THE IMPACT OF DOUBLE TAXATION TREATIES ON FOREIGN DIRECT INVESTMENT: EVIDENCE FROM LARGE DYADIC PANEL DATA

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To increase inward foreign direct investment (FDI), policy makers increasingly resort to the ratification of double taxation treaties (DTTs). However, the effectiveness of DTTs in inducing higher FDI is still open to debate, as the empirical evidence of existing studies is anything but conclusive. In contrast to earlier approaches, we use a largely unpublished dataset on bilateral FDI stocks, covering a much larger and more representative sample of host and source countries. Controlling for standard determinants of FDI and employing various econometric specifications, our results indicate that DTTs do lead to higher FDI stocks and that the effects are substantively important as well.

I. INTRODUCTION

To increase foreign direct investment (FDI) in their country is a desirable policy goal for most policy makers. Yet, often the factors influencing the influx of FDI are not easily amenable to policy, either because they are unalterable, like natural endowment of physical resources, and cultural and geographic proximity to major source countries, or because changing them is a very long-term process, as in the case of the efficiency of political institutions, market size, or the education and productivity of the local labor force. However, there are still a number of measures which can be taken to compete in the rivalry for foreign investment: on the one hand, restrictions imposed on investors regarding, e.g., the profit repatriation can be unilaterally eased, red tape or corporate taxes can be reduced, and on the other hand, bilateral measures can be taken, such as concluding bilateral investment treaties (BITs) or double taxation treaties (DTTs).[1]

The question addressed in this paper is whether the conclusion of a DTT leads to more bilateral FDI between the two respective countries. If existent, this benefit could compensate for the costs attached to DTTs. In addition to the costs of negotiating and ratifying the contract and giving up some fiscal sovereignty, there could also be a loss in tax revenues for at least one of the signing parties. This is particularly important from the point of view of developing countries as most treaties favor residence-based over source-based taxation.[2]

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1. There are a multitude of different names for double taxation treaties such as double taxation agreements, capital tax treaties, tax treaties, or treaties covering the taxation of investment and income.

2. It is important to clarify that the residence (or home) country is the state where the enterprise has its domicile, whereas the host country is the state where the foreign investment takes places and thus where the income is generated. For this reason, the latter is also referred to as the source country in the context of taxation, whereas in the context of FDI, the source country denotes the home country of the MNE.

ABBREVIATIONS

BITs: Bilateral Investment Treaties
DTTs: Double Taxation Treaties
FDI: Foreign Direct Investment
GMM: General Method of Moments
HWWI: Hamburg Institute of International Economics
LSE: London School of Economics
MNE: Multinational Enterprise
OLS: Ordinary Least Squares
RTA: Regional Trade Agreement

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We are, of course, not the first to analyze the effect of DTTs on FDI. However, our major original contribution to this literature is that we overcome two limitations of existing studies. These have either suffered from the absence of information on bilateral FDI, using instead aggregate FDI in a large and representative monadic country year sample (Di Giovanni, 2005; Neumayer, 2007), or, where they used bilateral FDI data, they have suffered from a small and unrepresentative dyad year sample (Blonigen and Davies, 2004, 2005; Coupé, Orlova, and Skiba, 2008; Davies, 2003, 2004; Egger et al., 2006). This applies in particular to the large number of developing countries, which are hardly covered in the estimations. Instead, we test the effect of DTTs on FDI in a dyadic country dataset, in which both developed and developing countries are very broadly represented over a long period of time. We find that DTTs increase the bilateral FDI stock between 27% and 31%.

The remainder of this article is structured as follows: the next section discusses the benefits and costs to the contracting partners of concluding DTTs. Section 3 presents trends in the development and coverage of DTTs, demonstrating that not only have DTTs become increasingly popular, but also their geographical coverage has extended to include many developing countries. Section 4 reviews existing studies which have examined the effect of DTTs on FDI and discusses their shortcomings. Section 5 explicates our research design, Section 6 reports results from the main estimations and robustness tests, while Section 7 concludes.

II. THE BENEFITS AND COSTS OF DTTs

Double taxation is generally defined as the imposition of comparable taxes in at least two countries on the same taxpayer with respect to the same subject matter and for identical periods (OECD, 2005). This may occur if one country claims taxing authority based on the residence or the citizenship of the taxpayer, while another country postulates taxing authority based on where the income originates. Another potential source of twofold taxation could be the fact that both countries claim either a certain taxpayer as a resident or that an income arises within its country (Doernberg, 2004). Also, different methods for the determination of the internal transfer price applied in two states can lead to a double taxation, e.g., a company has a production facility in two countries and delivers intermediate goods from the plant in country A to the factory in country B. If domestic rules in B set a value of 80 USD as appropriate, but country A ascertains a value of 100 USD, then revenues of 100 USD in the source country stand vis-à-vis expenses of only 80 USD in the recipient country (Lang, 2002).

Even though measures to prevent double taxation can be implemented unilaterally, countries have on a very large scale resorted to the conclusion of DTTs. By burdening economic activity in a foreign country twice, double taxation is often believed to have a negative effect on the total amount of FDI as well as on the allocation of FDI across countries. In the words of Egger et al. (2006: 902): "One of the most visible obstacles to cross-border investment is the double taxation of foreign-earned income." One major purpose of DTTs is thus the encouragement of FDI. Tax relief to foreign investors from double taxation is not the only purpose of DTTs, however. Another important purpose is the exchange of information. DTTs help to combat tax evasion and tax avoidance and to prevent double nontaxation by making information from one contracting state available to the other contract partner. In principle, these other aspects of DTTs could discourage FDI.

