International Studies Quarterly

International Studies Quarterly (2012) **56**, 645–660

Competing for Scarce Foreign Capital: Spatial Dependence in the Diffusion of Double Taxation Treaties[1]

Fabian Barthel and Eric Neumayer

London School of Economics and Political Science

Recent research suggests that double taxation treaties (DTTs) increase bilateral foreign direct investment (FDI). However, entering such a tax treaty is not unambiguously favorable for both partners if their bilateral FDI positions are asymmetric. Due to the usual bias toward residence-based taxation in DTTs, net capital importers can face a considerable loss of tax revenues when entering these treaties. Nevertheless, there is an ever denser and growing global network of such treaties. This article argues that net capital–importing countries are caught in a prisoners' dilemma: Collectively, they would be better off refusing to sign DTTs, but each one has an incentive to sign DTTs to gain a competitive advantage. Countries will look toward and be influenced by the policy choices of other focal countries and will follow their DTT activity. We find evidence for such spatial dependence in our analysis of DTT diffusion in a global sample over the period 1969–2005. Dyads are more likely to sign a DTT the more DTTs have previously been concluded by the regional peers of the dyad members as well as by other countries who compete with at least one of the dyad members in terms of export product structure.

Double taxation treaties (DTTs) are concluded between two independent tax jurisdictions and determine to what extent either of the contracting states is allowed to tax revenues of companies operating in both countries. Many capital-importing countries are keen to sign DTTs with major capital exporters, even though in the end the hoped-for benefits in terms of increased inflows of foreign direct investment (FDI) might be small compared to the considerable negotiation costs and the potentially large loss in tax revenues given that practically all DTTs favor residence over source taxation. With the risk of finding themselves worse-off, why do these countries strive to conclude DTTs such that there is an ever denser network of DTTs? We argue that even if capital-importing countries would be collectively better off not signing DTTs, they still individually have an incentive to sign DTTs because if other focal countries have done so, they are likely to lose out even more if they themselves do not sign DTTs. In other words, the proliferation of DTTs is driven by spatial dependence among capital-importing countries caught in a prisoners' dilemma. A country's propensity to enter a tax treaty therefore depends on whether other countries, which compete with the country for scarce foreign capital, have already signed a DTT with the same capital exporter.

Our paper builds on and contributes to two strands of previous research, namely the growing scholarship on spatial dependence in policy choices and the literature on tax treaties. While analyzing spatial dependence of policy choices at the monadic state level has become very popular recently, particularly, but not only in fiscal and tax policies (Simmons and Elkins 2004; Plümper, Troeger, and Winner 2009), the study of spatial dependence of policies in a dyadic setting of bilateral relations between states is still in its infancy. To our knowledge, there are only two published studies, both addressing the diffusion process of bilateral investment treaties (Elkins, Guzman, and Simmons 2006; Neumayer and Plümper 2010). We add to this nascent literature by analyzing spatial dependence in the diffusion of DTTs. As concerns the literature on tax treaties, comparatively little research has specifically addressed the global diffusion of DTTs, focusing instead on legal and economic issues of model treaties or particular dyads. Some authors interpret the spread of DTTs as evidence for the superior bargaining power of developed countries which impose DTTs on developing countries (Irish 1974; Dagan 2000). Rejecting this view, Brauner (2003) argues there are many cases in which developing countries wish to conclude tax treaties with developed countries, even if the latter often reject the request. Independently of who formally initiates negotiations, we argue similarly to Baistrocchi (2008) that capital-importing countries are prompted to seek DTTs for fear of driving FDI away to competing countries if these other countries, with which the country competes for scarce foreign capital, have already signed DTTs.

We test these arguments in a spatial Cox proportional hazards model analyzing the diffusion of DTTs in a global sample over the period 1969–2005. We find that the probability of a country signing a DTT with a given partner country increases if regional peers and foreign countries competing with the country in terms of export product structure have previously signed DTTs. In line with predictions, the strength of spatial dependence is stronger for heterogeneous country pairs consisting of an OECD member and a nonmember than for a global sample consisting of all dyads. Moreover, the spatial effect is systematically condi-

[1] We thank two referees for valuable comments. The Stata replication data and do-file will be made available upon publication at http://personal.lse.ac.uk/neumayer.

Barthel, Fabian and Eric Neumayer. (2012) Competing for Scarce Foreign Capital: Spatial Dependence in the Diffusion of Double Taxation Treaties. *International Studies Quarterly*, doi: 10.1111/j.1468-2478.2012.00757.x

tioned in ways consistent with the hypothesis that countries engage in DTT-signing activity because of competition for scarce foreign capital. Specifically, the estimated spatial effects are lower the higher the number of existing treaties signed by one of the dyad members, are higher during periods when countries have freshly become independent, and are thus first exposed to the force of competition and are higher when countries are more open to trade and thus more exposed to global economic exchange.

Trends in the Diffusion of Tax Treaties

The treaty between Austria–Hungary and Prussia agreed on June 22, 1899, is considered to be the first international DTT which resembles modern treaties (Easson 2000). The first model treaty was published in 1928 by a group of experts, which had been convoked by the League of Nations in 1921 in order to develop possible solutions to the problem of international taxation, and this model treaty still forms the basis for all DTTs in force today (Graetz and O'Hear 1997).

Until the end of the Second World War, only six treaties were signed.[2] This number rose to 25 treaties at the end of the decade. The diffusion gained considerable speed in the following decades, exhibiting an exponential rise in the number of treaties signed; see Figure 1, which shows the number of DTTs signed per year and the cumulative number of DTTs worldwide.

Easson (2000) distinguishes several geographical waves in the history of treaty formation. Before the end of World War II, the few treaties were concluded mainly among countries in Europe. Until the 1970s, most DTTs were agreed upon between developed economies. Around 1970, several developing nations, mostly in Asia and Africa, started to conclude tax treaties with developed countries, with the goal of attracting more FDI. In the 1980s, some of the socialist countries began to enter DTTs, and during the 1990s, the transition economies and the newly independent states of the former Soviet Union followed suit. The latest wave encompasses the countries in Latin America and the Middle East.

The aims and perceived benefits from concluding DTTs are manifold, including a division of the international tax base, an exchange of information, but also curtailing tax evasion, particularly via internal transfer pricing (Brauner 2003; Davies 2003a; Doernberg 2004). A motive that is particularly important for capital-importing countries is to enshrine the effectiveness of tax-related investment incentives to attract foreign capital, which can be defeated by lack of cooperation (Doernberg 2004). The benefits of entering a DTT may go beyond the mere treaty provisions, however, in that signatory countries may gain ''international economic recognition'' (Dagan 2000:32) or convey a ''credible commitment to predictability and legal stability'' (Baistrocchi 2008:383).

[2] Since the focus of this study is the diffusion of tax treaties, only the date of signature is recorded. All numbers therefore refer to treaties signed. Since some treaties were renegotiated, this does not reflect the number of negotiations. Furthermore, a very few treaties were cancelled or have never been ratified, that is, the actual number of DTTs in force is somewhat lower.

Concluding DTTs is not without costs, however. First, the process of negotiating and ratifying the treaty ties up administrative resources. Second, sometimes the domestic tax laws have to be adapted to the provisions of the treaty. However, most important is the potential loss of tax revenues, at least for one contracting state. Most DTTs follow the OECD model convention and thereby favor residence over source taxation: The domicile country of the investor is allowed to tax the worldwide income of its multinational corporations (MNCs) operating abroad, while taxation in the host country (and thereby the source country of the taxable income) is confined to the withholding taxes whose upper limits are set in the treaty negotiations (Dagan 2000). If FDI positions were fully symmetric, benefits offered to an investor from one contracting state should—in theory—be balanced out by the benefits given to the other country's investors in their own country. FDI flows and stocks are often highly asymmetric, however, such that the revenue sacrifice is regularly one-sided with the net capital importer (Easson 2000). Furthermore, capital-importing countries frequently lack the bargaining power to influence the treaty provisions in their interest (Pistone 2010). Thereby, the loss of tax revenues for the net capital importer is generally higher, the higher is the degree of asymmetry and the lower are withholding tax rates.

Despite these costs to one contracting party, there is an increasing number of DTTs signed between two countries with strongly asymmetric FDI positions, in which the FDI stock from one contracting partner in the other state considerably exceeds capital stocks in the reverse direction (mostly, but not only, developing countries find themselves in such a position). As can be seen from columns 5 and 6 in Table 1, asymmetric FDI stocks are the rule rather than the exception. For example, on average, in 2004, the FDI outward stock of the UK in a contracting partner was 16.7 times the respective outward stock of this partner in the UK, while 42 partner countries report no FDI in the UK at all. The average ratios are considerably smaller if weighted by the relative shares foreign countries account for as a percentage of overall FDI coming from a source country, but even there asymmetry is highly prevalent. In fact, only Australia has a mean weighted FDI asymmetry ratio of close to one, indicating that its FDI in- and outward stocks are nearly balanced on average. In the next section, we discuss why spatial dependence in signing DTTs will prompt even net capital–importing countries to sign DTTs if other countries, with which the country competes for scarce foreign capital, have already done so.

