

On the relevance of double tax treaties

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Abstract

This paper investigates the effects of double tax treaties (DTTs) on foreign direct investment (FDI) after controlling for their *relevance* in the presence of treaty shopping. DTTs cannot be considered a bilateral issue, but must be viewed as a network, since FDI can flow from home to host country through one or more conduit countries. Accounting for treaty shopping, we calculate the shortest (i.e. the cheapest) tax distance between any two countries allowing the corporate income to be channelled through intermediate jurisdictions. We consider the relevance of tax treaties vis-à-vis the domestic law and the entire tax treaties network and show that tax treaties that reduce the direct tax distance, both against domestic law and the entire existing treaty network, will increase FDI. Such a relevant treaty will increase direct FDI by roughly 20%. The effect increases with reductions in the direct tax cost and we can quantify this effect at almost 8% for a 10-percentage-point tax reduction below the minimum rate in the network. We also find that a treaty can lead to more direct FDI if the cheaper route is complicated and involves more than one conduit country.

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1 Introduction

Traditionally, double tax treaties (DTTs) served as an important policy tool to promote international economic activity by preventing international double taxation. However, despite the growing number of contributions, the empirical evidence on the effects of double tax treaties on bilateral FDI remains inconclusive (Blonigen & Davies, 2004; Egger, Larch, Pfaffermayr, & Winner, 2006; Neumayer, 2007; Egger & Merlo, 2011). The well intended motivation to eliminate double taxation has created a highly complex network of DTTs that span the globe, with often unforeseen consequences (Easson, 2000). While preventing international double taxation, DTTs shift taxing rights from capital-importing countries to capital-exporting countries, denying investors the benefits of lower source taxation (Braun & Zagler, 2014). Moreover, in order to avoid high host country withholding taxes on outgoing passive income, many multinational companies divert FDI via a third country with a more favourable tax treaty, a practice that has been labeled treaty shopping in the literature (OECD, 2015; Dyreng, Lindsey, Markle, & Shackelford, 2015). The OECD highlights that treaty shopping is one of the most significant sources of concerns regarding the Base Erosion and Profit Shifting (BEPS) project. Against this background, this paper investigates the effects of double tax treaties on foreign direct investment (FDI) controlling for the possibility of treaty shopping that might give multinational companies benefits, such as lower or no withholding taxes.

We follow the novel paper by Barrios et al. (2012) and interpret the international tax system as a network where the tax distance between two countries is defined as the cost of channelling corporate income from one country to another in terms of taxes to be paid. In particular, the tax cost between two countries consists of corporate income taxes to be paid in the host country, a non-resident withholding tax on the income of the subsidiary and corporate income taxes in the home country. We account for treaty shopping and calculate the shortest (i.e. the cheapest) distance between any two countries allowing for corporate income to be channelled through one or more intermediate jurisdictions. Our main hypothesis is that only *relevant* tax treaties - i.e. tax treaties that offer investors a financial advantage over the conditions under domestic law and given the entire existing tax treaties network - lead to more immediate home to host country FDI.

We indeed find that DTTs that offer investors a financial advantage over the conditions under domestic law increase FDI, whereas DTTs that do not provide this benefit have no impact on FDI. This effect is bigger for DTTs that offer a financial advantage over all other tax treaties in the network. Furthermore, for these network effects we differentiate between tax minimising indirect routes with one and two intermediate jurisdictions. We show that when the tax minimising indirect route involves only one conduit, tax treaties that do not improve conditions for investors have no effect on the bilateral FDI between home and host state. This case is indistinguishable from not having a treaty. If the indirect route involves two conduits, and is therefore more cumbersome, a DTT can lead to more direct FDI even if it is not offering a financial advantage over all other tax treaties in the network. Finally,

we find that the effects of network-relevant treaties on FDI increase with reductions in the direct tax distance below the minimum one in the network.

