance, incidence-based measures may still be endogenous due to the interaction between political economy and economic performance.

For a given country member of the RTA, $i \in N_1$, we define an *ex post* measure of trade openness, namely, the degree of trade openness as:

$$DTO_i^{N_1} = \frac{X_i^{N_1}}{\hat{Y}_i^{N_1}} \tag{9}$$

However, the interpretation of this index differs substantially from that of other indices of trade openness, including those proposed by Arribas et al. (2009), since in expression (9) the denominator is a GDP-corrected variant which takes into account both the share of country *i* with respect to other members of the RTA as well as the share of N_2 (countries not in N_1) with respect to the world's economy, *N*. We define it as:

$$\hat{Y}_i^{N_1} = \left(1 - a_i^{N_1}\right)\left(1 - b^{N_1}\right) Y_i \tag{10}$$

Should we consider distance-corrected indicators, expression (10) would morph into:

$$\hat{Y}_{i,d}^{N_1} = \left(1 - a_{i,d}^{N_1}\right)\left(1 - b_{i,d}^{N_1}\right) Y_i \tag{11}$$

where it can be checked that

$$\left(1 - a_{i,d}^{N_1}\right)\left(1 - b_{i,d}^{N_1}\right) = \frac{\sum_{j \in N_1 \setminus i} D_j / d_{ij}^{\theta}}{\sum_{j \in N} D_j / d_{ij}^{\theta}} \tag{12}$$

The discrepancy between the indicators $\hat{Y}_i^{N_1}$ and $\hat{Y}_{i,d}^{N_1}$ will indicate how the flows of country $i \in N_1$ to N_1 will differ due to the fact that country *i* is relatively far, or close, to its trade partners members of the agreement.

Equation (10) indicates that, according to the geographic neutrality criterion (Kunimoto 1977; Krugman 1996; Iapadre 2006), the trade volume (exports) from country *i* to other members of its RTA (i.e., to other countries in N_1) *should* be proportional both to what is internally consumed to $(1 - a_i^{N_1})$ and what is exported to other countries in the world which are not members of the trade agreement $(1-b^{N_1})$. According to expression (10), the larger the share of country *i* with respect to the economic size of free trade area, and the larger the share of the world's economy of those countries outside the RTA, the lower country *i*'s exports to N_1 members should be. An analogous expression to (10) can be derived for distance-corrected parameters. The interpretation should be also analogous, with the exception that since we are now correcting for distance, we should export more to physically-closer countries, and less to more distant countries.

The case $DTO_i^{N_1} < 1$ would indicate that country *i* exports *less* than what it *should* to countries in N_1, according to the geographic neutrality, or frictionless trade criterion, i.e., according to its GDP share of N_1. In contrast, when $DTO_i^{N_1} > 1$ country *i* is exporting *too much* to other members of the RTA (N_1), according to the geographic neutrality criterion. These ideas are similar to some of those outlined by the literature on trade potential, according to which some countries underexploit the potential of other countries as export markets (Jakab et al. 2001).

2.2. Degree of trade connectedness

Our RTA-tuned measures of trade integration also factor in some ideas by Epstein et al. (2007). They propose a different point of view to assess the evolution of trading patterns, using information on *who trades with whom*, rather than trade openness, i.e., taking implicitly into account the existence of a *world trade web* (Kali and Reyes 2007). Some initiatives in this promising field are devoted to understand how integrated each country is in this web, and assess some of the likely economic implications (Kali et al. 2007). Some of these studies analyze the Word Trade Web using complex network theory methods, which have also been recently used to analyze other issues in international economics (Rauch and Casella 2003).

Arribas et al. (2009) build on these ideas, by introducing measures for international trade integration that take into account both trade openness *and* trade connectedness. Their measures establish that trade openness is a relevant aspect of trade integration, but it is as relevant to measure how connected economies are in the world trade network. They also define, following the ideas of Frankel (2000), a *standard of perfect international integration* to assess the deviation of the actual trade integration from what the trade integration level would be under frictionless trade or, following Krugman (1996), geographically neutral trade, which will be defined later. Therefore, it is possible to measure the gap between each economy's level of trade integration and its *trade potential* (Egger 2002).

We build on Arribas et al. (2009) to construct indicators of *trade connectedness*, extending their ideas to take into account that some countries may be adhered to a RTA and, therefore, their trade can be biased towards their trade agreement partners. Following Arribas et al. (2011), and some of the ideas presented in the preceding section, our indicators will also consider how they can be affected by distance—despite RTA members use to be geographically close.

We define the trade volume (exports) between countries i and j, which are both adhered to the same RTA (i.e., $i \in N_1$ and $j \in N_1$), with respect to i's total exports as:

$$\alpha_{ij} = \frac{X_{ij}}{\sum_{j \in N_1} X_{ij}} \tag{13}$$

and let $A_{N_1} = \left(\alpha_{ij}^{N_1}\right)$ be the matrix of relative flows. Recall also that we assume $X_{ii} = 0$.

We now assume that for the geographic neutrality, or frictionless trade criterion (Berthelon and Freund 2008; Harrigan 2003; Baxter and Jermann 1997), to be fulfilled, country i's exports should be *proportional* to the (economic) size of the recipient country. In other words, the world trade *network* will be connected without frictions if country i's exports is:

$$\beta_{ij}^{N_1} = \frac{D_j}{\sum_{k \in N_1 \setminus i} D_k} \tag{14}$$

or, in case we controlled for distance,

$$\beta_{ij,d}^{N_1} = \frac{D_j / d_{ij}^{\theta}}{\sum_{k \in N_1 \setminus i} \left(D_k / d_{ik}^{\theta}\right)} \tag{15}$$

It is assumed that $\beta_{ii}^{N_1} = 0$, and $\beta_{ii,d}^{N_1} = 0$ its distance-corrected variant. Let $B_{N_1} = \left(\beta_{ij}^{N_1}\right)$ be the matrix of degrees of connectedness, and $B_{N_{1,d}} = \left(\beta_{ij,d}^{N_1}\right)$ its distance-corrected variant.

Given the previously defined matrices, we can also construct an *index* to measure the gap between the actual distribution of trade volumes (in the case being analyzed, exports), and those corresponding to a frictionless trade RTA.

Specifically, given an economy $i \in N_1$, the degree of connection is defined as[7]:

$$DTC_i^{N_1} = \frac{\sum_{j \in N_1} \alpha_{ij}^{N_1} \beta_{ij}^{N_1}}{\sqrt{\sum_{j \in N_1} \left(\alpha_{ij}^{N_1}\right)^2} \sqrt{\sum_{j \in N_1} \left(\beta_{ij}^{N_1}\right)^2}} \tag{16}$$

and its distance-corrected variant will be defined as:

$$DTC_{i,d}^{N_1} = \frac{\sum_{j \in N_1} \alpha_{ij}^{N_1} \beta_{ij,d}^{N_1}}{\sqrt{\sum_{j \in N_1} \left(\alpha_{ij}^{N_1}\right)^2} \sqrt{\sum_{j \in N_1} \left(\beta_{ij,d}^{N_1}\right)^2}} \tag{17}$$

The degree of connectedness, regardless of the variant considered (either distance-corrected or not corrected), will always take values between 0 and 1, given that all components $\alpha_{ij}^{N_1}$, $\beta_{ij}^{N_1}$ and $\beta_{ij,d}^{N_1}$ are nonnegative. The *DTC* will be close to one if *i*'s exports are geographically neutral (frictionless trade), and close to zero for an economy which exports more to smaller countries. In the distance-corrected case, we will be taking into account the fact that countries usually trade more with their neighbors. Therefore, they could exploit the trade potential of their neighbors more intensely.