Spatial Dependence: Why Policy Choices in Other Focal Countries Drive the Diffusion of DTTs

Tax treaties between two countries that are fully symmetric in their bilateral FDI positions are likely to be beneficial for both. However, DTTs among asymmetric countries, that is, where one signatory state is a net capital importer and the other one a net capital exporter, are a frequent phenomenon. Why do capital-importing countries sign DTTs that systematically favor

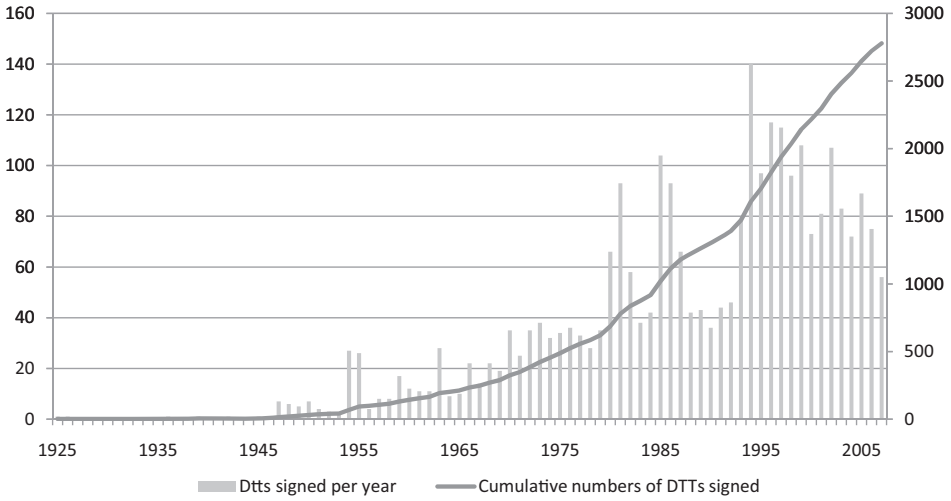

Fig 1. Newly Concluded DTTs per Annum (Left-hand Scale) and Total Number of DTTs Signed (right-hand scale). Data Source: IBFD (2009)

Table 1. DTT Details and FDI Stock Asymmetry of Selected Source Countries

Rank[*]	*Country*	*Number of DTTs*	*Fraction of Outward Stocks Covered by DTT*[†] *(%)*	*Mean FDI Asymmetry Ratio (Unweighted)*[‡]	*Mean FDI Asymmetry Ratio (Weighted)*[§]	*N*[¶]	*Number of DTT Partners without FDI Stock in Country*
1	France	123	99	6.5	2.7	58	9
2	United Kingdom	118	98	16.7	7.5	70	42
3	Norway	107	85	1.1	0.4	75	54
4	Denmark	105	93	4.1	2.4	81	25
5	Sweden	102	100	6.6	2.2	63	45
7	Switzerland	96	92	5.0	3.4	76	48
9	China	93	94	0.7	0.5	75	51
11	Germany	91	98	20.6	9.8	68	26
12	India	86	100	0.8	0.2	67	48
12	Netherlands	86	96	47.1	25.4	59	10
14	Russian Federation	85	84	1.1	0.5	68	45
15	Romania	84	100	0.7	<0.01	71	47
19	Malaysia	76	83	2.4	7.0	59	43
21	South Africa	73	93	1.3	5.6	54	33
24	United States	69	92	25.3	7.7	58	10
31	Singapore	61	72	9.8	71.3	47	29
33	Japan	60	92	71.9	82.4	47	18
57	Australia	42	87	3.7	1.2	27	9
89	Argentina	19	71	0.2	0.1	11	2

(*Notes.* [*]Countries ranked according to total number of DTTs signed.
[†]Year 2004 chosen for data availability.
[‡]Calculated as the FDI outward stock of country *i* in country *j* over the FDI stock of country *j* in country *i*: FDI_{ij}/FDI_{ji}.
[§]weighted by $FDI_{ij}/\sum FDI_i$.
[¶]Number of countries for which information on outward stock available.)

a distribution of the taxes generated from MNCs to the advantage of the capital-exporting residence country? It is the hope for additional FDI inflows, which motivates policymakers in net capital–importing countries to sign tax treaties. There is, however, controversy in the empirical literature over whether concluding DTTs actually leads to more FDI. On the whole, studies that have focused on a narrow sample of almost exclusively OECD countries have failed to find corroborative evidence (Davies 2003b; Blonigen and Davies 2004, 2005; Egger, Larch, Pfaffermayr, and Winner 2006), whereas studies that have analyzed more representative global samples find a positive effect of DTTs on FDI (Di Giovanni 2005; Neumayer 2007; Barthel, Busse, and Neumayer 2010). In fact, Barthel et al. (2010), the study with a sample of broadest country and time coverage, shows that a DTT, on average, is associated with an approximately 30% higher bilateral FDI stock and that this effect is larger for developing host countries. Naturally, a DTT is only one measure among a variety of factors that determine the attractiveness of a jurisdiction to foreign capital owners as a place to invest, but it is one which countries are free to engage in or not.

If DTTs are favorable to capital exporters and capital importers hope for more FDI after concluding

DTTs (and there is some evidence to back up this hope), why do all countries not simply sign a DTT with each other? The reason is that higher FDI does not necessarily mean more tax revenue for capital-importing countries, as two opposing effects occur: on the one hand, if the agreed withholding tax rate is lower than the domestic corporate tax rate, the host country will collect less from a single firm, but since there is more investment, the taxable profits should rise, too. A comprehensive analysis of the net effect needs to be done on a country level and needs to take into account not only the level of the applicable withholding and corporate tax rate, but also country-specific tax calculation rules and tax incentives, which is beyond the scope of this paper. Generally speaking, however, a DTT is not unambiguously favorable for both treaty partners in asymmetric dyads, because the net capital importer might face a loss in tax revenues, which might not be offset by increased inward FDI, nor by other positive effects of a DTT.

Yet, due to international competition for FDI, a country still can have an incentive to conclude such a tax treaty, because its own situation without a treaty deteriorates if other focal countries enter such treaties themselves and thereby gain a competitive edge. As pointed out by Guzman (1998) in the comparable case of BITs, an individual country has an incentive to negotiate a treaty with potential investors to make itself a more attractive location relative to other potential hosts, even if capital-importing countries as a group will not have any benefit. If similar host countries were to act as a group, there would be less competition and more market power for ''sellers'' (of investment locations). As a consequence, they would be able to increase the price (in terms of less fiscal and nonfiscal investment incentives). Even though this would discourage FDI on the margin, the overall gains would outweigh the losses. However, this behavior cannot be observed in practice. Our argument is that capital-importing countries are caught in a classical prisoners' dilemma: Each country would be better off refusing to sign a DTT, but signing a DTT is the dominant strategy given that the highest payoff occurs if one signed a DTT, but the others do not.

With multiple competing countries, the pressure on a single country to sign DTTs is greater the larger the share of competitors, which has already signed a treaty, where competitors are simply other states acting as substitutes from an investor's point of view. In general, the degree of substitutability of countries increases with their structural similarity as a potential location for FDI. This strategic interaction among governments also helps to explain why nearly all DTTs are bi- rather than multilateral, as in a multilateral setting no single country is able to gain a competitive advantage.

Which other focal countries are countries likely to look at? Since competition among countries is the main hypothesized reason for the diffusion of DTTs in our theoretical argument, we contend that countries look at their main competitors for scarce foreign capital as focal countries. Competitor countries can be identified in a multitude of ways, but further below we choose three specific variables: one captures competition in the markets a country exports to, the second competition in the products a country exports to world markets, while the third captures the regional identity of countries.[3] Countries in the same region are competitors for scarce foreign capital as they are often functional equivalents for foreign investors, particularly for FDI of the market-seeking type, that is, for FDI set-up for the purpose of producing for a particular foreign macro-region. Countries competing in the same range of products and services are competitors for a specific type of investment in specific economic sectors producing these goods and services. Countries exporting to the same foreign markets are competitors in these foreign markets, but do not necessarily compete for FDI. We include this connectivity variable to examine whether countries are simply driven by the DTT-signing activity of generally competing countries, rather than countries specifically competing for scarce foreign capital.

If competition for scarce foreign capital drives spatial dependence in the diffusion of DTTs, then the remaining question is why does this not lead to a situation in which all possible country pairs are covered by a DTT? The reason is that while countries fear to lose out in the scramble for FDI if they fail to sign a specific DTT, they need to balance this cost against the costs of concluding the DTT. First, there is a post-treaty cost stemming from the potential loss in tax revenue already mentioned. Second, there is also an upfront cost. Despite the widespread use of model treaties, the negotiation of a tax treaty is a lengthy process, which ties up a large amount of administrative resources. Especially developing countries lack the capacities to handle a significant number of simultaneous treaty negotiations. This is aggravated by the fact that some existing treaties are amended from time to time if general economic conditions change. Thuronyi (2010:444) argues that ''it would take a lifetime for most developing countries to negotiate a substantial number of treaties,'' since these countries only have weak capacity to administer treaties, and their tax administrations are typically challenged in terms of human resources. However, the same restrictions apply, if less severely, even to more advanced economies. The US Treasury Department has stated (US Senate Committee on Foreign Relations 2006):

> ''The primary constraint on the size of our tax treaty network may be the complexity of the negotiations themselves. Ensuring that the various functions to be performed by tax treaties are all properly taken into account makes the negotiation process exacting and time consuming.'' (Statement of Patricia A. Brown, February 2, 2006)

As a consequence, policymakers have to prioritize potential partner countries with which they strive to negotiate a treaty. In line with our argument, the extent to which competing nations have already signed tax treaties will affect the relative cost of holding out

[3] While countries often look at their regional peers in terms of competition for FDI, competition is not the only reason why countries may regard their regional peers as focal countries. Countries often also learn from others in their region as well as imitate or emulate their behavior. This is not a problem for our analysis; rather it ensures that we also capture some other reasons for spatial dependence in the diffusion of DTTs.

and not signing a treaty. Moreover, industry structure as well as the composition and destination of exports of a country change over time. Consequently, also the set of competing countries is bound to change over time. As a result, more and more treaties will be signed over time, but the process of diffusion will slow down and potentially come close to a halt when the web of treaties covers the main competitors, and concluding further DTTs generates higher costs than benefits to countries.