Our paper contributes to various strands of research. First, we advance the understanding of the effects of DTTs on combined effective tax rates (Marques & Pinho, 2014). In this regard, we calculate the benefit of every DTT on the combined effective tax rate relative to the conditions under domestic law. Second, we advance the literature that adopts a network approach to study the tax treaties network (Van't Riet & Lejour, 2017; Hong, 2017). Here, we improve the methodology and, by allowing for tax treaty shopping potential, we estimate the minimum tax cost between any two countries in our sample. We then evaluate the benefit of every particular DTT relative to the minimum tax distance between the two countries with the respective tax treaty. Third, we build on the work of Mintz and Weichenrieder (2010), Dreßler (2012) and Weyzig (2013), and analyse the effects of DTTs on FDI in the presence of treaty shopping. Overall, we advance the research on the effects of DTTs on FDI through a rich analysis that accounts for their differential impact instead of a simplified binary definition.

The remainder of this paper is structured as follows: Section 2 summarises the existing literature and identifies the research gap. In section 3 we discuss the theoretical background. In section 4 we discuss our sample and research methodology. We present our results in section 5. Section 6 concludes.

2 Literature

The economic effects of DTTs have been analysed in numerous studies. Using OECD data on the stocks and flows of bilateral aggregate FDI for the years 1982-1992, Blonigen and Davies (2005) find that new tax treaties have a strong negative impact on FDI. Blonigen and Davies (2004) confirm these results using US data. The authors attribute their results to DTTs reducing tax evasion, at least in the short run. For a sample of 67 DTTs and aggregate bilateral outward FDI between OECD countries from 1985-2000, Egger et al. (2006) find a negative average treatment effect of DTTs on FDI using different matching estimators and focusing on difference-in-differences. Baker (2014) uses a similar estimation strategy, i.e. propensity score-matched difference-in-difference estimation, and shows that tax treaties do not have any effect on FDI. Against all the results so far mentioned, Neumayer (2007) finds robust empirical evidence that DTTs increase FDI to developing countries. However, when the author splits developing countries into low-income and middle-income countries, he finds that DTTs are effective only in the group of middle-income countries.

Whereas studies using aggregate country- and country-pair-level data tend to find negative or statistically insignificant results, there is a tendency for studies based on micro-data to find some positive effects of DTTs. For instance, Egger and Merlo (2011) argue that DTTs have a positive effect on foreign investments of multinational firms using micro-data

on German multinational-firm activity over 1996-2005. Blonigen et al. (2014) use firm-level data from the United States Bureau of Economic Analysis on their activity in 174 countries between 1987 and 2007. They find a positive effect of DTTs on foreign direct investment, which is larger for firms that use differentiated inputs. These (multinational) firms benefit from treaty provisions establishing guidelines for resolving disputes between taxation authorities. In contrast, firms that use more homogenous inputs are on average less likely to see any significant effect. This difference can be explained by the additional regulations on the calculation of internal prices and encouraging the exchange of information between authorities.

A closely related stream of the literature considers the effects of DTTs on the location decision of multinational firms. Using micro-data from Sweden between 1965-1998, Davies et al. (2009) find a positive effect of DTTs on multinational firm's decision to locate the first affiliate in a treaty country. The authors argue that the positive effect of DTTs comes from the reduced investment uncertainty. Marques and Pinho (2014) analyse the extent to which tax treaties influence the number of new foreign subsidiaries incorporated by European multinationals between 2000 and 2009. The authors use two measures for tax treaties: a binary variable and an effective tax rate, which (very similar to the tax rate used in this paper) captures the corporate tax rates of both host and home countries, as well as tax-treaty features such as withholding tax rates and double taxation relief methods. However, in contrast to our paper, the authors ignore the possibility of treaty shopping and do not measure the impact of tax treaties relative to domestic law.

Prior literature offers several explanations for these ambiguous and inconclusive results. As argued by Owens (1962), and later pointed out by Davies (2004) and Baker (2014), for given tax rates, double taxation can be relieved just as easily unilaterally as through a bilateral tax treaty. In particular, since most capital exporting countries already offer tax credits or exemptions, treaties have only a very limited role in avoiding double taxation. More generally, Bösenberg, Egger and Erhardt (2016) suggest that the impact of DTTs depends on their content (e.g. which method of double tax relief is specified in a treaty or whether a treaty includes provisions on exchange of information) and the economic environment in which they occur (e.g. the profitability of bilateral multinational activity in absence of a treaty; the domestic corporate and withholding tax rates; and the unilateral method of double taxation relief). Meanwhile, the vast majority of the existing literature treats DTTs as a binary variable, thereby ignoring their complexity and their domestic and international interactions. To our knowledge, only Marques and Pinho (2014) analyse the effect of DTTs on the combined effective tax rates.