3. Bipartite Decomposition of the Factors Affecting Trade Integration in the EU

WE can define the degree of integration as a geometric average of both trade openness and trade connectedness. We label this indicator as *DTI*, and it depends both on the openness of

[7] The details on how this indicator is obtained are provided in Arribas et al. (2009).

the economy and the balance of its exports. Bearing this in mind, for an economy $i \in N_1$, the degree of trade integration is:

$$DTI_i^{N_1} = \sqrt{\min\left(DTO_i^{N_1}, 1/DTO_i^{N_1}\right) \times DTC_i^{N_1}} \tag{18}$$

and, in the case of the distance-corrected indicators,

$$DTI_{i,d}^{N_1} = \sqrt{\min\left(DTO_{i,d}^{N_1}, 1/DTO_{i,d}^{N_1}\right) \times DTC_{i,d}^{N_1}} \tag{19}$$

Note that the component corresponding to the degree of openness does not correspond to $DTO_i^{N_1}$ but to the minimum of $\left(DTO_i^{N_1}, 1/DTO_i^{N_1}\right)$—regardless of the distance correction. This must be done because, taking into account expression (9), cases for which $\hat{Y}_i^{N_1} < X_i^{N_1}$ may emerge, indicating the particular country under analysis is excessively open taking into account its share of the trade agreement's GDP and its share of the world GDP.

These identities hold if we consider the different indicators at different points in time. Therefore, we may consider a sequential approach to evaluate how openness and connectedness affect integration. In order to facilitate the presentation we will not distinguish between distance-corrected and distance-uncorrected indicators, since the expressions are analogous, and we will simplify expressions (18) and (19) considering the degree of openness can be higher than unity.

The expressions corresponding to this sequential decomposition are as follows:

$$\frac{DTI_{i,c}}{DTI_{i,b}} = \left(\frac{DTO_{i,c}}{DTO_{i,b}}\right)^{1/2} \times \left(\frac{DTC_{i,c}}{DTC_{i,b}}\right)^{1/2} \tag{20}$$

where b indicates a base period and c indicates a current period —or simply a more recent period than b.

For simplicity, we may denote by lower-case letters the square roots of the ratios of current period divided by base period indicators, for both *DTO* and *DTC*, i.e.:

$$dto = \left(\frac{DTO_{i,c}}{DTO_{i,b}} \right)^{1/2} \quad (21)$$

and:

$$dtc = \left(\frac{DTC_{i,c}}{DTC_{i,b}} \right)^{1/2} \quad (22)$$

Therefore, expression (20) becomes:

$$DTI_{i,c} = dto \times dtc \times DTI_{i,b} \quad (23)$$

Thus, the distribution of the degree of trade integration in the current period (DTI_c) can be constructed by successively multiplying the degree of trade integration in the base period (DTI_b) by each of the two factors, i.e., the degree of trade openness and the degree of trade connectedness. This in turn allows us to construct counterfactual distributions by sequential introduction of each of these factors.

Specifically, the counterfactual *c* period degree of integration distribution of the variable

$$DTI^{DTO} = dto \times DTI_b \quad (24)$$

isolates the effect on the distribution of changes in the degree of openness only, assuming that the degree of total connection is irrelevant. Therefore, the shift from DTI_b to DTI_c would be induced by changes in the degree of openness only.

On the other hand, the counterfactual *c* period degree of trade integration distribution of the variable

$$DTI^{DTC} = dtc \times DTI_b \tag{25}$$

then isolates the effect of the degree of trade connectedness, as if the degree of openness were irrelevant. Therefore, the shift from DTI_b to DTI_c would be induced by changes in the degree of connectedness only.

4. Statistical Sources and Selected Variables

THE data were taken from the CHELEM database[8] and correspond to 88 countries that together account for more than 95% of world output and 90% of international trade. The variable selected to measure flows between countries is the volume of exports, measured in nominal US Dollars[9]. The available information covers a relatively long period of time, from 1967 to 2007, uncovering entirely what some authors have termed the second wave of globalization (O'Rourke and Williamson 1999, 2002; Maddison 2001). Although the database also contained information for other countries, it was not available for all our sample years, and we therefore disregarded it.

The first three columns in table 1 contain information on N_2's shares of the world economy, i.e., of those countries not belonging to the trade agreement. They correspond to expression (2). For simplicity, and also for reasons of space, tables containing individual information for each country in our sample constrain the reported information to three years, namely, the

[8] Information on CHELEM (*Comptes Harmonisés sur les Echanges et l'Economie Mondiale* or *Harmonised Accounts on Trade and The World Economy*) database is available at: http://www.cepii.fr/anglaisgraph/bdd/chelem.htm.

[9] The computations for indicators based on imports do not alter the general results, although they may differ for some specific countries. These results are not reported due to space limitations, but are available from the authors upon request.

initial year (1967), the final year (2007) and an intermediate year (1987)[10]. The last three columns in table 1 control for distance to the trade partners (equation 3) and, therefore, b^{N_1} the index varies across countries. This is a way to introduce iceberg-type transportation costs, indicating that the rest of the world (N_2) becomes larger or smaller depending on how far it is from the *I* country being evaluated.

TABLE 1: Shares of world demand for N_2 (non-EU) economies, as defined in (2) and (3) (%)

Country	b^{N_1}			$b^{N_1}_{i,d}$		
	1967	**1987**	**2007**	**1967**	**1987**	**2007**
Austria	71.07	68.57	64.68	60.31	58.90	59.22
Belgium and Lux.	71.07	68.57	64.68	55.58	54.87	55.47
Bulgaria	71.07	68.57	64.68	62.91	61.22	61.49
Czech R.	NA	NA	64.68	NA	NA	58.79
Czech R. (former)	71.07	68.57	NA	59.64	58.39	NA
Denmark	71.07	68.57	64.68	60.41	59.05	59.43
Finland	71.07	68.57	64.68	63.99	62.13	62.35
France	71.07	68.57	64.68	57.35	56.47	56.79
Germany	71.07	68.57	64.68	57.07	56.05	56.61
Greece	71.07	68.57	64.68	63.71	61.91	62.06
Hungary	71.07	68.57	64.68	61.23	59.72	59.98
Ireland	71.07	68.57	64.68	61.05	59.65	59.51
Italy	71.07	68.57	64.68	60.35	58.74	59.27
The Netherlands	71.07	68.57	64.68	56.22	55.29	55.88
Poland	71.07	68.57	64.68	61.81	60.33	60.53
Portugal	71.07	68.57	64.68	63.8	61.76	61.41
Romania	71.07	68.57	64.68	63.35	61.65	61.88
Slovakia	NA	NA	64.68	NA	NA	59.29
Spain	71.07	68.57	64.68	62.24	60.42	60.15
Sweden	71.07	68.57	64.68	62.74	61.13	61.39
UK	71.07	68.57	64.68	57.26	56.56	56.71

The first three columns in table 2 report data on demand's shares (according to expression 1) for each country in our sample when distance does not enter the analysis ($a_i^{N_1}$). Columns four through six refer to the distance-corrected counterpart of ($a_i^{N_1}$), which introduces information on how far each country's trading partners are. Results show that the discrepancies between distance-uncorrected ($a_i^{N_1}$) and their distance-corrected counterparts, which are

[10] Results on all indicators for the remaining sample years are available from the authors upon request.

displayed in the last three columns of the table, vary a great deal across countries. The lower values correspond to larger economies, whereas larger discrepancies for $a_{i,d}^{N_1} / a_i^{N_1}$ correspond to smaller ones, reflecting the rationale of the iceberg-type transportation costs: if an economy j of size Y_j gets as close to economy i as possible, then its size will be reduced to Y_j / d_{ij}^{θ}, since "only a fraction of ice exported reaches its destination as unmelted ice" (Sa-muelson 1954). Therefore, the farther away economies are, the greater the reduction, with an intensity that depends on the θ parameter whose estimation has been described earlier. Large economies which are far from large exporting markets would then become smaller. In the case of the EU, economies are relatively close and the effect is not as strong as it could be for Australia or Chile, for instance. In addition, since internal distances are also included for computing $a_{i,d}^{N_1}$, smaller countries will inevitably tend to show larger values for $a_{i,d}^{N_1} / a_i^{N_1}$.