In addition, other regulations, calculation methods, and definitions are harmonized in a tax treaty, mitigating the uncertainty an investor faces when dealing with foreign fiscal systems and lessening the administrative effort. The tax authorities of either country profit from this harmonization, as the variety of different legislations they have to deal with is reduced. Closely related to the anti-tax-avoidance objective of exchanging information and setting rules for transfer-price calculation is the argument that DTTs may help to reduce harmful international tax competition from tax havens. Even though tax treaties are an insufficient measure (due to their bilateral character) to completely avoid harmful tax competition (Toumi, 2006), they include some regulations to at least mitigate the problem: the permanent establishment rule and the provisions against treaty shopping limit the circle of beneficiaries and curb (along with the transfer pricing restrictions) the opportunities to channel income through tax havens

(OECD, 1998).[3] Finally, similar to BITs, the benefits of concluding DTTs may go beyond any concrete treaty provision in that countries may acquire "international economic recognition" (Dagan, 2000: 32) or, in the words of Rosenbloom (1982, cited in Reese, 1987: 380), a "badge of international economic respectability" with a dense network of DTTs.

Against these benefits of DTTs, there are also a number of costs to the contracting parties. Negotiating and ratifying the contract ties up administrative resources. Given the length and labor intensity of the negotiation process, and the additional effort of matching versions in different languages, the costs can be substantial, especially, but not only, for smaller or developing countries.[4] The provisions in the treaty may conflict with domestic tax law, which has to be adapted as a consequence. Here, the national fiscal sovereignty is curtailed.

The most important cost factor is the potential loss of tax revenue since DTTs regularly favor residence over source taxation. Due to the reciprocity of FDI flows, benefits offered to investors from the contracting partner in one country should, in theory, be compensated by the same benefits given to that country's own investors in the other contracting state. This is because a country serves as both a host and a residence country for foreign investment at the same time. However, especially FDI flows and stocks between developing and developed countries are highly asymmetric, as developing countries are mainly net-capital importers. Entering a DTT therefore often leads to a loss of tax revenue in developing countries (Easson, 2000).

III. TRENDS IN THE DEVELOPMENT AND COVERAGE OF DTTs

Earlier historical treaties notwithstanding, the first model DTT was published in 1928, by a Group of Experts which had been convoked by the League of Nations in 1921. Even though since then the international tax legislation has become considerably more complex, the commentaries more extensive, and some tax loopholes have had to be closed, this model treaty still forms the basis for all DTTs in force today (Graetz and O'Hear, 1997).

Figure 1 illustrates the development of the annual average of new treaty conclusions, treaty terminations, and the number of total treaties in force. The pace of treaty conclusion has increased tremendously over the last decades: from an annual average of nearly 18 new conventions during the 1960s, to 58 DTTs per year in the 1980s, more than 80 in the 1990s, and reaching a peak with 117 newly concluded treaties in 1998. Since then, the expansion has lost some momentum, but has remained at a high average of 92 new DTTs per annum in 2004–2007. Noteworthy is the fact that the number of terminated treaties jumped up at the end of the 1980s. However, this cannot be interpreted as a renunciation of bilateral cooperation, since most of the terminated treaties were substituted by a renegotiated contract. Radaelli (1997) argues that these new contracts more strongly emphasize the role of tax treaties in avoiding tax evasion through transfer pricing, or guard more strictly against treaty shopping.[5]

A comprehensive worldwide network of bilateral tax treaties would require more than 18,000 DTTs.[6] However, the 2,351 treaties concerning the taxation of income and capital which were in force at the end of 2007 encompass nearly all OECD countries and cover a very large proportion of global FDI flows and stocks. Figure 2 shows the regional distribution of treaties concluded by the end of 2006.[7] Developed countries are involved as a signatory in 74% of all DTTs, with either developing countries (38%), another developed country (24%), or a transition economy (12%) representing the contracting partner. South-South treaties account for 16% of all treaties in force, while treaties involving a developing and a transition country represent 12%. Finally, only 80 DTTs (3%) were concluded between countries of the CIS and South-East Europe.

3. However, another perspective is that a wide treaty network has the unintentional consequence of opening up the benefits of harmful preferential tax regimes offered by treaty partners (OECD, 1998). The OECD advises countries against entering DTTs with tax havens (OECD, 1998).

4. Shelton (2004) points out that the negotiation of the Netherlands–United States treaty took more than 10 year and consumed probably several person–years of work. As of April 2003, Mauritius, a country with a population of just 1,200,000 had been in the process of negotiating or finalizing treaties with 16 countries.