Our study addresses this gap in the literature and analyses the effects of double tax treaties in a richer setting that goes beyond their binary treatment. Relying on the work of Mintz and Weichenrieder (2010), Dreßler (2012) and Weyzig (2013), we treat the international tax system as a network and subsequently account for treaty shopping potential when estimating the effects of DTTs on FDI. In order to avoid high host country withholding taxes on outgoing passive income, many multinational companies divert FDI via

a third country with a more favourable tax treaty. If a country has several tax treaties, MNEs will take advantage of the “worst” one - i.e. the most favourable one from the firm’s perspective - structuring their investment via the cheapest route (Brumby & Keen, 2016). It is plausible that DTTs have a different effect on investment depending on whether investors consider the direct route as a viable investment channel. Therefore, in contrast to the previous literature, instead of treating tax treaties as a binary variable, we evaluate their relevance given the entire tax treaties network and allow for a differential effect on FDI. We conduct our analysis using a panel with more than 140 countries and their corresponding tax treaties network between 2005 and 2012 allowing for sufficient variation under domestic law and in the tax treaties network, as opposed to the previous literature that concentrated on a single country or a single year. Finally, in contrast to the previous literature that takes into account only the world average corporate income tax as the rate to be credited in conduit situations, we do not use such approximations. Instead, we consider the actual taxes paid on route. By doing so, we are able to measure the impact of DTTs on combined effective tax rates given the entire tax treaties network and estimate the corresponding effect on FDI.

We build on the work of Mintz and Weichenrieder (2010), Dreßler (2012) and Weyzig, and (2013) consider the international tax system as a network where we account for treaty shopping potential when estimating the impact of DTTs on FDI. Mintz and Weichenrieder (2010) construct the chains of corporate structure for German multinationals across various countries for the year 2001 and relate these structures to the underlying fiscal motives. The level of withholding taxes is found to be important in determining which countries are used as a platform for investments. More specifically, higher bilateral withholding taxes to and from Germany substantially increase the probability that outward and inward FDI is diverted via a third country.

Dreßler (2012) traces the group structures of multinationals across 58 countries in the years 1996 to 2008 and analyses to what extent these structures are tax-efficient. In this case, the level of withholding taxes between two group members is found to be important in determining the probability of an indirect participation. Holding companies are generally established in jurisdictions where they can, at least potentially, lower the applicable withholding taxes. Accordingly, operative subsidiaries are likely to be held via intermediate companies located in jurisdictions with low withholding tax rates towards the country of the ultimate parent. However, in about half of the observations, the intermediate conduit company does not lower the overall tax burden and in about 5% of the cases the tax burden on such repatriated profits is actually higher.

Finally, Weyzig (2013) uses micro-data from Dutch Special Purpose Entities to analyse the geographical patterns and the structural determinants of FDI diversion. The results confirm that tax treaties are a key determinant of FDI routed through the Netherlands. In particular, the effect of tax treaties on FDI diversion partly arises from the reduction of dividend withholding tax rates, which provides evidence for tax treaty shopping.

3 Theoretical background

Following Barrios et al. (2012), we capture the features of the international tax system by measuring the tax distance between two countries, where tax distance is defined as the cost of channelling corporate income from one to another in terms of taxes to be paid. In particular, the tax cost of a multinational enterprise (MNE) consists of corporate income taxes to be paid in the country of residence of the parent as well as corporate income taxes and non-resident withholding taxes on the income of the subsidiary. The combined effective tax rate $t_{SR}(rm)$ for the multinational company can be determined depending on the relief method applied in the resident (home) country R on income from source (host) country S :

$$t_{SR}(no\ relief) = t_S + w_{SR} - t_S w_{SR} + t_R - t_S t_R \quad (1)$$

$$t_{SR}(deduction) = 1 - (1 - t_S)(1 - w_{SR})(1 - t_R) \quad (2)$$

$$t_{SR}(direct\ credit) = \max\{1 - (1 - t_S)(1 - w_{SR}), 1 - (1 - t_S)(1 - t_R)\} \quad (3)$$

$$t_{SR}(indirect\ credit) = \max\{1 - (1 - t_S)(1 - w_{SR}), t_R\} \quad (4)$$

$$t_{SR}(exemption) = 1 - (1 - t_R)(1 - w_{SR}) \quad (5)$$

where (rm_{SR}) is the applicable relief method, t_S the corporate tax rate in the source country, t_R the corporate tax rate in the residence country and w_{SR} the non-resident withholding tax on the income of the subsidiary.