TABLE 2: **Shares of EU demand as defined in (4) and (5) ($a_i^{N_1}$ and $a_{i,d}^{N_1}$) (%)**

Country	$a_i^{N_1}$			$a_{i,d}^{N_1}$			$a_{i,d}^{N_1} / a_i^{N_1}$		
	1967	**1987**	**2007**	**1967**	**1987**	**2007**	**1967**	**1987**	**2007**
Austria	1.92	2.53	2.22	3.26	3.96	3.43	1.70	1.57	1.55
Belgium and Lux.	3.40	3.03	2.89	5.32	4.42	4.21	1.57	1.46	1.46
Bulgaria	0.76	0.61	0.30	1.41	1.03	0.50	1.86	1.69	1.66
Czech R.	NA	NA	1.09	NA	NA	1.66	NA	NA	1.53
Czech R. (former)	2.12	1.24	NA	3.54	1.91	NA	1.66	1.54	NA
Denmark	2.09	2.13	1.81	3.85	3.58	3.01	1.84	1.68	1.66
Finland	1.48	1.77	1.43	2.45	2.72	2.18	1.65	1.54	1.52
France	18.70	18.57	15.90	22.09	21.43	18.37	1.18	1.15	1.15
Germany	17.56	20.81	17.81	21.63	24.70	21.28	1.23	1.19	1.19
Greece	1.50	1.37	2.15	2.87	2.37	3.63	1.91	1.73	1.69
Hungary	0.72	0.53	0.83	1.27	0.85	1.31	1.75	1.61	1.58
Ireland	0.56	0.60	1.36	0.99	0.97	2.16	1.77	1.63	1.59
Italy	12.83	15.38	12.41	18.87	21.08	17.04	1.47	1.37	1.37
The Netherlands	3.55	4.62	4.33	5.54	6.69	6.27	1.56	1.45	1.45
Poland	2.76	1.29	2.81	4.21	1.87	4.00	1.53	1.44	1.42
Portugal	0.95	0.98	1.50	1.88	1.74	2.55	1.97	1.76	1.70
Romania	1.52	0.71	1.14	2.61	1.12	1.78	1.71	1.59	1.56
Slovakia	NA	NA	0.46	NA	NA	0.76	NA	NA	1.64
Spain	5.27	6.41	9.39	7.82	8.90	12.72	1.48	1.39	1.35
Sweden	4.36	3.29	2.58	6.57	4.69	3.64	1.51	1.43	1.41
UK	17.95	14.14	17.59	23.34	17.85	21.96	1.30	1.26	1.25

5. Results

5.1. Degree of trade openness

The results on the degree of trade openness are reported in table 3. The first three columns refer to distance-uncorrected indices ($DTO_i^{N_1}$), whereas columns four through six refer to their distance-corrected counterparts ($DTO_{i,d}^{N_1}$), and the last three columns contain information on the discrepancies between these two set of indices. Results indicate that the degree of openness varies a great deal across countries. The countries with larger levels of $DTO_i^{N_1}$ in 2007 are Belgium (and Luxembourg), Czech Republic, Hungary, The Netherlands and Slovakia, indicating that the trade volumes of some new EU members now outperform those of older members. These countries show values of $DTO_i^{N_1}$ higher than unity (100%), indicating that they export more than they *should* according to their shares of the EU demand ($a_i^{N_1}$) and the share of the rest of the world in the world economy (b^{N_1}). On the other extreme, Spain, the United Kingdom and, especially, Greece are the countries with the lowest values of trade openness, which could a priori indicate that being peripheral is an impediment for reaching higher levels of openness.

The dispersion has also a strong temporal variation. In most cases comparing the values of 1967 and 2007 indicates that trade openness has increased. The highest increases correspond to new members such as Hungary or some of the countries which were very closed in the 1960s like Spain. In contrast, some countries have advanced much less in their process of openness to other EU members such as the United Kingdom or Greece —whose trade openness by 2007 is virtually the same as that of 1967.

The summary statistics reinforce the description of these patterns. Although the magnitude of the discrepancies among countries is quite high, the average level of trade openness has increased remarkably —actually, it has more than doubled, regardless of the assumption on distance. We cannot conclude that this effect is contaminated by the presence of outliers, since the median shows a similar pattern. However, inequalities are increasing, as the standard deviation has increased remarkably, in both cases —distance-uncorrected and distance-corrected indicators.

TABLE 3: Degree of trade openness (DTO^{N_1} , %)

Country	$DTO_i^{N_1}$			$DTO_{i,d}^{N_1}$			$DTO_{i,d}^{N_1} / DTO_i^{N_1}$		
	1967	**1987**	**2007**	**1967**	**1987**	**2007**	**1967**	**1987**	**2007**
Austria	36.27	51.69	83.26	26.81	40.11	66.18	0.74	0.78	0.79
Belgium and Lux.	91.62	137.64	191.51	60.89	97.26	142.46	0.66	0.71	0.74
Bulgaria	25.35	18.18	65.25	19.91	14.80	53.93	0.79	0.81	0.83
Czech R.	NA	NA	144.13	NA	NA	112.98	NA	NA	0.78
Czech R. (former)	22.95	30.76	NA	16.69	23.4	NA	0.73	0.76	NA
Denmark	46.50	47.04	62.58	34.61	36.65	50.09	0.74	0.78	0.80
Finland	35.88	42.53	54.73	29.11	35.64	46.01	0.81	0.84	0.84
France	24.09	39.34	44.65	17.05	29.44	34.69	0.71	0.75	0.78
Germany	51.47	65.34	87.01	36.49	49.13	68.06	0.71	0.75	0.78
Greece	11.79	24.40	12.21	9.53	20.35	10.40	0.81	0.83	0.85
Hungary	45.30	49.88	136.72	34.00	39.04	109.43	0.75	0.78	0.8
Ireland	64.19	120.65	84.36	47.89	94.33	68.04	0.75	0.78	0.81
Italy	24.79	34.96	43.25	19.44	28.56	36.10	0.78	0.82	0.83
The Netherlands	141.93	98.81	137.32	95.78	71.01	103.61	0.67	0.72	0.75
Poland	20.14	29.90	62.70	15.49	23.83	51.00	0.77	0.80	0.81
Portugal	22.10	50.40	46.76	17.83	41.74	39.56	0.81	0.83	0.85
Romania	20.25	29.55	40.03	16.17	24.32	33.45	0.80	0.82	0.84
Slovakia	NA	NA	161.80	NA	NA	76.22	NA	NA	0.47
Spain	8.85	24.93	37.93	6.97	20.34	31.98	0.79	0.82	0.84
Sweden	34.54	51.09	64.70	27.46	41.91	53.75	0.79	0.82	0.83
UK	19.65	37.33	30.83	14.24	28.23	24.53	0.72	0.76	0.80
Mean	39.35	51.81	79.59	28.76	40.00	60.62	0.75	0.79	0.79
Median	25.35	42.53	63.70	19.91	35.64	52.37	0.75	0.78	0.80
Std. dev.	31.77	32.73	48.99	21.05	23.44	33.77	0.04	0.04	0.08

The discrepancies between $DTO_{i,d}^{N_1}$ and $DTO_i^{N_1}$ should be evaluated with care. Low discrepancies, which are generally observed for large economies, would suggest that for these countries distance is not very *relevant*, since they are close to their exporting markets and, in addition, discrepancies between internal and external distances are not important. Higher discrepancies are more frequent among smaller economies. However, distance is playing a more important role than it could *a priori* seem, since the source of the discrepancies appears to be more related to discrepancies among b^{N_1} rather than $a_i^{N_1}$.