Data and Methodology

Choice of Dyadic Setting

Since a tax treaty is concluded between two states, a dyadic data setting where each observation consists of a country pair is the appropriate form of analysis. One can differentiate between directed and undirected dyads (Neumayer and Plümper 2010): While in the former case, dyadic activity between the dyad members *i* and *j* initiates with *i* and is directed toward *j*, in the latter case such a distinction is either not possible or theoretically unimportant, and dyad *ij* is therefore indistinguishable from dyad *ji*. In the context of DTTs, modeling either a directed or an undirected dyad can be theoretically justified. Since there is no conclusive argument for the choice of direction in a DTT dyad and information on who started the negotiations is not available in individual cases, the main analysis is based on undirected dyads. However, in the robustness section, we model DTTs as directed from OECD to non-OECD countries, similar to what Neumayer (2006) proposes for Bilateral Investment Treaties.

Data Description

The data set covers 186 countries and spans 37 years from 1969 to 2005. Modeled as undirected dyads, 186 countries can be combined to 17,205 country pairs. The data set encompasses 2,325 tax treaties,[4] covering 87.8% of all treaties up to 2005 in the International Bureau of Fiscal Documentation (IBFD) database, which is our source for information on DTTs. A total of 270 treaties are lost as their date of signature is before 1969; another 53 treaties are excluded because either one or both of the contracting states is not in the sample due to lack of data.

The dependent variable is a dummy for whether a DTT between a specific pair of countries has been signed. Since the focus of the analysis is on the diffusion of tax treaties, the date of signature, rather than the date of ratification or the date of effectiveness, is taken. For the same reason, all renegotiated contracts which replace a former treaty are excluded. Since each treaty country pair can phrase its own wording of the agreement, there is some heterogeneity among existing DTTs. Several arguments justify the homogenous treatment of all tax treaties however: First, the focus of analysis lies on treaties on the taxation of capital and income, which form a more homogenous subgroup of all possible tax treaties. Second, Avi-Yonah (2009) estimates that about 75% of the words of any arbitrary DTT are identical with the words of any other DTT. Third, the OECD Model Treaty is by far the most prevalent basis for existing DTTs (OECD 2005). For instance, the Andean Model treaty, which favors host countries of FDI, is practically irrelevant since it has rarely been used (Baistrocchi 2008). The UN Model Treaty (UN 2001), on the other hand, may be the preferred choice of developing countries when starting treaty negotiations. Yet, they often lack the political clout to prevail in treaty negotiations, and Pistone (2010) notes that the UN Model Ttreaty gradually lost importance over the last decades and is now rarely used for bilateral DTTs. There is thus sufficient justification for a uniform treatment of DTTs and thereby to follow the example of almost all other empirical studies examining tax treaties.

Besides the spatial lag variables, described in detail further below, the estimation model contains the following explanatory variables:

- *Product of populations*: Ceteris paribus, it is expected that two large countries are more likely to sign a DTT than a large and a small country or than two small countries, because more populous nations generally are more important players on the international stage.
- *Product of GDPs per capita*: To control for economic development, the product of the GDP per capita for both dyad members is included. As with population, it is anticipated that two rich countries have a higher propensity to enter a tax treaty than a rich and a poor nation and even more so than two poor countries.
- *Bilateral Trade*: The sum of bilateral exports and imports is taken as an approximation for the intensity of the bilateral economic ties. To reduce the skewness of the data, the log is taken, and to mitigate the potential endogeneity bias, the variable is lagged by one year.[5] A positive influence on the propensity to sign a DTT is expected.
- *Product of both countries' openness to trade*: Openness to trade is defined as the sum of imports and exports divided by GDP. The product of both countries' openness to trade is taken to model a complementary relationship. Since two open countries should be more likely to sign a DTT, a positive sign is anticipated.
- *BIT dummy*: BITs are an important means for bilateral economic cooperation. With respect to the positive signaling effect to potential investors, a DTT and a BIT might act as substitutes; however, since they differ in their key aspects, a complementary relationship, and therefore a positive influence, of a BIT is expected.
- *RTA dummy*: Another means for economic cooperation is the conclusion of a Regional

[4] Due to missing control variables, however, the number of treaty conclusions which are covered by our estimations is reduced to 1,385.

[5] To keep zeros in the sample, the smallest existing positive value is added to each observation before taking the log.

Trade Agreement (RTA), and thus, a positive association with the propensity to sign a DTT is expected.

- *OFC dummy*: Set to one if one of the dyad members is classified as a tax haven or as an Other Financial Centre (OFC) using the OECD country list. The OECD advises its members not to enter, to limit, or to terminate tax treaties with these countries (OECD 1998, 2004). Therefore, a lower propensity to sign a DTT is anticipated if one of the dyad members is on the OECD list.
- *Diplomatic representation dummy*: Set to one, if one country has a diplomatic representation in the other. Since diplomatic relations are a signal for political cooperation and reduce transaction costs in the negotiation process, a positive influence is expected.
- *Distance*: On the one hand, a larger distance between the capitals of both dyad members increases transaction costs in the negotiation of a DTT; on the other hand, as far as a tax treaty provides a positive signal toward stability and investor friendliness, these effects might be more important for remoter countries. The expected sign is therefore uncertain.
- *Product of Political Constraints*: Political constraints on the executive branch as a proxy measure for the institutional development of a county is included because poor institutions could hamper DTT negotiations (for example, by increasing transaction costs). On the other hand, in its role of providing stability for investors, a tax treaty might be more beneficial with countries with poorly developed institutions. Therefore, the sign is unclear. As these arguments apply to both dyad members, a complementary relationship is assumed and the product of political constraints in both countries is taken.
- *Minimum years of independence*: Measures the years of independence of the dyad member, which became politically independent at a later stage. Since only independent countries can sign DTTs, newly independent countries might need to catch up with other nations and sign treaties with the most important capital exporters. Therefore, the probability to enter a DTT is expected to decrease with years of independence.
- *Maximum number of DTTs*: Measures the higher number of existing treaties of either of the two countries in a dyad. As a country with a high number of existing treaties is likely to have signed DTTs with all important partner countries, the probability to negotiate a further DTT is anticipated to decrease with increasing number of existing treaties.
- *Country group dummies*: To control for inherent differences in the probabilities of signing a DTT between OECD and non-OECD countries,[6] a dummy taking the value of one if the dyad consists of two OECD countries and a dummy that is equal to one if an OECD and a non-OECD country form the country pair are included. The omitted reference categories are dyads where neither of the two countries is a member of the OECD.
- *Cumulative number of DTTs*: Two variables capturing the cumulative number of DTTs that country i and country j, respectively, have signed until year $t-1$ to control for the general, but time-varying propensity of a country to enter such treaties.

Spatial Lag Variables

To analyze spatial dependence in the diffusion of DTTs, a spatial lag model is used, in which the weighted values of the dependent variable in all other dyads is one of the explanatory variables. In undirected dyads as opposed to directed dyads, the flexibility to model spatial dependence is limited to so-called undirected dyad contagion, in which the policy choices of a dyad depend on the choices of other dyads (Neumayer and Plümper 2010). Ignoring other control variables, the basic model takes the form:

$$y_{ij} = \rho \sum_{km \neq ij} w_{pq} y_{km} + \varepsilon_{ij} \quad (1)$$

where y_{km} represents DTTs signed by all other dyads and w_{pq} is the weighting matrix measuring connectivity between dyad ij and other dyads km. There is considerable flexibility with respect to the choice of weighting matrix w_{pq}. Since each dyad member i and j may be influenced by DTTs signed by all other dyads except the dyad_{ij}, the weighting matrix w_{pq} contains the linkages between country i and countries in all other dyads on the one hand as well as linkages between country j and countries in all other dyads on the other. These linkages might be considered as complements or substitutes, that is, in the first case, both dyad members must be spatially influenced while in the latter it is sufficient that only one dyad member is subject to contagion.

To model the strength of connectivity between two units, three concepts of similarity are employed to identify focal countries:

- Common region: a dichotomous weighting matrix that takes the value of 1 if both i and k and j and m are, respectively, in the same region. For instance, in the dyad Germany–Ghana, Germany is influenced by other European countries, while Ghana is influenced by all other nations in Sub-Saharan Africa. A complementary relationship between the two linkages in the weighting matrix is assumed, that is, the example dyad

[6] Only Western developed OECD members are taken as OECD members: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Portugal, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States.

Germany–Ghana together is only influenced by DTTs signed between European countries (excluding Germany) with Sub-Saharan nations (excluding Ghana). Formally, this spatial lag is modeled as follows: $\sum_{km \neq ij} (w_{ik} \times w_{jm}) y_{km}$, with $i \neq k$ and $j \neq m$, where w_{ik} takes the value of one if both country i and country k are within the same region (analogous for w_{jm}).