About half of the countries in our sample operate an exemption system under which foreign dividends are not taxed in the residence country (5).¹ Other countries subject the received dividends to residence country taxation at the corporate tax rate t_R . Most of these countries avoid double taxation by crediting the taxes paid in the source jurisdiction on the amount of distributed dividends (3). Such credit is usually limited to corporate taxes due in the residence country. In some cases, also an indirect credit for the underlying corporate taxes is offered (4). Alternatively, a small number of countries does not exempt, nor credit foreign taxes, but instead allows them to be deducted as a business expense (2). Finally, some (especially less developed) countries do not provide for any form of double tax relief (1). The received dividends are then subject to full double taxation.

Next, we consider the possibility of an indirect repatriation of dividends, i.e. through a third (conduit) country C . It is rational for the MNE to choose the indirect route over the direct route, *ceteris paribus*, when its costs in terms of taxes are lower (Mintz & Weichenrieder, 2010; Weyzig, 2013; Van't Riet & Lejour, 2017). Since the corporate

¹This includes states that operate a territorial tax system where all foreign profits are exempt and states that adopt worldwide taxation with a participation exemption for foreign dividends. Some countries exempt only 95% of the received dividends with, typically, a foreign tax credit or no relief for the remaining 5% of the dividends. Other countries exempt 100% of the received dividends, but disallow the deduction of certain costs connected with the participation. To simplify the analysis, we ignore these distinct characteristics.

income tax of the source country t_S is always paid, irrespective of the relief method, we can define the direct tax distance d_{SR} between source country S and residence country R based only on the relevant withholding tax rate and the corporate income tax of the residence country. Depending on the relief method, the combined effective tax rate t_{SR} can be then defined as $1 - (1 - t_S)(1 - d_{SR})$, where d_{SR} accounts for the tax “distance” between the two countries measured in taxes paid en route:

$$d_{SR}(\text{no relief}) = t_P + w_{SR} \quad (6)$$

$$d_{SR}(\text{deduction}) = 1 - (1 - w_{SR})(1 - t_R) \quad (7)$$

$$d_{SR}(\text{direct credit}) = \max\{w_{SR}, t_R\} \quad (8)$$

$$d_{SR}(\text{indirect credit}) = \max\{w_{SR}, (t_P - t_R)/(1 - t_R)\} \quad (9)$$

$$d_{SR}(\text{exemption}) = w_{SR} \quad (10)$$

It follows that the condition for treaty shopping is that total taxes over the indirect route are less than over the direct one, i.e. $1 - (1 - d_{SC})(1 - d_{CR}) < d_{SR}$ where the total tax distance with an initial host $k = 1$ and final destination $k = n$ equals $1 - \sum_{k=2}^n (1 - d_{k-1,k})$ (Van’t Riet & Lejour, 2017). Accounting for the possibility of an indirect repatriation of dividends, the effective tax rate on overseas profits is the minimum between the effective tax rate on a direct route and on the indirect route.

Finally, in a one-period model, where all profits are repatriated, it can be shown theoretically that FDI is decreasing in the relative effective tax rate T where $1 - T = (1 - t_{SR})/(1 - t_R) = (1 - d_{SR})(1 - t_S)/(1 - t_R)$, where t_{SR} is again the effective tax rate on overseas profits and t_R the effective tax rate on domestic profits (Davies, 2003, 2004). As both source and residence tax rates will be picked up by home and host country fixed effects in an empirical estimation, we focus the subsequent analysis on tax distances.