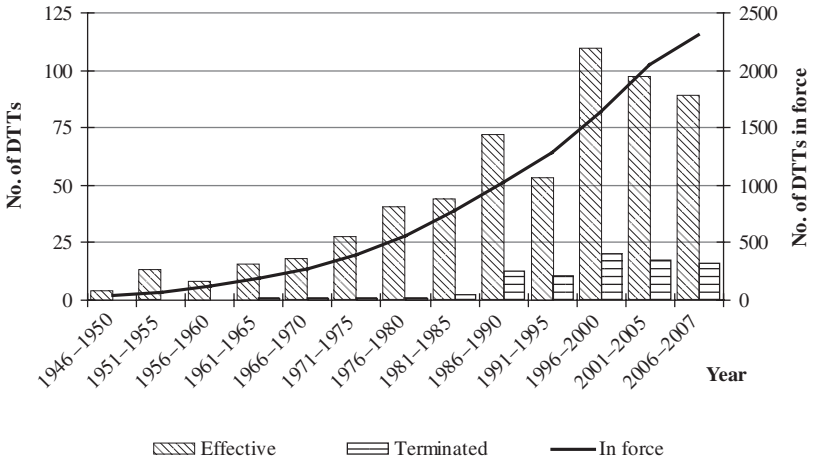
5. Radaelli focuses on U.S. treaties; however, since most treaties contain some anti-abuse provisions, this assessment should apply elsewhere as well.

6. Calculation based on 192 UN members. The exact figure depends on the number of independent tax authorities.

7. This chart includes also some DTTs other than treaties on income and capital, which are the focus of this article.

FIGURE 1

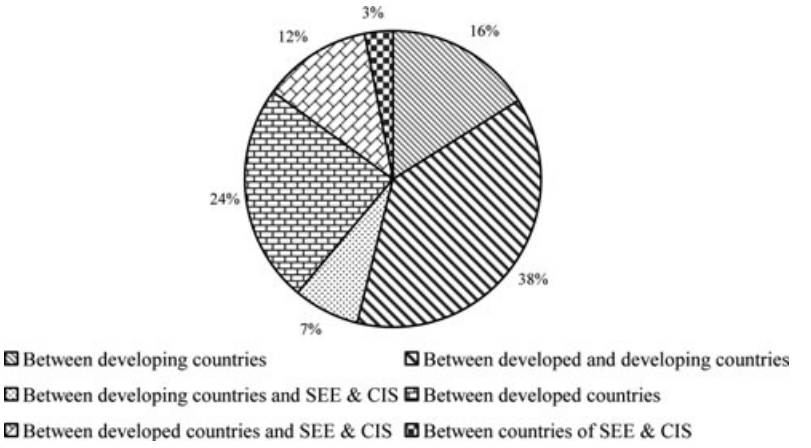
Average Annual Number of DTTs Concerning Income and Capital Taxation: New Effective Treaties, Terminated Treaties (Left-hand Scale), and Total Number of Treaties in Force (Right-hand Scale), 1946–2007



Source: IBFD (2008)

FIGURE 2

Total DTTs Concluded by the End of 2006 (by Country Groups)



Source: UNCTAD (2007b)

IV. EXISTING STUDIES ON DTTs AND FDI

As mentioned in the Introduction, existing empirical studies either suffer from a narrow and nonrepresentative sample size when using bilateral FDI data or need to resort to aggregate FDI data in order to achieve a large, representative sample size. Starting with the dyadic literature first, Davies (2003) examines the impact of treaty renegotiations over the period 1966–2000 on both inbound and outbound U.S. FDI. During this period, 20 treaty renegotiations took place. On the whole, Davies finds that DTT renegotiations had no effect on FDI.[8] One limitation of the study is sample selection: on the one hand, with one exception, all treaty renegotiations took place with developed countries. On the other

8. Davies (2004) comes to similar conclusions.

hand, only U.S. FDI activity is examined. This is even more critical, since the United States is notorious for its strictness in insisting on anti-tax avoidance and information exchange provisions in treaty renegotiations.

Focusing on U.S. inward and outward investment stocks, Blonigen and Davies (2004) examine the influence of a DTT conclusion on the size of bilateral FDI. The dataset contains 88 partner countries over up to 20 year from 1980 through 1999. Their analysis differentiates between new and old treaties, the former being concluded before the sample period, the latter from 1981 onwards. The authors argue that an endogeneity problem (DTTs may be correlated with unobserved variables and therefore correlated with the error term) is more likely to occur with old-treaty partners, since the United States tends to conclude DTTs with important partner countries such as Western European countries at an early stage. Similar to Davies (2003), Blonigen and Davies (2004) find that DTTs have no positive effect on inward or outward FDI. The degree to which this result can be generalized is again limited since the scope of the sample is confined to U.S. investments.

Blonigen and Davies (2005) broaden their research by using OECD data on bilateral FDI stocks and flows covering 23 developed source countries over the period of 1982–1992. They find a positive relationship between the existence of a DTT and higher FDI stocks and flows in ordinary least squares (OLS) estimation. Compared to a situation without a tax treaty, a DTT is accompanied by a 2.5 bn USD higher FDI stock in the host country and a 234 m USD higher inflow, respectively.[9] In order to address the endogeneity problem, the authors distinguish between new and old treaties. The impact of old treaties remains positive with even higher coefficients than in the aggregate estimation, whereas the new treaties have a negative—but not statistically significant—influence. Deploying fixed-effects estimation, the coefficient for new treaties stays negative and is now significant at the 5% level, revealing a 2.6 bn USD decrease in FDI stock and a 315 m USD decrease in FDI flows.[10]

The reservations toward the earlier studies still apply: the sample has been expanded beyond U.S. FDI, but it remains restricted in terms of country coverage (no developing source countries and a limited range of developing host countries) and time frame, which does not cover the boom of FDI activity during the 1990s. Furthermore, only 3% of the country pairs concluded a treaty during the examination period (compared to 74% with old treaties), raising the issue of a potential sample selection bias if the selected countries share certain characteristics which are not captured in the control variables.