- Export market similarity: Two countries are supposed to be close competitors if they export to similar third markets. Here, a substitutive relationship between the two linkages is assumed. In the Germany–Ghana example, a strong export similarity between Germany and a third country can offset a low similarity between Ghana and a fourth country. The reason is that if one country sees its main competitors engaging in DTT activity, then this should result in sufficient incentive for the country to engage in DTT activity itself.
- Export product similarity: Two nations are supposed to be close substitutes and thus rivals for investment location from the point of view of a foreign investor if they export a similar basket of goods, based on thirteen base product categories. As with export market similarity, the linkages in the weighting matrix are assumed to be substitutes. Formally, these spatial lags are represented by $\sum_{km \neq ij} (w_{ik} \times w_{jm}) y_{km}$.

To calculate export market and export product similarity, an approach suggested by Finger and Kreinin (1979) is adopted:

$$\text{Similarity}(ab_t) = \left\{ \sum_c \text{Min}[X_c(ac_t), X_c(bc_t)] \right\} \quad (2)$$

Where a and b are two countries exporting either a commodity c or to a market c and $X_c(ac)$ is the share of exports in commodity/market c of the total exports of a in year t [similarly for $X_c(bc)$].[7] The similarity of a and b is the sum of the minima of the shares of a certain commodity (or a target market) of the total exports of a and b, respectively. The resulting index ranges continuously from 0 to 1 and takes the value of 0 if the two countries export completely different products/export to completely different markets, and the value of 1 if both countries export exactly the same basket of goods/export to exactly the same markets.[8] The resulting weighting matrices are row-standardized, that is, for each row of the matrix, each cell is divided by its own row sum. Row standardization should not be applied without theoretical justification (Plümper and Neumayer 2010), but is justified here since every country should be subject to the same ''amount of contagion,'' regardless of how many competitors it has. The spatial lag is then the weighted average of the number of DTTs concluded by competitor countries.

Table 2 provides summary statistics and data sources for all variables. Ideally, one would either additionally control for the size of bilateral FDI stocks as a measure of foreign investment exposure in the partner country and the degree of asymmetry of the dyad or restrict the sample to dyads with asymmetric FDI positions. Unfortunately, these data were available only very scarcely until the early 1990s. Furthermore, data availability is non-random with information more completely obtainable for OECD countries. Including this variable would therefore lead to severe sample selection bias. Furthermore, as predicted by the gravity model, empirical work has found a high explanatory power of market size and distance on FDI, both included in the model (Blonigen, Davies, Waddell, and Naughton 2007).

Estimation Methodology

The aim of our analysis is to establish whether specific factors, particularly the treaty conclusions of focal countries, have a significant influence on the propensity to sign a treaty for a specific dyad, that is, how these factors influence the time until two specific countries conclude a DTT. Using this duration time in years as dependent variable, a semiparametric Cox proportional hazard model is used (Cox 1972).[9] The Cox model is preferred to other (parametric) event history models because in the analysis here, time dependency is more a nuisance while the interest is in the relationship between the covariates and the hazard rate.

The estimated Cox model is thus specified as follows:

$$h(t|X_{ijt}Y_{ijt}) = h_0(t)\exp(\beta' X_{ijt} + \gamma' Y_{ijt}) \quad (3)$$

where $h_0(t)$ is the baseline hazard function which also absorbs effects that do not vary across dyads and is not estimated; X_{ijt} is the set of dyad control variables outlined above, where i and j are the two dyad members. Y_{ijt} is a matrix containing the spatial lag variables, which capture the DTT-signing behavior of other focal countries. The covariates only induce proportional shifts in the subgroup-specific baseline hazards, but do not change its shape. The parameters β and γ are estimated via maximization of the partial likelihood (Blossfeld, Golsch, and Rowher 2007). The

[7] The export product similarity measure covers 13 key commodity sectors with data taken from World Bank (2009). Products have been grouped into key commodity sectors to mitigate the problem of missing data. The export market similarity measure covers all markets for which data are available in UN (2009), which cover practically all countries in the world.

[8] Missing data in the export structure (for example, country a's export in ores and metals), is implicitly set to zero in this approach, since the export shares of the remaining twelve product groups are calculated without ores and metals. As the minimum share of a certain product category for country a and b is taken, in this example country a's zero is smaller than any value for country b in this product group. As a consequence, if missing values are in truth positive and not zero values, the similarity measure underestimates the true similarity. Therefore, these similarity measures should be regarded as the lower bound. In contrast, simply taking the correlation between country a's and country b's export structure would overestimate the similarity in case of missing values.

[9] We also estimated a Logit model as a robustness test. To mirror the Cox model, a dyad is excluded from the sample in the year after a DTT is signed. As suggested by Carter and Signorio (2007), the baseline hazard is modeled by adding a linear, squared, and cubic term of duration time as regressor. The results confirm our findings and are available with the replication data.

TABLE 2. Summary Statistics and Data Sources

Variable	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*	*Source*
DTT	212,244	0.007	0.081	0	1	IBFD (2009)
Product of populations (ln)	212,244	31.592	2.363	22.276	41.543	World Bank (2009)
Product of GDPs per capita (ln)	212,244	14.765	2.079	9.374	21.072	World Bank (2009)
Bilateral trade (ln, t−1)	212,244	9.986	7.765	0	25.237	Rose (2009)
Product of openness to trade	212,244	5,296.2	4,604	65.432	94,121.9	World Bank (2009)
BIT	212,244	0.046	0.209	0	1	UNCTAD (2007)
RTA	212,244	0.079	0.269	0	1	WTO (2009)
OFC	212,244	0.209	0.407	0	1	OECD (2009)
Diplomatic representation	212,244	0.307	0.461	0	1	Bayer (2006)
Distance (ln)	212,244	8.782	0.705	4.54	9.90	Bennett and Stam (2005)
Product of Political Constraints	212,244	0.125	0.191	0	0.786	Henisz (2000)
OECD-OECD dyad	212,244	0.009	0.009	0	1	
OECD-nonOECD dyad	212,244	0.262	0.440	0	1	
Min. years of independence	212,244	36.718	17.10	2	81	CIA (2010)
Max. number of DTT (t−1)	212,244	24.428	23.98	0	118	IBFD (2009)
Cumulative number of DTTs country *i* (t−1)	212,244	12.993	19.52	0	120	IBFD (2009)
Cumulative number of DTTs country *j* (t−1)	212,244	15.987	21.73	0	120	IBFD (2009)
Spatial lags						
W: Common region (product) (t−1)	212,244	0.049	0.081	0	1	Own calculations, based on IBFD (2009) and World Bank (2009)
W: Export market similarity (sum) (t−1)	212,244	0.094	0.046	0.015	0.219	Own calculations, based on IBFD (2009) and World Bank (2009)
W: Export product similarity (sum) (t−1)	212,244	0.100	0.050	0.012	0.279	Own calculations, based on IBFD (2009) and UN (2009)

(Note. W denotes the weighting matrix used to create the spatial lags. The spatially lagged variable is a dummy taking the value of one in years a DTT has been signed and in all subsequent years.)

date from which a dyad starts accumulating risk (of signing a tax treaty) is taken as 1925 since in this year the first modern treaty was signed between countries that still exist nowadays, namely, Italy and Germany. However, because DTTs can only be signed between two independent tax jurisdictions, a dyad enters the analysis only in the year in which both countries became independent.[10] Dyads drop out of the sample the year after they have signed a DTT.

The inclusion of a spatially lagged dependent variable introduces a potential, but likely to be small, degree of endogeneity since dyads affect each other. Fully solving this problem would require a full spatial maximum likelihood Cox estimator, which is currently not available. To at least mitigate this problem somewhat, the spatial lags are lagged by one year. In addition, this is reasonable since the spatial effect is unlikely to occur instantaneously, but countries need some time to react. Another potential problem is typically referred to as spatial clustering or unobserved spatial heterogeneity. This occurs since spatial patterns may not be due to spatial dependence, but can be due to the fact that close dyads are more likely to be similar than more distant dyads. In this case, the spatial lags could spuriously capture effects which have nothing to do with spatial dependence (Plümper and Neumayer 2010). Ideally, one would include dyad-fixed effects to control for time-invariant dyad-specific heterogeneity in the propensity to sign a tax treaty. However, this is not feasible since the Cox proportional model essentially performs a binary outcome analysis at each point in time where at least one DTT is concluded (Cleves, Gould, and Guiterrez 2004). Therefore, insufficient degrees of freedom are available to include a full set of dyad dummies. As an alternative, we include, as already mentioned above, two variables measuring the total number of DTTs signed by country *i* and country *j*, respectively, in year *t*−1 to control for the general, but time-varying, propensity of a country to enter tax treaties. Since this measure is time variant, it captures the overall propensity of a country toward signing DTTs more closely than a country fixed effects approach, which would be feasible but would assume that this effect is constant over time. A nonconstant measure is appropriate because some countries reveal principal changes in their DTT-signing behavior with periods of inactivity followed by periods of activity and the reverse (for example, China's first treaty with Japan in 1983 marked the beginning of a period of comprehensive treaty negotiations).

Main Results

Table 3 presents the main estimation results. Looking at the control variables first, the results generally are in line with expectations. Ceteris paribus, two more populous countries are always, while two richer countries are sometimes, more likely to sign a DTT. Even after controlling for size (population) and the level of development (GDP per capita) of the two dyad members, there is evidence that bilateral trade increases

[10] Information on independence of tax jurisdictions unfortunately is not available. Therefore, the year of political independence of a country is taken as independence date. In the cases where a DTT was signed before this date, the year of DTT signature is taken as the year of independence.