5.2. Degree of trade connectedness

Results on the degree of trade connectedness are reported in table 4. Their values are much more homogeneous and, in many cases, higher than those corresponding to the degree of trade openness —regardless of the correction by distance. These indices indicate that countries export *proportionally* to the rest of the RTA members, in proportions according to each country share of EU demand. Discrepancies among countries do also exist, but their importance has decreased remarkably during the sample period, as indicated by the standard deviation, which has decreased substantially —almost by half, from 13.88 in 1967 to 6.78 by 2007. In contrast to the degree of openness, although the mean (and the median) has increased, this has occurred to a much lower degree. However, this occurs due to the fact that the initial (1967) values were already high. Indeed, by 2007 the distance-corrected degree of trade connectedness was still substantially higher than the distance-corrected degree of trade openness.

Some countries are responsible for the average increase of the degree of connectedness. It is the case of most new EU members in the sample such as Bulgaria, Hungary and Poland. The evaluation of the Czech Republic and Slovakia is more difficult due to the temporal discontinuity, although one may hypothesize that the combined effect should also be of a large increase. In contrast, with the exception of Belgium (and Luxembourg), the older EU members show a more modest pattern, partly because the initial (1967) values were already high. Some countries such as Italy not only exhibited a high initial level (91.62%) but it has been increasing over time (by 2007 it was 94.9%). Other countries whose degrees of openness were rather low such as Greece or the United Kingdom also exhibit high degrees of connectedness.

Therefore, although some exceptions do exist, joining the EU for many countries has the effect not only of facilitating an increase in the volume of exports, as shown by the degree of openness, but also to allow a much higher *balance* in the exports —the number of trading partners increase, and countries export more to larger economies. In addition, this pattern does not seem to be strongly affected by distance, indicating that the *death of distance* (Brun et al. 2005) may be closer within the boundaries of a regional trade agreement.

TABLE 4: Degree of trade connectedness (DTC^{N_1})

Country	$DTC_i^{N_1}$			$DTC_{i,d}^{N_1}$			$DTC_{i,d}^{N_1} / DTC_i^{N_1}$		
	1967	**1987**	**2007**	**1967**	**1987**	**2007**	**1967**	**1987**	**2007**
Austria	79.46	80.36	74.32	82.13	82.39	77.09	1.03	1.03	1.04
Belgium and Lux.	69.92	89.77	90.04	73.96	92.80	92.69	1.06	1.03	1.03
Bulgaria	54.56	28.02	75.59	57.44	28.60	78.25	1.05	1.02	1.04
Czech R.	NA	NA	73.31	NA	NA	77.20	NA	NA	1.05
Czech R. (former)	47.68	50.32	NA	49.30	52.43	NA	1.03	1.04	NA
Denmark	76.60	84.90	75.36	78.20	87.27	78.00	1.02	1.03	1.04
Finland	80.28	73.81	77.14	82.07	76.49	79.58	1.02	1.04	1.03
France	86.84	95.69	92.04	85.95	95.55	90.93	0.99	1.00	0.99
Germany	79.15	91.57	88.07	80.61	93.21	88.76	1.02	1.02	1.01
Greece	90.52	92.93	84.08	91.66	93.77	85.78	1.01	1.01	1.02
Hungary	52.05	64.53	76.34	55.54	66.76	78.44	1.07	1.03	1.03
Ireland	54.92	71.65	82.64	62.25	76.51	85.17	1.13	1.07	1.03
Italy	91.62	97.74	94.90	92.50	98.20	95.49	1.01	1.00	1.01
The Netherlands	80.92	85.43	82.62	86.79	90.07	86.38	1.07	1.05	1.05
Poland	66.24	58.74	80.08	67.75	60.47	82.48	1.02	1.03	1.03
Portugal	77.55	93.85	74.06	77.46	94.75	78.66	1.00	1.01	1.06
Romania	77.24	85.15	82.83	79.19	86.86	85.06	1.03	1.02	1.03
Slovakia	NA	NA	73.05	NA	NA	76.22	NA	NA	1.04
Spain	96.21	94.65	89.28	96.29	95.58	90.26	1.00	1.01	1.01
Sweden	80.70	84.62	80.05	82.47	86.44	81.92	1.02	1.02	1.02
UK	79.42	92.63	86.65	77.80	93.81	88.14	0.98	1.01	1.02
Mean	74.84	79.81	81.62	76.81	81.68	83.82	1.03	1.03	1.03
Median	79.15	85.15	81.35	79.19	87.27	83.77	1.02	1.02	1.03
Std. dev.	13.88	18.27	6.78	12.97	18.15	5.87	0.04	0.02	0.02

5.3. Degree of trade integration

The results on the degree of trade integration are reported in table 5 combines the effect of the degree of openness and the degree of trade connectedness. Therefore, the results are what one could *a priori* expect from this combined effect. Consequently, the descriptive statistics show an increasing pattern for both the mean and the median, regardless of the assumption on distance considered, whereas the standard deviation has decreased comparing the initial and final years, but by 1987, right after Portugal and Spain joined the EU, there value peaked.

TABLE 5: Degree of trade integration (DTI^{N_1})

Country	$DTI_i^{N_1}$			$DTI_{i,d}^{N_1}$			$DTI_{i,d}^{N_1} / DTI_i^{N_1}$		
	1967	**1987**	**2007**	**1967**	**1987**	**2007**	**1967**	**1987**	**2007**
Austria	53.68	64.45	82.96	46.92	57.49	75.02	0.87	0.89	0.90
Belgium and Lux.	80.04	80.76	65.02	67.11	95.01	77.59	0.84	1.18	1.19
Bulgaria	37.19	22.57	74.06	33.82	20.57	68.50	0.91	0.91	0.92
Czech R.	NA	NA	67.62	NA	NA	78.82	NA	NA	1.17
Czech R. (former)	33.08	39.35	NA	28.69	35.02	NA	0.87	0.89	NA
Denmark	59.68	63.20	72.43	52.02	56.55	65.58	0.87	0.89	0.91
Finland	53.67	56.03	68.52	48.88	52.21	64.16	0.91	0.93	0.94
France	45.74	61.36	67.61	38.28	53.04	58.47	0.84	0.86	0.86
Germany	63.82	77.35	92.32	54.23	67.67	81.01	0.85	0.87	0.88
Greece	32.67	47.62	33.79	29.56	43.68	31.46	0.90	0.92	0.93
Hungary	48.56	56.73	70.85	43.45	51.05	80.43	0.89	0.90	1.14
Ireland	59.37	77.06	88.06	54.60	84.96	79.48	0.92	1.10	0.90
Italy	47.66	58.46	67.57	42.41	52.95	61.49	0.89	0.91	0.91
The Netherlands	75.51	91.88	73.55	91.17	79.97	87.75	1.21	0.87	1.19
Poland	36.52	41.91	74.73	32.40	37.96	68.45	0.89	0.91	0.92
Portugal	41.40	68.77	62.06	37.16	62.89	58.33	0.90	0.91	0.94
Romania	39.55	50.16	60.73	35.78	45.96	56.35	0.90	0.92	0.93
Slovakia	NA	NA	63.71	NA	NA	73.58	NA	NA	1.15
Spain	29.18	48.57	61.37	25.90	44.09	56.12	0.89	0.91	0.91
Sweden	52.80	65.75	75.90	47.59	60.19	70.01	0.90	0.92	0.92
UK	39.50	58.80	54.51	33.28	51.46	48.38	0.84	0.88	0.89
Mean	48.93	59.51	68.87	44.38	55.41	67.05	0.90	0.92	0.98
Median	47.66	58.80	68.07	42.41	52.95	68.47	0.89	0.91	0.92
Std. dev.	14.19	16.23	12.39	15.56	17.68	13.31	0.08	0.08	0.12