Egger et al. (2006) estimate the effect of tax treaties on bilateral outward FDI from OECD source countries over the period of 1985–2000 with a two-step selection model. Arguing that treaty conclusion is an endogenous event, they presume a self-selection into the treatment group, i.e., the group of country pairs between which a DTT is in force. This treatment group covers 67 observations, while the control group without treaties encompasses 719 observations. In a first step, the authors estimate the propensity of a specific country pair to enter a DTT with a probit model. In the second step, they conduct a difference-in-difference estimation, using the difference between the 2-year average of FDI-log after and the biannual average prior to treaty conclusion as the dependent variable. Using different criteria (e.g., similar propensity to sign a DTT) for assorting, the same calculation method is applied to the control group. Comparing the difference of FDI stock for the treaty group with the difference of a similar control group, one can estimate the average effect of the treatment. Egger et al. find a negative effect of DTTs on FDI.

Coupé, Orlova, and Skiba (2008) concentrate their research on the influence of both BITs and DTTs on the FDI flows from OECD into transition economies, covering 17 source and nine host economies over the period of 1990–2001. No consistent results are found as the sign and statistical significance of the estimated treaty coefficients depend largely on the estimator used (OLS, random effects, fixed effects, two-stage least squares).

Turning toward studies, which use aggregate rather than bilateral FDI data in larger and more representative samples, Di Giovanni

9. This magnitude appears to be very high, taking into account a sample mean of 3.4 bn USD outbound stocks and 283 m USD outflows, respectively.

10. Since the fixed-effects (FE) estimator only uses the variation within each country pair, time-invariant variables, and thus also the old-treaty variable, cannot be estimated separately. Interestingly, the negative coefficient can be seen as an argument against potential reverse causality, since there is no obvious reason why higher FDI activity should lead to fewer DTTs.

(2005) examines the impact of various macroeconomic and financial variables on cross-border M&A activities as a component of FDI over the period from 1990 to 1999, covering 193 countries. He finds that a DTT is accompanied by increased cross-border acquisition activities. Neumayer (2007) estimates the effect of DTTs on FDI to developing countries, using both dyadic outbound FDI stocks from the United States as well as the total inbound FDI stocks of developing countries and the FDI inflows to developing countries as dependent variables. The former dataset encompasses data from 1970 to 2001 and 114 host countries, the latter dataset covers 120 host countries from 1970 on for the FDI flows and from 1980 on for the stocks, respectively. The effect of a DTT conclusion with the United States is measured by a dummy variable; however, since the other FDI data are in aggregate form and are thus nondyadic, the explanatory variable is replaced by the cumulative number of DTTs the specific country has signed with OECD countries, weighted by the OECD country's share of FDI outward flows relative to total world outward FDI flow. Regarding the U.S. data, Neumayer finds that the existence of a DTT is associated with a 22% higher FDI outbound stock in fixed-effects estimations. The positive impact is confirmed in the nondyadic dataset, suggesting that countries with a higher number of cumulative DTTs have both a higher FDI stock as well as higher FDI inflows. Separating the data in two subsamples of low- and middle-income developing countries, the positive effect is only found for the latter group.

In conclusion, the studies that employ bilateral FDI data by and large fail to find a positive effect of DTTs on FDI. However, their major limitation is the small and nonrepresentative sample size. The couple of studies that employ aggregate FDI data in a large and representative sample come to the opposite conclusion: DTTs increase FDI. In this study, we will analyze whether this positive effect carries over to bilateral FDI data once a large and representative country sample is employed.

V. RESEARCH DESIGN

A. The Dependent Variable

Given that we employ dyadic fixed-effects estimation throughout, which is exclusively based on the within-variation in the data, measuring FDI in stocks rather than flows is more appropriate (Egger and Merlo, 2007). We use absolute FDI stocks rather than FDI stocks as a share of a country's GDP since the latter measure would capture the relative importance of FDI to the host country, but not FDI stocks directly.

Our main innovation and contribution to the existing literature on DTTs and FDI is the use of dyadic FDI stock data for a large and representative sample covering both developed and developing countries. Our sample covers 30 FDI source countries, of which 10 are developing countries, and 105 FDI host countries, of which 84 are developing countries. The appendix lists the countries included in the sample.

To achieve such a large and representative sample of dyadic FDI, we undertook a number of steps. Most importantly, we purchased FDI stock data from UNCTAD (2008), which are not publicly available. Our starting point is the bilateral inward FDI stock. For those dyads which do not report any inward FDI stock data but report outward FDI stock data, we reversed these to fill in missing inward FDI stock data. Where they overlap, inward and reversed outward FDI stock data are very highly correlated at $r = 0.86$. The combined FDI stock data from UNCTAD were then combined with publicly available data from OECD (2008) for the relatively small share of dyads for which UNCTAD does not report data. Where they overlap, data from the two sources are very highly correlated (both instock and reversed outstock data from both sources are correlated at $r = 0.99$ with each other). For around half of all dyads in our sample, there are no reported FDI stock data at any point of time. We have set the FDI stock to zero for these dyads if there are no reported FDI flow data at any point of time for these country pairs either. The reason is that in these cases we can be fairly confident that there are no, or virtually no, bilateral FDI stocks existent. This mainly affects dyads between some developing countries, but also some dyads between one of the medium-sized or small developed countries and small developing countries.