Table 3. Estimation Results of Cox Proportional Hazard Model

Model	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*
Spatial lags							
W: Common region (t−1)	1.419 (5.51)***			1.483 (5.73)***	1.353 (5.29)***		1.421 (5.51)***
W: Export market similarity (t−1)		6.143 (1.07)		−4.287 (−0.78)		5.577 (0.97)	−4.507 (−0.81)
W: Export product similarity (t−1)			11.06 (4.00)***		9.965 (3.55)***	11.00 (3.97)***	9.982 (3.56)***
Control variables							
Product of populations (ln)	0.117 (4.18)***	0.127 (4.50)***	0.0945 (3.33)***	0.114 (4.01)***	0.0909 (3.19)***	0.0982 (3.41)***	0.0878 (3.04)***
Product of GDPs per capita (ln)	0.0560 (1.96)*	0.0728 (2.56)**	0.0407 (1.39)	0.0538 (1.87)*	0.031 (1.05)	0.043 (1.47)	0.0287 (0.97)
Bilateral trade (ln, t−1)	0.126 (7.03)***	0.120 (6.88)***	0.118 (6.69)***	0.125 (7.05)***	0.123 (6.83)***	0.118 (6.67)***	0.123 (6.85)***
Product of openness' to trade	6.55e-05 (10.45)***	6.59e-05 (10.53)***	6.01e-05 (9.46)***	6.49e-05 (10.25)***	6.09e-05 (9.62)***	6.09e-05 (9.64)***	6.02e-05 (9.45)***
BIT	1.322 (16.28)***	1.359 (16.84)***	1.356 (17.03)***	1.326 (16.32)***	1.313 (16.38)***	1.348 (16.93)***	1.317 (16.42)***
RTA	−0.161 (−1.58)	−0.132 (−1.31)	−0.125 (−1.24)	−0.170 (−1.68)*	−0.144 (−1.43)	−0.112 (−1.13)	−0.154 (−1.53)
OFC	−0.441 (−3.85)***	−0.416 (−3.68)***	−0.439 (−3.98)***	−0.446 (−3.88)***	−0.452 (−4.05)***	−0.433 (−3.92)***	−0.457 (−4.08)***
Diplomatic representation	1.157 (11.91)***	1.110 (11.27)***	1.126 (11.43)***	1.155 (11.88)***	1.174 (12.12)***	1.131 (11.51)***	1.171 (12.08)***
Distance (ln)	−0.273 (−5.56)***	−0.364 (−7.80)***	−0.379 (−8.18)***	−0.277 (−5.65)***	−0.280 (−5.66)***	−0.367 (−7.85)***	−0.284 (−5.77)***
Product of political constraints	0.718 (4.57)***	0.752 (4.88)***	0.736 (4.82)***	0.728 (4.65)***	0.686 (4.43)***	0.719 (4.73)***	0.697 (4.52)***
Dummy for OECD-OECD dyad	−0.286 (−1.26)	0.0786 (0.37)	0.146 (0.70)	−0.294 (−1.30)	−0.221 (−0.98)	0.135 (0.65)	−0.23 (−1.03)
Dummy for OECD-non-OECD dyad	−0.609 (−6.31)***	−0.412 (−4.44)***	−0.341 (−3.76)***	−0.603 (−6.20)***	−0.558 (−5.78)***	−0.362 (−3.94)***	−0.551(−5.67)***
Min. years of independence	−0.0064 (−3.38)***	−0.0078 (−4.09)***	−0.0069 (−3.66)***	−0.0066 (−3.45)***	−0.0055 (−2.88)***	−0.0066 (−3.47)***	−0.0057 (−2.95)***
Max. number of DTTs (t−1)	−0.0331 (−8.66)***	−0.0362 (−9.47)***	−0.0372 (−10.10)***	−0.0334 (−8.60)***	−0.0336 (−9.00)***	−0.0366 (−9.77)***	−0.0339 (−8.94)***
Cumulative number of DTTs country i (t−1)	0.0418 (10.81)***	0.0442 (11.40)***	0.0438 (11.70)***	0.0421 (10.67)***	0.0411 (10.68)***	0.0433 (11.21)***	0.0414 (10.55)***
Cumulative number of DTTs country j (t−1)	0.0405 (10.79)***	0.0431 (11.49)***	0.0432 (11.98)***	0.0407 (10.69)***	0.0402 (10.90)***	0.0427 (11.54)***	0.0405 (10.80)***
Observations	212,244	212,244	212,244	212,244	212,244	212,244	212,244
DTT conclusions covered	1,385	1,385	1,385	1,385	1,385	1,385	1,385

(*Notes.* W denotes the weighting matrix used; Coefficients displayed; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

the propensity to enter a tax treaty. Countries that already have signed a BIT are more likely to sign a DTT as well. The positive sign indicates that a BIT and a tax treaty are regarded as complements rather than substitutes. Oddly, the coefficient of RTA is negative in all specifications, but not statistically significant. A dyad, in which one or both countries are classified as an offshore financial center by the OECD, is statistically significant less likely to sign a DTT in all model specifications. If two countries have diplomatic representations, they face an increased hazard of signing a DTT, which could be either due to closer political ties in general or due to reduced transaction costs. On the other hand, more distant countries are less likely to enter a DTT. The stability of political systems, as measured by the product of the Political Constraints variable, exhibits a positive and highly significant influence on the hazard to sign a tax treaty. OECD members are generally richer, trade more, and have closer political ties. After controlling for these factors and their general propensity to enter tax treaties, dyads consisting of two OECD countries are not more likely to sign a DTT, while dyads with one OECD member and a nonmember are less likely to sign a DTT compared to a dyad with two non-OECD members. This is somewhat unexpected, but is driven by the covariates: Once the controls for population size and GDP per capita as well as for their DTT history are removed, the dummy for an OECD–OECD dyad becomes positive and highly significant throughout. However, the OECD–non-OECD dummy variable remains negative and statistically significant. Newly independent countries have a higher propensity to sign DTTs. The higher the maximum number of DTTs signed by either of the two dyad members, the lower the likelihood of signing a DTT, consistent with theoretical expectations. A higher propensity to sign DTTs, as captured by the cumulative number of DTTs signed by either dyad member, increases the likelihood that this dyad will sign a DTT as well.

Turning to the variables capturing spatial dependence, the first three models estimate the effect of each of the spatial lags separately. Yet, the effects are not necessarily mutually exclusive and can occur simultaneously. Therefore, in models IV–VII, different combinations of the spatial effects are estimated. For treaties signed by countries in the same regions, the effect of an increase by one standard deviation (0.081) is to raise the hazard of signing a DTT by 12.2% in model I. For the export product similarity measure in model III, this effect is 73.8%. The spatial lag using export market similarity as a weighting matrix is insignificant throughout. Looking at model V, which includes both common region and the export product similarity, it can be seen that both effects become somewhat smaller, but remain statistically significant. When all three spatial lags are incorporated into model VII, the effects are not much different compared to the other model specifications.

It seems that countries are not only influenced by the behavior of their regional peers, but also and, in substantive terms, much more strongly so by the treaty signing of countries which export a similar basket of goods. No evidence, however, is found that policymakers respond to DTT actions of countries which serve similar export markets. This is exactly what one would expect if our argument is correct that countries are not affected by what other countries do, with which they generally compete in third markets, but are affected by what other countries do with which they specifically compete for FDI. Most countries try to attract a specific type of FDI, such as investment in a particular economic sector, from which they can reap the most benefits, rather than investment whose finished goods are exported to a specific market. Furthermore, each country has a given set of natural endowments and domestic capabilities and is thereby able to attract a certain type of investment which can make productive use of these inputs. Similar export products thus indicate a similar industrial and endowment structure, which in turn makes these countries close substitutes from a foreign investor's point of view. In other words, countries which export similar products strongly compete with each other for FDI, whereas countries which are located in the same macro-region also compete, if less so, and countries which merely export any range of goods and services to similar markets generally compete with each other, but do not necessarily compete with each other for scarce foreign capital.

Robustness Tests

Our argument on the causes of spatial dependence relates to net capital–importing countries competing for scarce foreign capital. Some developed countries also fall into this category, but it is predominantly developing countries which face an asymmetric capital position. Competition for scarce foreign capital should also be stronger among developing countries, which can benefit more from FDI and face tighter capital constraints. Even though we controlled for different types of dyads in our main specification, in the first robustness check, we constrain our analysis to dyads consisting of one OECD member and one nonmember.