However, although some of the results are predictable given the DTI^{N_1} combines two effects which have already been discussed, some findings deserve further comments. For instance, considering distance-uncorrected indicators, all new EU members from the former Eastern Bloc in our sample show an increasing pattern. In some cases such as Poland or Bulgaria the level of trade integration has doubled or virtually doubled. In others the increase has been more modest, but also high. Some older members such as Spain show similar patterns, especially because their initial levels were quite low, and others such as Germany were already quite integrated in 1967 and by 2007 excel as the most integrated EU country in the sample —when distance does not enter the analysis.

In contrast, there are some old members such as Belgium (and Luxembourg) and the Netherlands whose integration levels have actually *decreased*. However, this result is reached because of the particular way in which the degree of trade integration is computed. As indicated in equations (18) and (19), in those particular cases for which the degree of trade openness is higher than unity, we consider that the country is exporting *in excess* compared to its size and the size of the RTA and, therefore, we penalize this behavior by considering it is also far from its full trade potential. As a result, Belgium's degree of trade integration has decreased due to this particular way to combine the effect of trade openness and the effect of the degree of trade connectedness.

5.4. Bipartite decomposition of the factors affecting the degree of trade integration

We can elaborate more carefully on how the different components of trade integration contribute to its evolution. The decomposition has been developed with further detail in section 3. Tables 6, 7 and 8, which compare years 1967 to 2007, 1967 to 1987 and 1987 to 2007 (respectively), report the corresponding results[11]. In all three cases the initial year corresponds to the subscript *b* in section 3 and the final year correspond to subscript *c*. The computations corresponding to the distance-corrected indicators have also been performed but are not displayed for reasons of space. In addition, the cases of the Czech Republic and Slovakia are not reported when comparing 2007 to other years due to their discontinuity over time.

It should first be noted that the results in all three tables do not match exactly those presented in the previous sections. The results for the degree of trade integration which were reported in table 5 assume that the contribution of the degree of openness must be dealt with care, since it can be inverted according to the formula (18) —or (19) for the distance-corrected case. However, in tables 6, 7 and 8 the percentage change in DTI^{N_1} (first column in each table) has been computed according to expression (18) and, therefore, the result will be inconsistent with that for the percentage change in DTO^{N_1} (column 2) in those cases where the latter is larger than unity (or 100%).

[11] For instance, the fourth column in each table corresponds to $(dto - 1) \times 100$, and the fifth column to $(dtc - 1) \times 100$.

TABLE 6: **Percentage change of bipartite decomposition indexes, 1967-2007**

Country	Percentage change in DTI^{N_1}	Percentage change in DTO^{N_1}	Percentage change in DTC^{N_1}	Contributions to percentage change in DTI^{N_1} of	
				Change in DTO^{N_1}	Change in DTC^{N_1}
Austria	54.53	129.57	-6.48	51.52	-3.29
Belgium and Lux.	-18.77	109.02	28.78	44.57	13.48
Bulgaria	99.14	157.36	38.53	60.43	17.70
Denmark	21.36	34.59	-1.62	16.01	-0.81
Finland	27.67	52.52	-3.92	23.5	-1.98
France	47.82	85.35	5.99	36.15	2.95
Germany	44.65	69.06	11.27	30.02	5.49
Greece	3.42	3.53	-7.11	1.75	-3.62
Hungary	45.90	201.8	46.66	73.72	21.10
Ireland	48.31	31.42	50.48	14.64	22.67
Italy	41.76	74.44	3.58	32.08	1.77
The Netherlands	-2.60	-3.24	2.10	-1.64	1.04
Poland	104.62	211.38	20.90	76.46	9.95
Portugal	49.91	111.58	-4.50	45.46	-2.28
Romania	53.56	97.69	7.24	40.60	3.56
Spain	110.33	328.65	-7.21	107.04	-3.67
Sweden	43.76	87.32	-0.81	36.86	-0.41
UK	37.98	56.9	9.10	25.26	4.45
Mean	45.19	102.16	10.72	39.69	4.89
Median	45.28	86.34	4.78	36.5	2.36
Std. dev.	34.25	82.03	18.64	27.28	8.56

When comparing years 1967 and 2007 (table 6) it is apparent that the main contributor to the overall change in the DTI^{N_1} is the degree of trade openness, with only one exception corresponding to the Netherlands. The increase in the degree of trade openness is, on average, more than ten times larger. However, this large discrepancy is not uniformly distributed across countries, since some particular countries excel on this regard, especially those countries which were not EU members by 1967 (Austria, Bulgaria, Spain, Hungary, Poland, or Romania). In contrast, table 7, which compares years 1967 and 1987, reports a much different results for the former communist bloc members in our sample, including a *negative* percentage change in the degree of trade integration for Bulgaria, which is offset in the 1987-2007 period (table 8).

TABLE 7: Percentage change of bipartite decomposition indexes, 1967-1987

Country	Percentage change in DTI^{N_1}	Percentage change in DTO^{N_1}	Percentage change in DTC^{N_1}	Contributions to percentage change in DTI^{N_1} of	
				Change in DTO^{N_1}	Change in DTC^{N_1}
Austria	20.05	42.52	1.13	19.38	0.56
Belgium and Lux.	0.90	50.22	28.4	22.57	13.31
Bulgaria	-39.31	-28.28	-48.65	-15.31	-28.34
Czech R. (former)	18.94	34.04	5.54	15.77	2.73
Denmark	5.89	1.17	10.84	0.58	5.28
Finland	4.39	18.54	-8.07	8.88	-4.12
France	34.15	63.32	10.19	27.80	4.97
Germany	21.19	26.95	15.69	12.67	7.56
Greece	45.77	106.98	2.67	43.87	1.33
Hungary	16.83	10.10	23.98	4.93	11.34
Ireland	29.79	87.96	30.47	37.10	14.22
Italy	22.65	41.00	6.68	18.75	3.29
The Netherlands	21.67	-30.38	5.56	-16.56	2.74
Poland	14.76	48.48	-11.31	21.85	-5.83
Portugal	66.13	128.07	21.01	51.02	10.01
Romania	26.83	45.92	10.24	20.80	5.00
Spain	66.47	181.72	-1.63	67.85	-0.82
Sweden	24.53	47.9	4.85	21.61	2.40
UK	48.85	89.95	16.64	37.82	8.00
Mean	23.71	50.85	6.54	21.12	2.82
Median	21.67	45.92	6.68	20.80	3.29
Std. dev.	23.88	51.85	17.46	20.90	9.26

Some of the results can be explained by the fact that the sample period covers a time when the European continent was divided (roughly) into two trading blocs: the Eastern *versus* the Western part of Europe. The former communist countries that have recently joined the EU had obviously only sporadic and limited trade relations to Western Europe prior to the early 1990s and, once the iron curtain was lifted, most of these countries opened up to the West, intensifying their trade relations with Western Europe in a short period of time. Our results indicate that there are remarkable differences among these countries in their trade indicators after joining the EU, and that their patterns differ for each component of trade integration considered.