We take the natural log of FDI stocks.[11] Doing so allows an easy interpretation of estimated coefficients as elasticities and, more importantly, reduces skewness of the dependent variable, which increases the model fit substantially. Note that we use FDI stock data in

11. We set the very small number of observations with negative FDI stocks equal to 0.1 before taking the log. The same applies to the larger number of observations with zero FDI stocks.

nominal USD, since there is no adequate deflator available for FDI in many developing countries. Using the U.S. deflator instead is likely to bias the results (Baldwin and Taglioni, 2006). We therefore use year-specific time dummy variables in all estimations. They also account for any trends in total FDI that affect all dyads equally.

The analysis covers the period from 1978 to 2004. While UNCTAD's Data Extract Service provides FDI data since 1970, very few countries report FDI stocks for the early or mid-1970s at a bilateral level. As a consequence we start with 1978, thereby avoiding any biases arising from an extremely small sample of reporting countries in the early periods.

B. Explanatory Variables

Our explanatory variable of main interest is the presence of a DTT. Existing studies differ in that some take the year of signature (e.g., Neumayer, 2007), while others take the year of ratification as the treaty's start period (e.g., Coupé, Orlova, and Skiba, 2008). The DTT signature date is usually referred to as the date of conclusion. The treaty partners commit themselves to arrange the procedures necessary under domestic law for the final conclusion of the treaty. However, to enter into force, the treaty must be ratified by the parliaments or heads of state of the contracting states and a formal exchange or deposit of the instruments of ratification has to take place. From this point on, the states are bound to honor the terms of the treaty. Yet, the most important date is in fact when the provisions become effective, which is specified in one of the last articles of the treaty and is typically January 1 of the year following ratification. Because the date of effectiveness is what matters most to foreign investors, we take the year of effectiveness as the start of the DTT (taken from IBFD, 2008). The binary DTT variable is labeled *dtt_dummy*.

As control variables, we include the following set of standard determinants of FDI often employed in the empirical literature:

- The log of total host GDP in (nominal) USD (*lnGDP*), taken from World Bank (2006), to control for market size, which is expected to have a positive influence on FDI (market-seeking FDI).
- The log of host GDP per capita in (nominal) USD (*lnGDPpc*), taken from World Bank (2006), to control for the mean purchasing power of domestic consumers.
- The log of the inflation rate in the host country in percent, measured by the GDP deflator (*lnInflation*), taken from World Bank (2006), as a proxy for macroeconomic distortions, suggesting a negative impact on FDI.
- Ratio of sum of imports and exports to GDP in the host country (*Trade openness*) from World Bank (2006), to control for openness of trade. Since a considerable part of international trade is intra-industry trade, a positive sign is expected. Furthermore, openness to trade may serve as a proxy for general openness toward foreigners and for a positive attitude toward globalization.
- A dummy is included taking the value of one, if the home and host country have signed a bilateral or common regional trade agreement (RTA), which is either a customs union or a free trade agreement (Source: WTO, 2007). A positive sign is expected.
- The binary variable *bit_dummy* controls for the existence of a bilateral investment treaty (Source: UNCTAD, 2007a). By entering such a treaty, the host country commits itself to meeting various obligations regarding the protection of investments, e.g., "fair and equal treatment," "full protection and security," or "protection against unreasonable or discriminatory measures" (Salacuse and Sullivan, 2005: 82–83). Also, provisions are agreed upon for the settlement of investment disputes. Such a contract reduces uncertainty and should therefore foster FDI (Neumayer and Spess, 2005; Busse, Königer, and Nunnenkamp, 2008).

Table 1 presents descriptive summary variable statistics.

TABLE 1
Descriptive Variable Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
ln FDI stock	33,066	1.13	4.14	−2.30	12.53
dtt_dummy	33,066	0.35	0.48	0	1
dtt_age	33,066	7.24	12.68	0	79
bit_dummy	33,066	0.16	0.36	0	1
bit_age	33,066	1.58	5.00	0	43
ln GDP (host)	33,066	24.21	2.09	19.64	30.02
ln GDP p.c. (host)	33,066	7.71	1.57	4.47	10.57
ln inflation (host)	33,066	2.47	1.65	−4.07	10.11
Trade openness (host)	33,066	70.35	36.29	10.08	233.94
Regional trade agreement	33,066	0.15	0.35	0	1

C. Estimation Technique

In our main estimations, we use a dyadic fixed-effects estimator, i.e., each dyad of countries has its own intercept. One advantage is that all factors that a country pair has in common and that are time-invariant (common border, language, geographical distance, historical ties, etc.) are automatically controlled for.[12] Dyad fixed effects also automatically exclude all "old treaties," i.e., treaties that were concluded before the start of our estimation period (1978), from having an effect on the estimation results since dyads with such treaties have no within-variation in the treaty dummy variable. Far from representing a nuisance of fixed-effects estimation, this exclusion of old treaties actually represents an advantage because it deals with the problem that older treaties are more likely to be correlated with unobserved variables and therefore endogenous, i.e., correlated with the error term. We use standard errors that are fully robust toward arbitrary autocorrelation and heteroskedasticity (i.e., standard errors are clustered on dyads).