The results are presented in Table 4. The significance levels and effect sizes of the controls are by and large the same as in the whole sample (Table 3). Regarding the spatial lags, the effects are in general similar to the whole sample: The spatial lag using the common region and the export product similarity–weighting matrix are positive and significant, while no evidence for a (positive) effect for the spatial lag using the export market similarity can be established. The effect sizes of the two former spatial lags differ from the whole sample, with the spatial lag using the common region–weighting matrix being slightly smaller and the coefficient on the spatial lag using the export product similarity–weighting matrix being considerably larger. In model VII, an increase in the common region–weighted spatial lag by one standard deviation raises the propensity of a dyad to sign a DTT by 10.8%, while the effect for the spatial lag weighted by export product similarity is 146.6%. This indicates that regional peers matter less in heterogeneous dyads, in which competition for FDI generally is stronger (and

Table 4. Estimation Results for OECD Member and Non-member Country Dyads

Model	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*
Spatial lags							
W: Common region (t−1)	1.145 (3.09)***			1.293 (3.57)***	1.122 (3.08)***		1.266 (3.53)***
W: Export market similarity (t−1)		−11.11 (−0.99)		−19.52 (−1.89)*		−9.57 (−0.84)	−18.23 (−1.73)*
W: Export product similarity (t−1)			18.75 (3.56)***		18.39 (3.44)***	18.56 (3.52)***	18.05 (3.37)***
Control variables							
Product of populations (ln)	0.0996 (1.84)*	0.111 (2.08)**	0.0698 (1.25)	0.0927 (1.72)*	0.0549 (0.97)	0.067 (1.20)	0.0483 (0.86)
Product of GDPs per capita (ln)	0.0639 (1.12)	0.0831 (1.50)	0.0359 (0.62)	0.051 (0.90)	0.0133 (0.23)	0.0309 (0.53)	0.00159 (0.03)
Bilateral trade (ln, t−1)	0.169 (3.81)***	0.147 (3.40)***	0.156 (3.51)***	0.167 (3.80)***	0.177 (3.90)***	0.154 (3.47)***	0.176 (3.89)***
Product of openness' to trade	7.12e-05 (7.15)***	7.21e-05 (7.18)***	6.64e-05 (6.49)***	7.05e-05 (6.94)***	6.51e-05 (6.36)***	6.61e-05 (6.39)***	6.44e-05 (6.15)***
BIT	0.979 (8.65)***	1.034 (9.04)***	1.028 (9.12)***	1.010 (8.88)***	0.994 (8.88)***	1.045 (9.25)***	1.022 (9.11)***
RTA	0.00268 (0.01)	0.16 (0.71)	0.0672 (0.29)	0.0659 (0.28)	−0.0487 (−0.20)	0.104 (0.46)	0.00963 (0.04)
OFC	−0.555 (−3.87)***	−0.552 (−3.89)***	−0.601 (−4.25)***	−0.552 (−3.86)***	−0.597 (−4.20)***	−0.600 (−4.24)***	−0.592 (−4.18)***
Diplomatic representation	0.941 (5.74)***	0.908 (5.55)***	0.910 (5.60)***	0.926 (5.66)***	0.936 (5.76)***	0.904 (5.57)***	0.923 (5.69)***
Distance (ln)	−0.295 (−3.58)***	−0.461 (−5.88)***	−0.418 (−5.46)***	−0.336 (−4.06)***	−0.286 (−3.49)***	−0.446 (−5.72)***	−0.323 (−3.93)***
Product of political constraints	1.214 (5.65)***	1.298 (6.25)***	1.268 (6.17)***	1.202 (5.63)***	1.182 (5.62)***	1.271 (6.21)***	1.175 (5.63)***
Min. years of independence	−0.00413 (−1.41)	−0.00487 (−1.63)	−0.00325 (−1.09)	−0.00436 (−1.49)	−0.00285 (−0.97)	−0.00333 (−1.11)	−0.00304 (−1.03)
Max. number of DTTs (t−1)	−0.0446 (−8.51)***	−0.0494 (−9.39)***	−0.0480 (−9.31)***	−0.0460 (−8.74)***	−0.0443 (−8.57)***	−0.0488 (−9.37)***	−0.0455 (−8.75)***
Cumulative number of DTTs country i (t−1)	0.0578 (10.92)***	0.0620 (11.74)***	0.0600 (11.45)***	0.0588 (11.15)***	0.0567 (10.81)***	0.0607 (11.55)***	0.0576 (10.99)***
Cumulative number of DTTs country j (t−1)	0.0540 (10.56)***	0.0582 (11.46)***	0.0572 (11.37)***	0.0548 (10.84)***	0.0538 (10.68)***	0.0578 (11.50)***	0.0545 (10.91)***
Observations	55,633	55,633	55,633	55,633	55,633	55,633	55,633
DTT conclusions covered	620	620	620	620	620	620	620

(*Notes*. W denotes the weighting matrix used; Coefficients displayed; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

TABLE 5. Estimation Results for Specific Target Contagion in a Directed Dyad Dataset (from OECD Member to Non-member Country)

Model	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*
Spatial lags: specific target contagion							
W: Common region (t−1)	0.941 (3.11)***			1.089 (3.30)***	0.831 (2.60)***		1.120 (3.38)***
W: Export market similarity (t−1)		0.72 (0.53)		−1.49 (−1.06)		−1.832 (−1.06)	−4.215 (−2.51)**
W: Export product similarity (t−1)			2.302 (2.37)**		1.538 (1.51)	3.162 (2.73)***	3.269 (2.98)***
Control variables							
Product of populations (ln)	0.101 (1.86)*	0.129 (2.38)**	0.120 (2.22)**	0.0935 (1.70)*	0.0994 (1.83)*	0.113 (2.06)**	0.0768 (1.38)
Product of GDPs per capita (ln)	0.0749 (1.33)	0.100 (1.80)*	0.0885 (1.58)	0.0683 (1.20)	0.0708 (1.26)	0.0807 (1.42)	0.0468 (0.81)
Bilateral trade (ln, t−1)	0.161 (3.63)***	0.143 (3.25)***	0.147 (3.34)***	0.167 (3.67)***	0.161 (3.62)***	0.152 (3.37)***	0.178 (3.82)***
Product of openness' to trade	7.76e-05 (6.95)***	7.79e-05 (7.06)***	7.98e-05 (7.21)***	7.65e-05 (6.71)***	7.92e-05 (7.05)***	7.92e-05 (7.08)***	7.77e-05 (6.73)***
BIT	0.948 (8.15)***	0.990 (8.56)***	0.975 (8.37)***	0.955 (8.24)***	0.940 (8.02)***	0.984 (8.47)***	0.948 (8.14)***
RTA	−0.107 (−0.41)	−0.00211 (−0.01)	−0.00467 (−0.02)	−0.121 (−0.46)	−0.0981 (−0.38)	−4.53E-05 (−0.00)	−0.126 (−0.48)
OFC	−0.560 (−3.86)***	−0.549 (−3.82)***	−0.586 (−4.04)***	−0.552 (−3.79)***	−0.585 (−4.00)***	−0.589 (−4.06)***	−0.594 (−4.05)***
Diplomatic representation	0.942 (5.81)***	0.928 (5.68)***	0.919 (5.62)***	0.950 (5.86)***	0.933 (5.74)***	0.921 (5.64)***	0.942 (5.81)***
Distance (ln)	−0.333 (−4.03)***	−0.427 (−5.44)***	−0.425 (−5.38)***	−0.329 (−3.97)***	−0.341 (−4.14)***	−0.435 (−5.52)***	−0.337 (−4.09)***
Product of political constraints	1.129 (5.13)***	1.203 (5.66)***	1.165 (5.45)***	1.134 (5.16)***	1.105 (5.02)***	1.175 (5.51)***	1.107 (5.01)***
Min. years of independence	−0.00312 (−1.04)	−0.00469 (−1.55)	−0.00436 (−1.44)	−0.00318 (−1.06)	−0.00298 (−0.99)	−0.00451 (−1.48)	−0.00291 (−0.96)
Max. number of DTTs (t−1)	−0.0526 (−9.44)***	−0.0542 (−6.62)***	−0.0605 (−9.05)***	−0.0458 (−5.72)***	−0.0589 (−8.89)***	−0.0557 (−6.73)***	−0.0471 (−5.78)***
Cum. number of DTTs OECD member (t−1)	0.0618 (11.55)***	0.0640 (12.10)***	0.0639 (12.17)***	0.0608 (11.28)***	0.0622 (11.69)***	0.0632 (12.00)***	0.0598 (11.18)***
Cum. number of DTTs non-OECD member (t−1)	0.0585 (11.24)***	0.0605 (11.53)***	0.0609 (11.89)***	0.0569 (10.72)***	0.0594 (11.48)***	0.0598 (11.48)***	0.0561 (10.67)***
Observations	55,418	55,418	55,418	55,418	55,418	55,418	55,418
DTT conclusions covered	615	615	615	615	615	615	615

(*Notes*. W denotes the weighting matrix used; Coefficients displayed; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

asymmetry is higher), while treaty conclusions of countries with a similar export product structure matters more.

In Table 5, we go one step further in not only restricting the sample to dyads consisting of one OECD and one non-OECD country, but also presuming that DTTs are directed from the OECD to the developing country. Power-based or ''coercive'' (Simmons, Dobhin, and Garrett 2006:790) theories suggest that dominant capital exporters such as the United States or Germany are able to control the agenda and start treaty negotiations according to their schedule and needs (Elkins et al. 2006). Furthermore, due to the redistributive effect of tax treaties, capital exporters are able to increase their tax revenues at the expense of capital importers by signing a DTT. Therefore, in Table 5, we model DTT conclusions between an OECD member and a nonmember as a directed dyad in which the process is initiated by the former and directed toward the latter. In such a setting, various forms of spatial contagion can be tested (Neumayer and Plümper 2010). Following our theoretical argument, we restrict our analysis to specific target contagion, in which the propensity of a non-OECD member to sign a DTT with a given specific OECD member depends on the weighted sum of DTTs signed by other non-OECD members with the very same OECD member. The results for the control variables are consistent with the previous analysis in an undirected dyad, and also, the results for the spatial lags are in line with our previous findings. In model VII, a one standard deviation increase (0.14) in the spatial lag using the common region–weighting matrix increases the probability of signing a DTT by 17.0%, whereas the corresponding effect for the spatial lag using the export product similarity–weighting matrix is 47.6%.