4 Data and network analysis

4.1 Data

In order to construct our network analysis, we collect tax data for a sample of 146 countries between the years 2005 and 2012.² Our main source of data on domestic and international tax system are the IBFD Global Corporate Tax Handbooks for the years 2009-2012 and IBFD Online Tax Platform. For the countries included in the Global Corporate Tax Handbooks we collect information on the domestic tax system and, in particular, on taxation of foreign income (including the methods of double tax relief), as well as domestic corporate and withholding tax rates from the respective yearbook. To the extent that a country is not

²We are limited to this time span, as domestic tax data are not available systematically for the years before 2005, whereas data on FDI are not yet available for the years after 2012.

available in a Global Corporate Tax Handbook, we consult the closest to the missing year data source for the taxation of foreign income, including the IBFD Online Tax Platform, and, unless indicated otherwise, assume the same method of taxation of foreign income for the missing years.

Moreover, we update all domestic corporate and withholding tax rates with the EY (Ernst and Young) Corporate Tax Guides if the IBFD data are not available for a particular year. For instance, for the years 2005-2008, the EY Corporate Tax Guides are our only source of data on domestic corporate and withholding tax rates. We further hand-collect the relevant withholding tax rates and methods of double tax relief from the respective DTTs and applicable protocols. Also, as the treaties network is subject to four types of changes, we check when new treaties become effective; if treaties have been terminated at a later point in time; if the conditions of the treaties have been changed through protocols in the following years; and if the conditions of the treaties have been altered through amendments in domestic law.³ Overall, we consult more than 3000 tax treaties that became effective before 2013 and around 300 accompanying protocols.

We obtain data on bilateral inward FDI stocks between 2005 and 2012 from the UNCTAD (United Nations Conference on Trade and Development) database and we invert them to measure the investment from the home to the host country. In presence of FDI diversion via a third country, we would ideally want to observe the indirect investment from the home to the host country via the conduit country. However, the available data reports only the immediate home to host country FDI stocks. Therefore, we can estimate only the impact of DTTs on these immediate home to host country FDI stocks.⁴ Finally, the information on bilateral investment treaties (BITs) is from the Investment Policy Hub of UNCTAD.

4.2 Network analysis

Recent contributions by Van 't Riet and Lejour (2017) and Hong (2017) employ a network approach to study the centrality of countries in the tax treaties network and, respectively, the structure of tax-minimising (direct and indirect) investment routes. Both studies analyse the tax treaties network for a single year and ignore any changes in the tax treaties network over time. Moreover, both studies use an adapted Floyd-Warshall shortest path algorithm to estimate these tax-minimising investment routes, thereby overestimating the

³If under the tax treaty between country A and country B dividends are subject to a withholding tax rate that is equal to the withholding rate under domestic law, any change in the domestic rate affects directly the rate under the tax treaty.

⁴FDI data present one additional challenge: whereas our measure of tax distance consists of the cost of channeling corporate income from one country to another in terms of taxes to be paid, firms may use debt financing instead of dividend. To the extent that FDI stocks include debt financing, the relationship between FDI stocks and tax distance becomes weaker and we are less likely to find significant results. Moreover, as DTTs do not create tax liabilities, they cannot increase the tax cost of debt financing. Therefore, the identification of *relevant* tax treaties is not biased by including tax treaties that leave investor worse off.

potential for tax treaty shopping.⁵

We take a different approach and develop a Visual Basic Application (VBA) tool to recalculate the tax distance for every possible combination of host, home and intermediate countries.⁶ In this way, we can take into account the actual taxes paid in the jurisdiction before the one receiving the dividends - typically the intermediate jurisdiction - instead of nominal or world-average corporate tax rates. The single limitation of our approach is that we assume and restrict the number of possible intermediate jurisdictions to two in order to avoid long computation time of the analysis. However, this may not be an unrealistic assumption, as Mintz and Weichenrieder (2010) show that only 0.2% of German multinational firms use cross-border group structures with three or more pass-through entities. Moreover, when we analyse our network using the Floyd-Warshall algorithm (allowing for an unlimited number of conduits) we do not find any indirect connection with three or more intermediate jurisdictions that would further reduce the tax distance between any two countries in our sample. Thus, we believe that our approach is superior to the Floyd-Warshall algorithm and allows for a more accurate network analysis.