In robustness tests, we also use Arellano and Bond's (1991) general method of moments (GMM) dynamic panel estimator. Our T is relatively large, which gives a very large number of potential instruments. Using too many instruments can bias the estimation results (Roodman, 2007). Unfortunately, it is not clear what constitutes too many. We follow Roodman's (2007) advice to restrict the number of lags to a maximum of medium length and to check the robustness of results toward increasing and decreasing the lag length. We have therefore restricted the use of lagged instruments to a total maximum of six, but our results are robust toward using the full instrument set as well as using instruments up to a total maximum of four lags.

12. We do not follow the approach suggested by Silva and Tenryro (2006), who recommend estimating the model in levels (rather than logs) with a Poisson estimator for two reasons. First, we need to include dyad-specific fixed effects, but the conditional fixed effects Poisson or Negative Binomial estimators, implemented as xtpoisson and xtnbreg in Stata, are not true fixed-effects models (Guimarães, 2008). Allison and Waterman (2002) find that the unconditional fixed-effects model, implemented as nbreg in Stata with fixed effects added "manually," represents better the fixed effects. However, estimating a negative binomial model with almost 3,000 dyad-specific fixed effects added manually requires a memory size that is beyond the computing capacity of our highest powered PC, which allocates 5 GB of memory space to Stata. Second, the dynamic estimation model fails to converge as Stata encounters a discontinuous region when estimating this model with xtnbreg. For the static model, estimating the model in levels with xtnbreg leads to an estimated coefficient that is also statistically significant at the .01 level (z-value of 5.24). We regard this as another piece of evidence for the robustness of our results.

VI. RESULTS

Table 2 presents our main estimation results. We start with a static model, i.e., a model, in which no lagged dependent variable is included (column 1). We briefly discuss results on the control variables first. With the exception of trade openness, which has the expected positive coefficient sign, but is not statistically significant at conventional levels, all variables have statistically significant coefficients in line with expectation. Host countries with larger

TABLE 2
Main Estimation Results

	FE static (1)	**FE dynamic (2)**	**Arellano-Bond GMM (3)**
dtt_dummy	0.246	0.094	
	(2.83)***	(2.18)**	
dtt_age			0.090
			(9.57)***
bit_dummy	0.303	0.071	
	(4.05)***	(2.34)**	
bit_age			0.019
			(2.15)**
ln FDI stock (t-1)		0.679	0.266
		(24.27)***	(3.96)***
ln GDP	0.180	0.081	0.165
	(4.35)***	(4.34)***	(6.34)***
ln GDP p.c.	0.848	0.249	–0.089
	(7.10)***	(4.46)***	(1.42)
ln inflation	–0.009	–0.005	–0.004
	(1.74)*	(2.08)**	(1.88)*
Trade openness	0.001	0.001	0.000
	(1.47)	(1.88)*	(0.94)
Regional trade agreement	0.323	0.085	0.040
	(3.53)***	(2.49)**	(1.22)
Observations	33,066	28,965	25,714
Number of dyads	2,937	2,676	2,515
R-squared	0.20	0.56	
Test no second-order autocorrelation (p-value)			–0.67(0.51)

Notes: Standard errors clustered on country dyads. Constant and year-specific time dummies included, but coefficients not reported.

*,**, and ***indicate statistical significance at 0.1; 0.05; 0.01 levels, respectively.

The results for the Arellano-Bond GMM estimation refer to robust one-step estimates; t- and z-values reported in parentheses.

economies, higher per capita income as well as lower inflation rates and which have concluded a BIT with the source country receive more FDI from this country. Our variable of main interest, *dtt_dummy*, has the expected positive and statistically significant coefficient. In order to interpret its substantive importance, one needs to take into account the necessary correction for the estimated variance for dummy variable coefficients in semilogarithmic equations (see Kennedy, 1981). The estimated average effect of concluding a DTT is to increase FDI stocks by around 27.3%.

Egger and Merlo (2007) argue that static models tend to overestimate the effect of BITs (and, by implication, DTTs) as they ignore the dynamic nature of FDI. In column 2 we therefore include the lagged dependent variable. The coefficient of the *dtt_dummy* variable cannot be directly compared to the one from the static model because in the dynamic model it merely represents the short-run effect, which is estimated at around 9.7%. The long-run effect needs to take into account the coefficient of the lagged dependent variable and is estimated at around 31%. The dynamic long-run effect of DTTs is thus not much different from the static effect, and is in fact slightly higher.

Fixed-effects estimations with the lagged dependent variable included suffers from some Nickell (1981) bias, which only vanishes as T, the number of time periods of the panel, becomes large. To eliminate this bias, we use Arellano and Bond's (1991) generalized method of moments (GMM) estimator. It has the additional advantage that the endogeneity of variables can be explicitly taken into account. There is the possibility that the estimated effect of *dtt_dummy* suffers from reverse causality bias: rather than the successful conclusion of DTTs increasing bilateral FDI, countries may conclude DTTs with whom they have a large bilateral FDI stock. The same argument applies to the conclusion of BITs.