A key assumption of a proportional hazard model is that the proportionality is maintained over time, that is, the size of the effect of a covariate is independent of when the effect occurs. To test this assumption, a Grambsch and Therneau (1994) test was performed, which indicated that, in some model specifications, the spatial lags using the common region–weighting matrix, the product of populations and GPD per capita, the trade measure, RTA, OFC, distance, years of independence, the OECD/non-OECD dummy variables, and the variables capturing previous treaty signing behavior were prone to exhibiting nonproportional effects. These variables were therefore interacted with the log of duration to explicitly model time dependence.[11] Results from this additional robustness test are available in the web appendix to this article.[12]

Extension: Conditional Spatial Policy Dependence

In addition to the robustness tests reported above, we have also extended the analysis presented in the previous section. If our argument is correct that competition for scarce foreign capital drives spatial dependence in the diffusion of DTTs, then the strength of the spatial dependence effect should systematically differ across countries in predictable ways. In other words, the strength of the spatial effects should increase or decrease depending on the values of other variables, that is, it should be conditioned by these other variables (Neumayer and Plümper 2012). Specifically, the number of existing DTTs, the year of a country's independence, and general trade openness should condition the spatial effects. The spatial effect should be larger for countries that have signed only a few tax treaties, because countries with an extensive DTT network are more likely to have covered all important capital-exporting countries already and are therefore less subject to competitive pressure. Similarly, the spatial effect should be larger in the early years of a country's independence. As long as a country is not independent, it cannot sign tax treaties[13]; however, over the course of time, other independent competitor countries can sign tax treaties and gain a competitive advantage. Once a nation becomes independent, it is ''dropped'' into the actual competitive situation. We therefore expect that the pressure to sign tax treaties is stronger right after gaining independence, as a country will try to equalize its competitive disadvantage. Finally, the spatial effect should be stronger the more open a country is to trade. All else equal, a country which is more open to foreign trade should be more exposed to competitive pressure from abroad, should be more eager to attract foreign capital, and be more willing to sign international treaties.

Tables 6–8 test these conditional spatial policy dependence arguments, based on modified versions of models I to III (coefficients of control variables are similar and therefore not shown for reasons of space). Table 6 reports results from an analysis of whether the strengths of the spatial effects depend on the number of treaties a country already has signed. The conditioning variable measures the higher number of treaties signed by either of the dyad members [Number of DTTs (max)]. All coefficients of the spatial lag variables are positive and significant, giving us the spatial effect in dyads, in which neither of the dyad member countries has previously signed any treaties. Most importantly, in line with theoretical predictions, the interaction effects are negative and significant throughout, indicating that the competitive pressure decreases as the number of treaties signed increases.

In Table 7, we report results from testing the hypothesis that the spatial effects are conditioned by years since independence. The coefficients of spatial lags using the common region and the export product similarity–weighting matrix are positive and significant, given as the spatial effects in dyads in which one of the dyad members has just gained independence. As expected, the interaction effects are negative and statistically significant at least at the ten-percent level. The effect of tax treaties signed by other countries is higher the shorter the period since independence and decreases over time, which supports the argument that

[11] In principle, any interaction with time can be chosen. As pointed out by Box-Steffensmeier and Zorn (2001), using the log of time is the most widely employed version. Applying $\sqrt{\text{time}}$ or time as multiplicators affects the results only marginally.

[12] Available at http://personal.lse.ac.uk/neumayer.

[13] As discussed above, tax treaties can be signed between independent tax jurisdictions. Since comprehensive data are not available, the year of political independence is taken as a proxy.

Table 6. Estimation Results for Spatial Lags Interacted with Maximum Number of DTTs

Model	*I*	*II*	*III*
W: Common region (t−1)	4.504 (8.07)***		
W: Common region (t−1) × max. DTT (t−1)	−0.0541 (−5.60)***		
W: Export market similarity (t−1)		19.25 (3.19)***	
W: Export market similarity (t−1) × max. DTT (t−1)		−0.210 (−7.14)***	
W: Export product similarity (t−1)			19.94 (6.64)***
W: Export product similarity (t−1) × max. DTT (t−1)			−0.192 (−7.53)***
Max. number of DTTs (t−1)	−0.0258 (−6.47)***	−0.0126 (−2.42)**	−0.0125 (−2.51)**
Observations	212,244	212,244	212,244
DTT conclusions covered	1,385	1,385	1,385

(*Notes.* To save space, coefficients of control variables not displayed, model specification as in Table 3; W denotes the weighting matrix used; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

Table 7. Estimation Results for Spatial Lags Interacted with Years since Independence

Model	*I*	*II*	*III*
W: Common region (t−1)	2.469 (5.69)***		
W: Common region (t−1) × min. years of independence	−0.0242 (−2.72)***		
W: Export market similarity (t−1)		7.825 (1.36)	
W: Export market similarity (t−1) × min. years of independence		−0.0684 (−1.74)*	
W: Export product similarity (t−1)			13.46 (4.31)***
W: Export product similarity (t−1) × min. years of independence			−0.0619 (−1.82)*
Min. years of independence	−0.000792 (−0.33)	0.000223 (0.05)	0.00145 (0.31)
Observations	212,244	212,244	212,244
DTT conclusions covered	1,385	1,385	1,385

(*Notes.* To save space, coefficients of control variables not displayed, model specification as in Table 3; W denotes the weighting matrix used; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

Table 8. Estimation Results for Spatial Lags Interacted with Openness to Trade

Model	*I*	*II*	*III*
W: Common region (t−1)	1.033 (3.24)***		
W: Common region (t−1) × product of openness'	5.86e-05 (2.42)**		
W: Export market similarity (t−1)		6.146 (1.05)	
W: Export market similarity (t−1) × product of openness'		−0.000000259 (−0.00)	
W: Export product similarity (t−1)			12.36 (4.37)***
W: Export product similarity (t−1) × product of openness'			−0.000203 (−2.23)**
Product of openness' to trade	5.43e-05 (6.72)***	6.59e-05 (3.21)***	0.000101 (5.48)***
Observations	212,244	212,244	212,244
DTT conclusions covered	1,385	1,385	1,385

(*Notes.* To save space, coefficients of control variables not displayed, model specification as in Table 3; W denotes the weighting matrix used; Robust standard errors clustered on country dyads; *Z*-values in parenthesis; Breslow approximation for tied events; *statistically significant at .1, **.05, or ***.01 level.)

newly independent countries are subject to a higher pressure to enter DTT negotiations.

Table 8 presents results for the product of trade openness of the two countries as the conditioning variable. The coefficients of the spatial lag variables are positive and significant for common region and export product similarity, giving us the effect for the (nonexistent) case in which both countries are fully autarchic. The interaction effect for the common region–weighted spatial lag variable is significantly positive, in line with expectations. However, unexpectedly the interaction effect is significantly negative for the export product similarity–weighted spatial lag. All in all, there is thus no evidence for a higher competitive pressure for more open economies.

Conclusion

The last decades have witnessed the global diffusion of double taxation treaties. The vast majority of these treaties involve net capital importers. The present system of tax treaties exhibits, due to the strong reliance on the OECD model treaty, a considerable resident bias in terms of taxation rights. This means that net capital importers can lose considerable amounts of tax revenues when entering such a treaty. Or, as stated by Irish (1974:292), the scheme ''of tax treaties creates the anomaly of aid in reverse – from poor to rich countries.'' This fact, however, has not tarnished the popularity of DTTs in asymmetric dyads where one country exports sizably larger amounts of capital into the partner country than the FDI that flows in the reverse direction. We have argued here that capital-importing countries find themselves in a prisoners' dilemma situation. While it is not beneficial for them as a whole to enter treaties with the standard provisions, each single country has an incentive to sign in order to gain a competitive edge in the global competition for capital. Furthermore, if other focal countries have signed tax treaties with major capital exporters, a single country has an even stronger incentive to conclude a DTT to offset its inferior position.

The theoretical prediction that treaty conclusion by regional peers as well as by export-product and export-market competing countries affect the DTT behavior of others was tested empirically. In line with theoretical expectations, we found robust evidence that the treaty conclusion between two countries is in fact positively influenced by existing tax treaties of these focal countries. However, a striking result of our analysis was that countries are only influenced by other countries which export a similar basket of goods, but not by those serving similar export markets. This indicates that only the former group is regarded as competitors for foreign capital as countries strive to attract a certain type of FDI rather than a broad range of investors which export finished products to a specific market.

Spatial dependence in DTT-signing activity implies that the diffusion of DTTs becomes a quasi-automatic process as there is positive contagion: The more dyads have signed, the higher the pressure on the remaining dyads to also sign one. This process is likely to stop when net capital–importing countries believe that they will no longer lose out by refusing to sign further DTTs or, conversely, believe they can no longer benefit from signing further treaties. Difficult as a conclusive judgement on this is, a termination of the diffusion process appears to be a long way off still.

References

Avi-Yonah, Reuven S. (2009) Double Tax Treaties: An Introduction. In *The Effect of Treaties on Foreign Direct Investment: Bilateral Investment Treaties, Double Taxation Treaties and Investment Flows*, edited by K. P. Sauvant and L. E. Sachs. Oxford: Oxford University Press.