For every year, we update the tax treaties network with all relevant changes. In particular, we account for changes in the provisions of tax treaties through amending protocols; for changes in the provisions of the tax treaties through changes under domestic law (for tax treaties that refer to conditions under domestic law); we add new tax treaties that become effective; and remove tax treaties that have been terminated or replaced by new ones in the course of the year being analysed. We assume a fully owned subsidiary engaged in an active course of business and consider only domestic anti-abuse provisions.⁷ Specifically, we account for higher withholding taxes upon dividends distributions to tax havens and subject-to-a-minimum-tax clauses.

Several countries in our sample levy a higher withholding tax on dividends when these

⁵The Floyd-Warshall algorithm calculates total taxes over the indirect route taking into account only the nominal taxes in the intermediate jurisdictions. Assume that the home country relieves double taxation through the indirect credit method, whereas the intermediate jurisdiction exempts foreign dividends. Under the Floyd-Warshall algorithm, the home country credits the underlying corporate tax at the full nominal tax rate. However, the actual tax rate on the dividends in the intermediate jurisdiction is 0%. Van 't Riet and Lejour (2017) tackle this problem by substituting the nominal corporate tax rate in any intermediate jurisdiction with a worldwide average corporate tax rate.

⁶VBA is an implementation of Microsoft's programming language Visual Basic 6 and it is built into most Microsoft Office applications, including Microsoft Excel.

⁷Assuming a subsidiary engaged in an active course of business allows us to ignore potential anti-abuse provisions targeted against treaty shopping. While this presents a limitation, the significant differences in the subjective and objective scope of these provisions make it fairly impossible to treat them in a systematic way. Moreover, whereas the OECD has put an effort in combating treaty shopping, its actions and recommendations are only recent and later than our sample years (see for instance OECD, 2015). Finally, the effectiveness of anti-treaty shopping rules proves disputable, as shown in the joined cases *Deister Holding* and *Juhler Holding* where the Court of Justice of the European Union declared the German provisions as not compatible with the EU freedom of establishment. To the extent that we overestimate the potential for treaty shopping, we are less likely to find an effect of tax treaties and our results should be interpreted as the lower bound.

are distributed to a parent located in a tax haven. Because most of the domestic tax havens lists are not comprehensive, we adopt a common tax haven list for all countries in our sample across the entire time period (Dyreg & Lindsey, 2009).⁸ In accordance with the majority of these domestic provisions, we exclude the anti-abuse treatment when a DTT is in place. Similarly, several countries in our sample adapt a subject-to-a-minimum-tax clause as a condition for claiming the benefits of participation exemption and exemption from withholding tax on dividends.⁹ Since we observe to what corporate tax rates the subsidiary and the parent company are subject to, we can easily control for this condition.

We describe the entire international network of double tax treaties with a set of tax treaty dummies and a measure of bilateral taxes. Our first variable is a dummy that verifies if a DTT between two countries is present, *Treaty*. This is the standard variable used in the previous literature. Country pairs that did not conclude a treaty will be our reference category throughout our estimations. For every year in our sample, we then measure the direct tax distance between any two countries taking into account a possible tax treaty between these two countries, *DirectTaxDistance*.

Measuring the direct tax distance permits us to distinguish between treaties. First, we define *RelevantDomestic* tax treaties as tax treaties that reduce the effective tax rate on overseas profits below the one under domestic law of the source and residence country. For example, in the year 2012, ignoring the bilateral tax treaty, the tax distance between Argentina as the home state and Belgium as the host state is 25% under the domestic law of both countries. However, the applicable DTT reduces the direct tax distance to approximately 1.5%. Hence, the tax treaty is *relevant* relative to the domestic law provisions. We label tax treaties that do not provide for this benefit as *IrrelevantDomestic*. Further, we expect *RelevantDomestic* DTTs to increase the bilateral FDI and *IrrelevantDomestic* to have no effect.

The innovative element in our analysis is to identify if there exists an indirect route along which the tax distance would be reduced as opposed to the direct route.¹⁰ For example, in 2012, a South African parent company investing directly in a US subsidiary has to pay 5% tax on distribution of dividends after considering the tax treaty between both countries. However, if the same investment is made through a conduit company in the Netherlands the tax cost can be reduced to 0%.