Unfortunately, the Arellano and Bond (1991) estimator also has a disadvantage. This estimator removes any correlation between the explanatory variables and fixed effects by first differencing the variables. For a dummy variable, which is zero at first and then always one from the year the DTT becomes effective onwards (until its possible termination), this creates the problem that the first-differenced variable is zero at first, is one only in the year of becoming effective, and zero again in all subsequent years. In other words, by first differencing the *dtt_dummy* variable, the Arellano and Bond (1991) estimator can only estimate an effect of DTTs in the first year of becoming effective. This is not the effect we are interested in. Instead, we want to know the effect that a DTT exerts over its entire lifetime. To overcome this problem, we replace the *dtt_dummy* with a variable that measures the years passed since becoming effective, with the year of conclusion set to one (*dtt_age*). In first differences, this new variable is zero for all years prior to becoming effective and then one for all years from becoming effective onwards (until its possible termination).[13] In nonreported estimates we tested but failed to find evidence for a nonlinear effect of treaty age on FDI.

Column 3 presents our GMM estimation results. Note that the estimation results are not directly comparable to the static or dynamic fixed-effects results since the relevant variable is no longer the existence of a DTT, but the number of years since a DTT has been effective. Importantly, however, once we eliminate the Nickell bias and control for endogeneity, the results suggest that (the age of) a DTT still has a positive effect on the bilateral FDI stock.

We have undertaken a large number of additional estimations to check whether our results are robust toward changes in the sample. To keep the exposition simple, we only report the estimated coefficients of the *dtt_dummy* variable for all three model specifications. In row 1 of Table 3 we restrict the sample to a similar sample as the one contained in Blonigen and Davies (2005), while row 2 does the same for the sample used in Egger et al. (2006). If our argument is correct that nonrepresentative sample size is

13. Note that, contrary to FE estimations with *dtt_dummy* as the explanatory variable, old treaties, i.e., treaties concluded before the start of our sample period, will have an effect with the *dtt_age* variable in the GMM estimations. This is not really problematic, however, since in GMM estimations the *dtt_age* variable is explicitly treated as endogenous. That is, similar to the lagged dependent variable, the first-differenced *dtt_age* and *bit_age* variables are instrumented with their levels lagged two or more periods. Of course, one can always question whether instruments internal to the system solve the endogeneity problem. However, we could not find any instruments external to the system for use in IV estimation that would fulfill the necessary requirements of being relevant (the instruments sufficiently affect the instrumented variable), redundant (the instruments have no independent effect on the dependent variable), and fulfilling the identifying restriction (the instruments have an effect on the dependent variable exclusively via the variable instrumented for). As Deaton (2009) argues, many instruments used in the academic literature are not truly exogenous and are therefore invalid instruments.

TABLE 3
Robustness Test Results

	FE static dummy (1)	FE dynamic dummy (2)	Arellano-Bond GMM treaty age (3)
Blonigen and Davies (2005) sample (1982–1992)	−0.1048 (−0.501)	0.1112 (0.876)	0.0722 (1.384)
Egger et al. (2006) sample (1985–2000)	−0.2243 (−0.571)	−0.0852 (−0.344)	0.0689 (2.647)***
Excluding dyads of zero FDI	0.1256 (1.620)	0.0951 (1.793)*	0.0351 (3.480)***
Developing host countries	0.3839 (4.872)***	0.0842 (2.908)***	0.0328 (4.335)***
Developing host countries & developed source countries	0.4027 (4.487)***	−0.2385 (−1.235)	0.1169 (2.305)**
Middle-income countries	0.5095 (4.997)***	0.0912 (2.492)**	0.0191 (2.888)***
Low-income countries	0.2012 (1.840)*	0.0844 (1.581)	0.0478 (3.578)***
Developing countries, excl. resource-intensive countries	0.2930 (3.674)***	0.0519 (1.783)*	0.0337 (3.700)***
Developing countries, excl. transition countries	0.4054 (4.811)***	0.0846 (2.850)***	0.0297 (3.979)***

Notes: Standard errors clustered on country dyads. Constant, year-specific time dummies and control variables included, but coefficients not reported.

*,**, and ***indicate statistical significance at 0.1; 0.05; 0.01 levels, respectively.

Results on Arellano-Bond tests for second-order autocorrelation not reported, but tests fail to reject the hypothesis of no such correlation.

the main reason for the finding in the extant literature that DTTs do not have a positive effect on FDI, then our DTT variables should no longer be positive and statistically significant in these estimations. This is in fact the case, with the exception of the GMM estimations for the sample used in Egger et al. (2006). This therefore mirrors the existing results and buttresses our argument that sample size matters.

To make our sample as representative as possible, we have, under certain conditions (see Section 5 above), filled dyads which did not report any FDI stocks with values of zero. If they are in fact zero or close to zero, then this procedure is correct as these dyads belong to the relevant population. One might nevertheless be concerned that these observations drive our results. In row 3 of Table 3 we therefore exclude all observations with FDI stock values of zero in our dependent variable. As can be seen, while the estimated coefficients become smaller in the static and the GMM estimations compared to the full sample, they remain positive and statistically significant with the exception of the static estimation, in which case the estimated coefficient is almost significant, however (p-value of 0.106).

In row 4 we restrict the sample to developing host countries only, for which any potential increase in FDI is relatively more important given the likely loss in tax revenue following the conclusion of a DTT.[14] DTTs continue to have a positive and statistically significant effect on bilateral FDI stocks. In row 5, we further restrict the sample to developed source countries. With the exception of the FE dynamic estimation, DTTs continue to exert a positive effect on FDI.