Baistrocchi, Eduardo. (2008) The Use and Interpretation of Tax Treaties in the Emerging World: Theory and Implications. *British Tax Review* 4: 352–391.

Barthel, Fabian, Matthias Busse, and Eric Neumayer. (2010) The Impact of Double Taxation Treaties on Foreign Direct Investment: Evidence from Large Dyadic Panel Data. *Contemporary Economic Policy* 28 (3): 366–377.

Bayer, Reşat. (2006) *Diplomatic Exchange Data Set, v2006.1*. Available at http://correlatesofwar.org. (Accessed September 13, 2012).

Bennett, D. S., and A. Stam. (2005) *EUGene—Expected Utility Generation and Data Management Program*. Available at http://eugenesoftware.org/. (Accessed September 13, 2012).

Blonigen, Bruce A., and Ronald B. Davies. (2004) The Effects of Bilateral Tax Treaties on U.S. FDI Activity. *International Tax and Public Finance* 11: 601–622.

Blonigen, Bruce A., and Ronald B. Davies. (2005) Do Bilateral Tax Treaties Promote Foreign Direct Investment? In *Handbook of International Trade, Volume II*, edited by E. K. Choi and J. C. Hartigan. London: Blackwell.

Blonigen, Bruce A., Ronald B. Davies, Glen R. Waddell, and Helen T. Naughton. (2007) FDI in Space: Spatial Autoregressive Relationships in Foreign Direct Dnvestment. *European Economic Review* 51: 1303–1325.

Blossfeld, Hans-Peter, Katrin Golsch, and Götz Rowher. (2007) *Event History Analysis with Stata*. London: Lawrence Erlbaum Associates.

Box-Steffensmeier, Janet M., and Christopher J. W. Zorn. (2001) Duration Models and Proportional Hazards in Political Science. *American Journal of Political Science* 45 (4): 972–988.

Brauner, Yarif. (2003) An International Tax Regime in Crystallization. *Tax Law Review* 56 (2): 259–328.

Carter, David B., and Curtis S. Signorio. (2007) *Back to the Future: Modelling Time Dependence in Binary Data*. Rochester, NY: University of Rochester.

CIA. (2010) The World Factbook. Available at https://www.cia.gov/library/publications/the-world-factbook/index.html. (Accessed September 13, 2012).

Cleves, Mario A., William W. Gould, and Roberto G. Guiterrez. (2004) *An Introduction to Survival Analysis Using Stata*. College Station, TX: Stata Press.

Cox, D. R.. (1972) Regression Models and Life-Tables (with Discussion). *Journal of the Royal Statistical Society, Series B* 34: 187–220.

Dagan, Tsilly. (2000) The Tax Treaties Myth. *New York University Journal of International Law and Politics* 32: 939–996.

Davies, Ronald B. (2003a) The OECD Model Tax Treaty: Tax Competition and Two-Way Capital Flows. *International Economic Review* 44 (2): 725–753.

Davies, Ronald B. (2003b) *Tax Treaties, Renegotiations, and Foreign Direct Investment*. University of Oregon Economics Working Paper No. 2003–14. Eugene: University of Oregon.

Di Giovanni, J. (2005) What Drives Capital Flows? The Case of Cross-border M&A Activity and Financial Deepening. *Journal of International Economics* 65: 127–149.

Doernberg, Richard L. (2004) *International Taxation in a Nutshell*. St. Paul, MN: Thomson West.

Easson, Alex. (2000) Do We Still Need Tax Treaties? *Bulletin for International Fiscal Documentation* 54 (12): 619–625.

Egger, P., M. Larch, M. Pfaffermayr, and H. Winner. (2006) The Impact of Endogenous Tax Treaties on Foreign Direct Investment: Theory and Evidence. *Canadian Journal of Economics* 39: 901–931.

Elkins, Zachary, Andrew T. Guzman, and Beth A. Simmons. (2006) Competing for Capital: The Diffusion of Bilateral Investment Treaties, 1960–2000. *International Organization* 60 (4): 811–846.

Finger, Joseph M., and M. E. Kreinin. (1979) A Measure of ''Export Similarity'' and Its Possible Uses. *The Economic Journal* 89: 905–912.

Graetz, Michael J., and Michael M. O'Hear. (1997) The ''Original Intent'' of U.S. International Taxation. *Duke Law Journal* 46: 1021–1109.

Grambsch, Patricia M., and Terry M. Therneau. (1994) Proportional Hazards Tests and Diagnostics Based on Weighted Residuals. *Biometrica* 81: 515–526.

Guzman, Andrew T. (1998) Why LDCs Sign Treaties That Hurt Them: Explaining the Popularity of Bilateral Investment Treaties. *Virginia Journal of International Law* 38: 639–688.

Henisz, W. J.. (2000) The Institutional Environment for Economic Growth. *Economics and Politics* 12 (1): 1–31.

International Bureau of Fiscal Documentation (IBFD). (2009) Tax Treaty Database. Available at http://www.ibfd.org/IBFDProducts/Tax-Treaties-Database. (Accessed September 13, 2012).

Irish, Charles R. (1974) International Double Taxation Agreements and Income Taxation at Source. *International and Comparative Law Quarterly* 23 (2): 292–316.

Neumayer, Eric. (2006) Self-Interest, Foreign Need and Good Governance: Are Bilateral Investment Treaty Programs Similar to Aid Allocation? *Foreign Policy Analysis* 2 (3): 245–267.

Neumayer, Eric. (2007) Do Double Taxation Treaties Increase Foreign Direct Investment to Developing Countries? *Journal of Development Studies* 43 (8): 1501–1519.

Neumayer, Eric, and Thomas Plümper. (2010) Spatial Effects in Dyadic Data. *International Organization* 64 (1): 145–166.

Neumayer, Eric, and Thomas Plümper. (2012) Conditional Spatial Policy Dependence: A Theoretical and Methodological Guide. *Comparative Political Studies* 47 (5): 819–849.

Organization for Economic Cooperation, Development (OECD). (1998) *Harmful Tax Competition: A Global Issue*. Paris: OECD.

Organization for Economic Cooperation, Development (OECD). (2004) *The OECD's Project on Harmful Tax Practices: The 2004 Progress Report*. Paris: OECD.

Organization for Economic Cooperation, Development (OECD). (2005) *Model Tax Convention on Income and Capital: Condensed Version*. Paris: OECD.

Organization for Economic Cooperation and Development (OECD). (2009) *A Progress Report on the Jurisdictions surveyed by the OECD Global Forum in Implementing the Internationally Agreed Tax Standard*. Available at http://www.oecd.org/dataoecd/50/0/43606256.pdf. (Accessed September 13, 2012).

Pistone, Pasquale. (2010) Tax Treaties with Developing Countries: A Plea for New Allocation Rules and a Combined Legal and Economic Approach. In *Tax Treaties: Building Bridges between Law and Economics*, edited by Michael Lang, Pasquale Pistone, Josef Schuch, Claus Staringer, Alfred Stock and Martin Zagler. Amsterdam: IBFD.

Plümper, Thomas, and Eric Neumayer. (2010) Model Specification in the Analysis of Spatial Dependence. *European Journal of Political Research* 49 (3): 418–442.

Plümper, Thomas, Vera E. Troeger, and Hannes Winner. (2009) Why is there no Race to the Bottom in Capital Taxation? Tax Competition between Countries of Unequal Size, Different Levels of Budget Rigidities and Heterogeneous Fairness Norms. *International Studies Quarterly* 53 (3): 761–786.

Rose, Andrew. (2009) *Data on Bilateral Trade*. Available at http://haas.berkeley.edu/~arose. (Accessed September 13, 2012).

Simmons, Beth, and Zachary Elkins. (2004) The Globalization of Liberalization: Policy Diffusion in the International Political Economy. *American Political Science Review* 98 (1): 171–189.

Simmons, Beth, Frank Dobhin, and Geoffrey Garrett. (2006) Introduction: The International Diffusion of Liberalism. *International Organization* 60 (4): 781–810.

Thuronyi, Victor. (2010) Tax Treaties and Developing Countries. In *Tax Treaties: Building Bridges between Law and Economics*, edited by Michael Lang, Pasquale Pistone, Josef Schuch, Claus Staringer, Alfred Stock and Martin Zagler. Amsterdam: IBFD.

UNCTAD. (2007). Investment Instruments Online. Available at http://www.unctadxi.org/templates/Startpage____718.aspx. (Accessed at September 13, 2012).

United Nations (UN). (2001) *United Nations Model Double Taxation Convention*. New York: United Nations.

United Nations (UN). (2009) *Commodity Trade Statistics Database (COMTRADE)*. New York: United Nations Statistics Division.

US Senate Committee on Foreign Relations. (2006) *Testimony of Patricia A. Brown, Deputy International Tax Counsel (Treaty Affairs), United States Department of the Treasury Before the Senate Committee on Foreign Relations on Pending Income Tax Agreements*. Available at http://foreign.senate.gov/imo/media/doc/BrownTestimony060202.pdf. (Accessed September 13, 2012).

World Bank. (2009). World Development Indicators. Available at http://data.worldbank.org/data-catalog/world-development-indicators. (Accessed May 1, 2009).

World Trade Organization (WTO). (2009). *Regional Trade Agreements Information System*. Available at http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx. (Accessed September 13, 2012).