Once we estimate the minimum direct and indirect tax cost between any two countries,

⁸Our sample includes the following tax havens listed in Table 1 in Dyreg and Lindsey (2009): Aruba, Bahamas, Bahrain, Barbados, Bermuda, Botswana, British Virgin Islands, Brunei, Cayman Islands, Cyprus, Gibraltar, Guernsey, Ireland, Isle of Man, Jersey, Latvia, Lebanon, Liechtenstein, Luxembourg, Macau, Maldives, Malta, Mauritius, Monaco, Panama, Seychelles, Singapore, Switzerland, Uruguay, U.S. Virgin Islands.

⁹Note that this differs from subject to *a* tax condition. Here, we assume that all companies are subject to tax.

¹⁰This implies looking at 144 different routes with a single conduit for each of our 146 home countries to each of our host countries, and 144 times 143 different routes for two conduits, effectively comparing 440 million cases.

we ask whether *RelevantDomestic* tax treaties remain relevant also considering the entire treaty network. We define *RelevantNetwork* tax treaties as tax treaties that reduce the effective tax rate on overseas profits not only below the one under domestic law, but also below the minimum one in the network. In the Argentina - Belgium example above, the lowest possible tax distance when channelling income through the network is 12.5%.¹¹ In absence of the bilateral tax treaty, the MNE has a tax incentive to choose the indirect route over the direct one. However, with a direct tax distance of only 1.5%, the DTT between Argentina and Belgium takes away the advantage of the indirect one and further reduces the minimum tax distance between the two countries by 11 percentage points.

By contrast, the *IrrelevantNetwork* dummy indicates tax treaties that reduce the direct tax distance, but not the minimum (indirect) tax distance between the source and the residence country. Consider the case of Argentina as the home country and Germany as the host state. In 2012, the direct tax distance between the two countries is about 26.4% under their domestic law, while the minimum tax distance through the network is 12.5%. Thus, also in this case, we expect the MNE to tax-prefer the indirect route rather than the direct one. Moreover, the DTT between the two countries reduces the direct tax distance to 21.25%, which is still higher than the minimum tax distance through the network. As a result, the tax treaty between Argentina and Germany is irrelevant to the MNE's decision to invest via a third country. To the extent that MNEs make use of treaty shopping opportunities, we expect *RelevantNetwork* DTTs to have a bigger effect on FDI than *IrrelevantNetwork* tax treaties.

We can further decompose the *RelevantNetwork* dummy and differentiate between relevant DTTs that are strictly better than the tax treaties network - *StrictlyRelevant* - and relevant DTTs that just cut the tax cost of the direct route to the minimum in the network, *WeaklyRelevant*. This distinction allows us to separate the effects of relevant DTTs on the intensive and extensive margin. In theory, *StrictlyRelevant* tax treaties should stimulate FDI between two countries for two reasons. On the extensive margin, firms may relocate investments from the indirect route to the direct route or invest directly where they did not invest via a conduit company despite its tax benefit in absence of the DTT. Along the intensive margin, firms would also benefit from a lower overall tax burden, and this should increase FDI. Presuming non-negligible costs to treaty shopping, *WeaklyRelevant* tax treaties may increase FDI between the home and the host state if firms relocate investments from the indirect route to the direct route. This effect occurs only on the extensive margin.

We can also narrow down the *IrrelevantNetwork* dummy and distinguish between irrelevant tax treaties where the tax minimising indirect investment route involves one conduit

¹¹One of the possible indirect routes is through the United Kingdom and Bolivia: the tax distance between Belgium and the UK is 0% (no withholding tax in Belgium and participation exemption in the UK) and so is the the tax distance between the UK and Bolivia (no withholding tax in the UK, while foreign dividends are not subject to tax in Bolivia). Finally, the tax distance between Bolivia and Argentina is 12.5% resulting in an overall cost of 12.5%.

country - *IrrelevantNetwork1* - or two conduit countries - *IrrelevantNetwork2*. If treaty shopping is costly, MNEs may be less likely to use more complex investment structures. Accordingly, we expect the effects of irrelevant DTTs on direct FDI to increase with the number of intermediate jurisdictions needed to set up the tax minimising indirect route.