In rows 6 and 7 we constrain the sample to middle- and low-income developing host countries, following World Bank (2008) classification. DTTs seem to have a positive effect in both subsamples, even if for low-income countries the coefficient of *dtt_dummy* is marginally insignificant in the dynamic FE estimations. The sizes of the respective coefficients are relatively similar across the subsamples and comparable to the sample with all developing host countries included.

In rows 8 and 9 we exclude resource-intensive and transition countries from the sample of developing countries, respectively.[15] Excluding these groups of countries does not change dramatically the estimated coefficients of *dtt_dummy* and *dtt_age*, respectively. They remain positive and statistically significant and while the coefficient size is somewhat smaller if

14. Developed countries are defined as United States, Canada, Western Europe, Japan, Australia, and New Zealand. Developing countries are all the other countries.

15. A country is classified as resource-abundant if its resource rents, that is, energy plus mineral depletion in percent of GNI, are higher than 15% on average of the first 3 year in the sample (1978–1981). This corresponds to the World Bank (2006) criterion; however, data is not available for all countries, which may be problematic since countries in which FDI is likely to be resource-seeking are not classified as such (e.g., Azerbaijan or Kazakhstan). Transition countries are defined as the East European former Communist countries as well as the Russian Republic.

resource-intensive countries are excluded compared to the results for the full developing country sample, the estimated confidence intervals of the two coefficients overlap to a large extent.

VII. CONCLUSION

It is not surprising that policy makers around the world are engaged in fierce competition for FDI, as host countries could benefit from activities of multinational enterprises (MNEs) through the inflow of additional capital, technology spillovers or increased competition. At least regarding policy instruments, it is still disputed how to effectively increase the attractiveness of a country for foreign investors. In this paper, we examined one important policy instrument, namely, the impact of DTTs on FDI stocks in the host economy. Apart from using a relatively long time period, the main advantage of our empirical analysis is the inclusion of an unprecedented number of both host and source countries, which reduces the risk of distorted results due to a sample selection bias.

After controlling for various determinants of bilateral FDI stocks, our results show that DTTs are indeed positively associated with foreign investment in the host country. The results hold for different specifications of the econometric model, including an instrumental variable GMM approach, and various subsamples. Since the estimated coefficients for the DTT variable are not only statistically significant, but also substantively important, our results indicate that policy makers have resorted to an effective means to promote FDI by concluding DTTs.

However, alongside the favorable impact of DTTs on FDI stocks, the potential negative effects of DTTs also have to be considered. As we have pointed out, negotiating a DTT could absorb valuable administrative resources, which particularly applies to (low-income) developing countries. Likewise, depending on the final outcome of the negotiations on the DTT, host countries potentially face losses in tax revenues. For many developing countries, these losses are not offset by tax reductions for domestic investors abroad due to the prevailing asymmetry in FDI stocks. As a consequence, each country should carefully ponder the pros and cons of negotiating a DTT.

In terms of future research, it would be clearly useful to weigh the costs and benefits of concluding a tax treaty from a policy perspective. Based on our findings, two opposing effects regarding tax income could occur: on the one hand, if the agreed withholding taxes are lower than the existing corporate tax rate, the tax authority collects less from a single company; however, as the DTT attracts more FDI, overall tax revenues might rise. In addition, particularly developing countries could profit from the beneficial impact of the foreign capital mentioned above. Obviously, this type of analysis should be performed at a country level, as the analysis can be quite complex.

APPENDIX

List of Source Countries

Argentina, Australia, Austria, Belgium-Luxembourg, *Brazil*, Canada, *Chile*, *Colombia*, Denmark, Finland, France, Germany, Iceland, Ireland, Japan, *Korea (Republic of)*, *Malaysia*, *Mexico*, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, *Thailand*, *Turkey*, United Kingdom, United States, *Venezuela*

Note: Developing source countries in italics.

List of Host Countries

Albania, Algeria, Angola, Argentina, Australia, Austria, *Azerbaijan, Bangladesh,* Belgium-Luxembourg, *Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon,* Canada, *Chile, China, Colombia, Congo (Republic of), Costa Rica, Côte d'Ivoire, Croatia, Czech Republic,* Denmark, *Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia,* Finland, France, *Gambia,* Germany, *Ghana,* Greece, *Guatemala, Guinea, Guyana, Haiti, Honduras, Hungary,* Iceland, *India, Indonesia,* Ireland, *Israel*, Italy, Japan, *Jordan, Kazakhstan, Kenya, Korea (Republic of), Latvia, Lithuania, Madagascar, Malaysia, Mali, Mauritius, Mexico, Mongolia, Morocco, Mozambique,* Netherlands, New Zealand, *Nicaragua, Niger, Nigeria,* Norway, *Oman, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Poland,* Portugal, *Romania, Russian Federation, Saudi Arabia, Senegal, Seychelles, Slovak Republic,* Spain, *Sri Lanka, Sudan, Swaziland,* Sweden, Switzerland, *Syrian Arab Republic, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda,* United Kingdom, United States, *Uruguay, Venezuela, Vietnam, Zambia, Zimbabwe.*

Note: Developing host countries in italics.

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