TABLE 8: **Percentage change of bipartite decomposition indexes, 1987-2007**

Country	Percentage change in DTI^{N_1}	Percentage change in DTO^{N_1}	Percentage change in DTC^{N_1}	Contributions to percentage change in DTI^{N_1} of	
				Change in DTO^{N_1}	Change in DTC^{N_1}
Austria	28.72	61.08	-7.52	26.92	-3.83
Belgium and Lux.	-19.5	39.14	0.30	17.96	0.15
Bulgaria	228.14	258.85	169.77	89.43	64.25
Denmark	14.60	33.03	-11.24	15.34	-5.79
Finland	22.30	28.66	4.51	13.43	2.23
France	10.19	13.49	-3.81	6.53	-1.93
Germany	19.35	33.16	-3.82	15.4	-1.93
Greece	-29.05	-49.98	-9.53	-29.28	-4.88
Hungary	24.88	174.12	18.29	65.57	8.76
Ireland	14.27	-30.08	15.34	-16.38	7.40
Italy	15.59	23.71	-2.91	11.23	-1.47
The Netherlands	-19.95	38.97	-3.28	17.89	-1.65
Poland	78.31	109.7	36.32	44.81	16.75
Portugal	-9.76	-7.23	-21.09	-3.68	-11.17
Romania	21.07	35.48	-2.73	16.4	-1.37
Spain	26.35	52.15	-5.67	23.35	-2.88
Sweden	15.44	26.65	-5.4	12.54	-2.74
UK	-7.30	-17.4	-6.46	-9.12	-3.28
Mean	24.09	45.75	8.95	17.68	3.15
Median	15.51	33.1	-3.55	15.37	-1.79
Std. dev.	56.34	73.03	42.13	27.71	16.46

6. Comparing RTA-membership Corrected and Uncorrected Indicators of Integration

THE indicators introduced and the corresponding results discussed in the previous sections do take into account that a number of countries in our sample are members of an RTA (specifically, the EU). They have been *tuned* in order to take into account how RTA membership can affect to their corresponding levels of integration, along with its components —trade openness and connectedness.

The indicators constitute modified versions of those presented in Arribas et al. (2009) and Arribas et al. (2011), where the distance-uncorrected and distance-corrected indicators of trade integration were introduced, respectively. When building the indicators, none of these papers considered explicitly how RTA membership can affect the results. Therefore, the present section is devoted to compare the results for our sample countries when considering the RTA-membership uncorrected indicators introduced in Arribas et al. (2009), and the RTA-membership *corrected* indicators —i.e., those which have been presented in this paper. In order to keep the discussion focused, the comparison is confined to the distance-uncorrected indicators only[12].

In order to compare the two series of indices, namely, RTA-membership corrected (DTO^{N_1}, DTC^{N_1} and DTI^{N_1}) and RTA-membership uncorrected (DTO^{N}, DTC^{N} and DTI^{N}) we consider nonparametric methods. Given the remarkable discrepancies found across countries for all the indices examined, especially for the degree of trade openness (DTO^{N_1}), it may be more appropriate to consider methods which are more robust to deviations from normality and, in addition, that extend the comparisons to the entire distributions instead of confining them to summary statistics only.

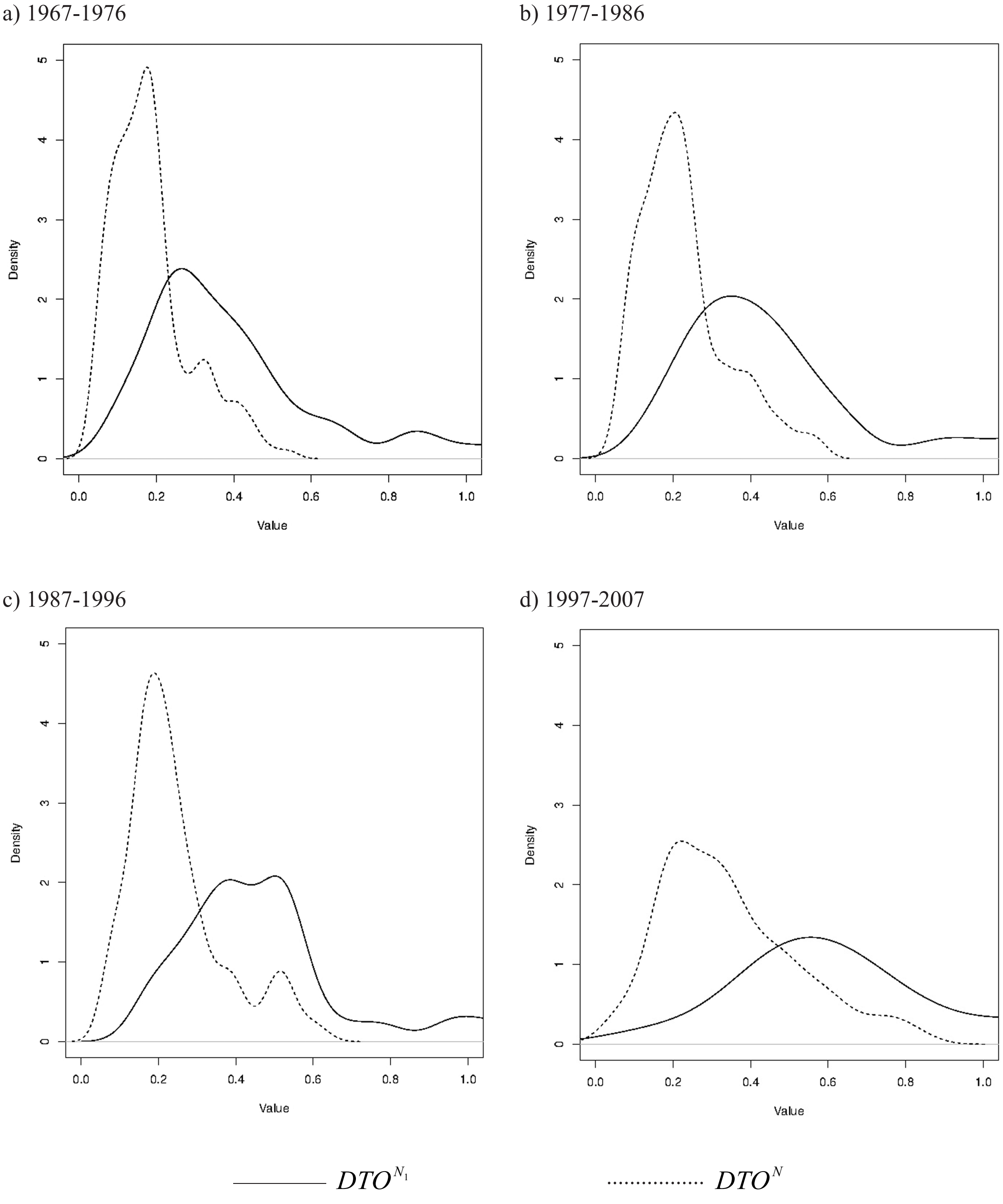
Therefore, using similar ideas to those in Baier and Bergstrand (2009), we use kernel methods to estimate nonparametrically the densities corresponding to our six series of indicators, namely, degree of trade openness, degree of trade connectedness and degree of trade integration for the RTA-membership corrected indicators (DTO^{N_1}, DTC^{N_1} and DTI^{N_1}, respectively), and for the RTA-membership uncorrected (DTO^{N}, DTC^{N} and DTI^{N}, respectively).

Results are reported in figures 2, 3 and 4 for the *DTO*, *DTC* and *DTI*, respectively. Each subfigure contains two lines, the solid line corresponding to the RTA-membership corrected indicators and the dashed line corresponding to the RTA-membership uncorrected ones. The sample period has been split in four subperiods of ten years each (approximately) in order to get a temporal view on the evolution of the indices.

As shown in figure 2, the discrepancies between the RTA-membership corrected and uncorrected indicators are blatant. The distributions found for the DTO^{N} indices are always tighter than those corresponding to DTO^{N_1}. This indicates that the openness of EU countries to the rest of the world is more homogeneous compared with the openness towards other members of the RTA. These tighter distributions hold for all sample subperiods, although in the last subperiod (figure 2d) the distributions are more spread, indicating higher dispersion.

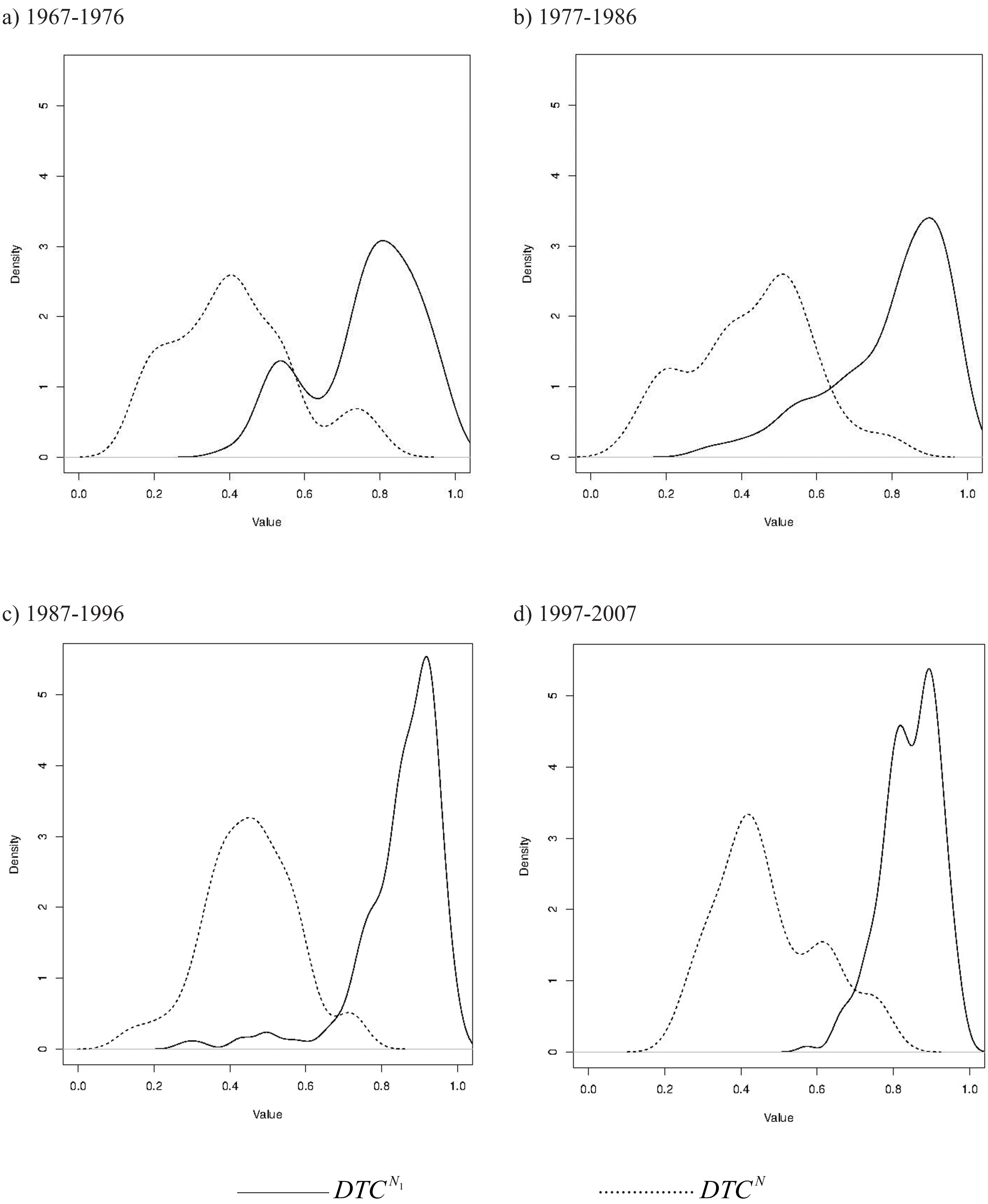
[12] The results corresponding to the comparison with the indicators introduced in Arribas et al. (2011) will not be reported but are available from the authors upon request. In addition, the interested reader is deferred to the Arribas et al. (2009) paper for a detailed presentation of the RTA-uncorrected and distance-uncorrected indicators.

FIGURE 2: **Densities of the degree of trade openness, DTO^{N_1} and DTO^{N} distance-uncorrected**



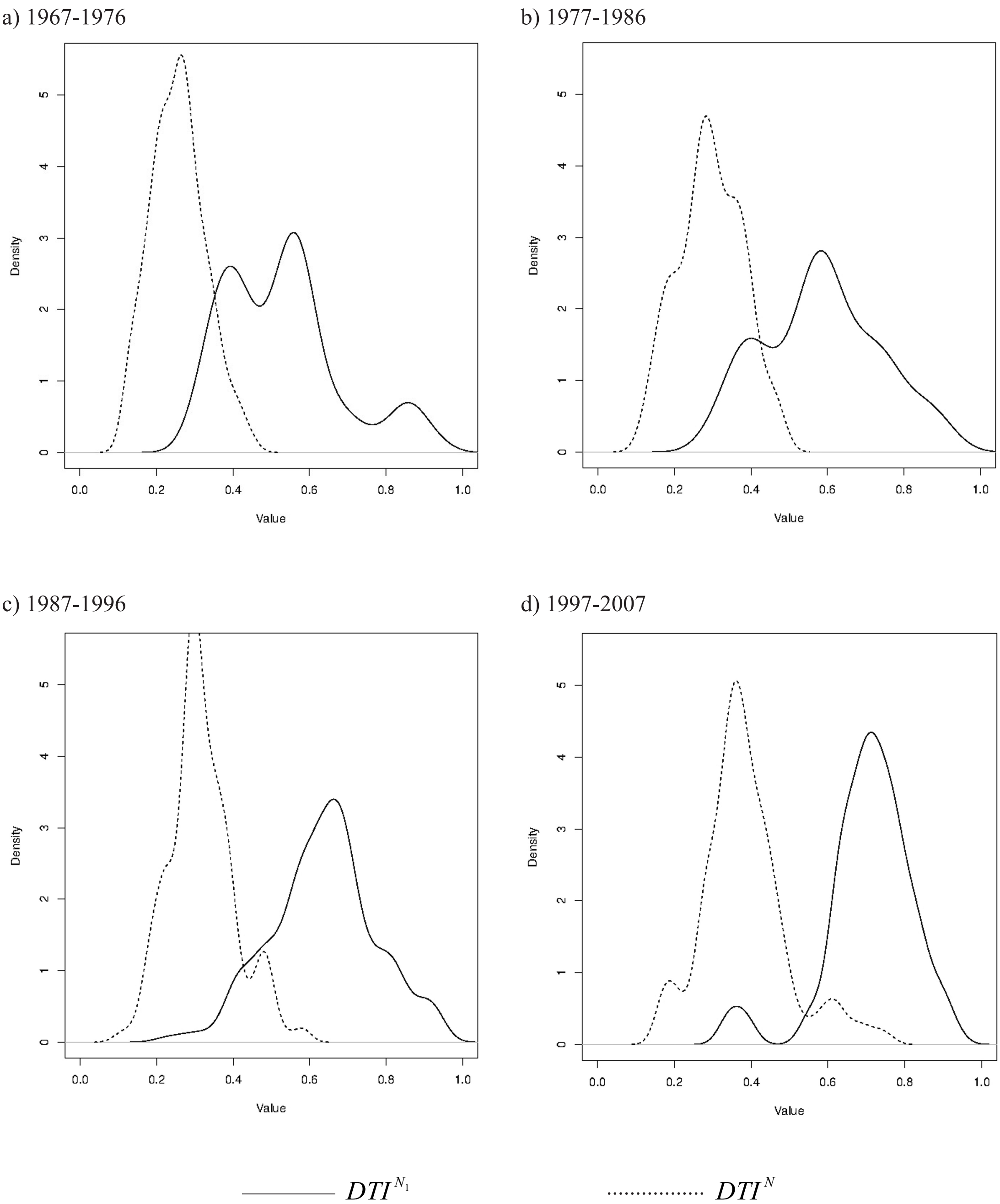
Notes: All figures contain densities estimated using kernel density estimation. The bandwidths are chosen following the plugin method proposed by Sheather and Jones (1991), and the chosen kernel is the Gaussian. The solid line in each subfigure represents the densities for RTA-membership corrected indicators, whereas the dashed lines correspond to RTA-membership uncorrected densities. Results from applying the Li (1996) indicated that the differences between the densities corresponding to DTO^{N1} and DTO^{N} were significant at the 1% level in all cases.

FIGURE 3: Densities of the degree of trade connectedness, DTC^{N_1} and DTC^{N}, distance-uncorrected



Notes: All figures contain densities estimated using kernel density estimation. The bandwidths are chosen following the plugin method proposed by Sheather and Jones (1991), and the chosen kernel is the Gaussian. The solid line in each subfigure represents the densities for RTA-membership corrected indicators, whereas the dashed lines correspond to RTA-membership uncorrected densities. Results from applying the Li (1996, 1999) indicated that the differences between the densities corresponding to DTC^{N1} and DTC^{N} were significant at the 1% level in all cases

FIGURE 4: Densities of the degree of trade i, DTI^{N_1} and DTI^{N}, distance-uncorrected



Notes: All figures contain densities estimated using kernel density estimation. The bandwidths are chosen following the plugin method proposed by Sheather and Jones (1991), and the chosen kernel is the Gaussian. The solid line in each subfigure represents the densities for RTA-membership corrected indicators, whereas the dashed lines correspond to RTA-membership uncorrected densities. Results from applying the Li (1996, 1999) indicated that the differences between the densities corresponding to DTI^{N1} and DTI^{N} were significant at the 1% level in all cases.

In contrast, the solid line in each subfigure, corresponding to DTO^{N_1} shows a much more spread distribution which, in addition, contains a non-negligible amount of multimodality, as shown by the bumps one may observe at the right tail of the distributions in figures 2a, 2b and 2c. Therefore, although the bulk of the probability mass is shifting rightwards over time —in the 1967-1976 period it is in the vicinity of 0.3, whereas in the 1997-2007 period it lies in the vicinity of 0.6 —the variety of behaviors within the RTA is becoming quite large.

Figure 3 reports results for the degree of trade connection. They vary considerably with respect to those found for the degree of trade openness. The connectedness of the EU members when taking into account the rest of the world has remained rather stable when comparing the different subperiods under analysis. Although the shape of the densities has changed, it is not possible to stress a particular pattern, and the probability mass tends to concentrate more tightly around the vicinity of 0.4-0.5. In contrast, the densities corresponding to the RTA-membership corrected indicators introduced in section 2 are much tighter compared to the uncorrected ones and, in addition, they are becoming even tighter and shifting rightwards. This pattern was difficult to uncover via the analysis of the summary statistics reported in section 5.2. Therefore, although the trade openness of the EU countries shows remarkable dispersion, which increases over time, the connectedness among the members increases, probably because the number and size of exporting markets that can be reached with ease has increased sharply.

Figure 4 reports the results corresponding to the degree of trade integration. They combine the effects of the and the and, as such, the evolution of the densities is what one might expect from what is displayed in figures 2 and 3. The final view (figure 4d) indicates that the degree of trade integration of EU countries is much higher when considering the RTA(EU)-membership corrected indicators, and that integration is increasing much more rapidly than when compared with the integration with the rest of the world. However, this pattern is not shared by all EU members, as indicated by the remarkable mode in the vicinity of 0.4 in figure 4d, which corresponds to Greece.

7. Concluding Remarks

THIS article has attempted to provide some new insights on the issue of how regional trade agreements (RTAs) affect trade flows. For decades, the literature has dealt with this question from a gravity equation perspective, a log-linear OLS regression specification, typically interpreted theoretically as a reduced-form from a formal general equilibrium model (Baier and Bergstrand 2009). In this and other particular instances such as the assessment of the ex-post trade effects of a currency union, or the trade creating and trade diverting effects associated with RTAs, the gravity model has become the favorite tool (Carrère 2006). The literature dealing with these questions has grown rapidly, and some articles have stressed potential problems such as the issue of endogeneity (Baier and Bergstrand 2007; Egger et al. 2010) or the proper formulation of the model (choice of variables) as well as about proper econometric techniques (Carrère 2006).

Our approach is based on constructing indicators of international trade integration which, in contrast to Arribas et al. (2009), take into account that some subsets of countries in the sample are members of RTAs. Our indicators consider that the level of trade integration advances both due to openness and connectedness. Therefore, large values of integration can only be attained if economies are *open* (but not *excessively* open) and also connected with more trade partners and, more importantly, with partners which represent large shares of EU demand. These ideas echo some recent papers which adopt network approaches to examine trade flows, modeling the *world trade web* (Kali and Reyes 2007), or those others who have considered a *geographic neutrality* criterion (Krugman 1996).

The application to the case of the EU indicates that there are large discrepancies among country members. The largest discrepancies are found for degree of trade openness, for which several countries show values larger than unity—they export too much to other EU countries in proportion to their share of EU demand, and the share of the EU in the world economy. These discrepancies are increasing over time, possibly because of the last enlargements, since some of the new members have very high degrees of openness. In contrast, the degree of trade connectedness is much more homogeneous, and its average increase is attributable to many countries.

Comparing the results of the indicators presented in this paper (which we label as RTA-membership corrected indicators) to those in Arribas et al. (2009) (which we label as RTA-membership uncorrected indicators) can provide some new insights on the issue of the effect of RTAs on members' international trade. The densities corresponding to the RTA-membership corrected indicators indicate that, for all the considered periods, the trade integration advances much more rapidly with other EU members than with other countries outside the agreement —although *de jure* integration exists because of the signature of the agreement. Although both openness and connectedness contribute to this increase, the positive effect of the latter on trade integration is much more generalized.

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