4.3 Summary statistics

Our sample consists of 138 countries in 2005 and 2006, 142 countries in 2007 and 2008 and 146 countries for the years 2009 - 2012.¹² This corresponds to 18,906 unique country pairs in the first year of our sample and 21,170 unique country pairs in the last year.¹³ Due to missing economic data, the econometric analysis covers only 133 countries.

Table 1 summarises the characteristics of the international tax network. In 2005, 12 out of 138 countries apply no unilateral method of double tax relief; 7 countries the deduction method; 37 offer direct credit; 13 use indirect credit; and the remaining 69 countries exempt foreign dividend income. Ignoring bilateral DTTs, about 10% of all country pairs are left with no relief; less than 6% deduct foreign taxes from the taxable income; approximately 29% credit the host withholding tax from the domestic tax liability; almost 11% credit also the underlying corporate tax; and slightly more than 44% apply the exemption method. Once we include bilateral tax treaties, the shares of no relief and deduction drop to approximately 9% for the former and 5% for the latter; the percentage of countries using the direct credit method remains stable around 29%; indirect credits' share raises above 11%; while the use of exemption method increases the most to more than 45%.

In terms of the cheapest connection on route, we observe that for more than 55% of all country pairs the direct connection is the cheapest one. Further, 35% achieve the minimum tax distance on an indirect route with one conduit company and 9% on an indirect route with two conduits. Overall, 6,780 out of 18,906 unique country pairs have a zero tax distance, where there are no repatriation taxes on distributed income. Corporate income is taxed thus only once, at the level of the subsidiary, and there is no economic double taxation.¹⁴ Almost 51% of the zero tax distance connections occur on the direct connection, more than 41% on an indirect route with one intermediate country and the remaining 7.4% on an indirect route with two intermediates.

In 2005, 3,439 country pairs had an effective DTT.¹⁵ Out of these, 1,519 country pairs had a *RelevantDomestic* tax treaty to the extent that it reduced the direct tax distance. Among these DTTs, about half, 761, remain relevant once accounted for the possibility

¹²Due to missing domestic tax data we have to exclude from the network analysis Algeria, Cambodia, Laos and Libya between 2005 and 2008; and Belarus, Madagascar, Montenegro and Serbia in 2005 and 2006.

¹³Note that the tax distance between two countries can be asymmetric, i.e. it is more expensive to distribute dividends from country *A* to country *B* than vice versa.

¹⁴Note that the same outcome is achieved under the EU Parent-Subsidiary Directive.

¹⁵The effective date of tax treaties can differ between the two signatory countries. This explains the uneven number of effective DTTs.

Table 1: International tax network

		2005	2012
Number of countries:		138	146
Number unique country pairs:		18,906	21,170
Unilateral methods of double tax relief:	no relief	12	13
	deduction	7	7
	direct credit	37	35
	indirect credit	13	14
	exemption	69	77
Bilateral taxation (in absence of DTTs):	no relief	10%	11%
	deduction	6%	5.5%
	direct credit	29%	27%
	indirect credit	11%	10%
	exemption	44%	46.5%
Bilateral taxation (in presence of DTTs):	no relief	9%	10%
	deduction	5%	5%
	direct credit	29%	27.5%
	indirect credit	11.5%	10.5%
	exemption	45.5%	47%
Shortest distance:	direct	55%	52.5%
	one conduit	35%	36.5%
	two conduits	10%	11%
Number of zero tax distance connections:		6,780	9,116
Share of zero tax connections:	direct	51%	47%
	one conduit	42%	43%
	two conduits	7%	10%
Number of country-pairs with an effective tax treaty:		3,439	4,539
Number of effective tax treaties per type:	relevant domestic	1,519	2,152
	irrelevant domestic	1,920	2,387
	relevant network	761	1,088
	strictly relevant	321	356
	weakly relevant	440	732
	irrelevant network	758	1,064
	irrelevant network1	722	984
	irrelevant network2	36	80

of treaty shopping. The overwhelming majority (722 out of 758) of country pairs with a *IrrelevantNetwork* dummy is at disadvantage of a cheaper indirect route that involves only one conduit. Finally, more DTTs, 440 against 321 country pairs, cut the direct tax distance to the minimum one in the network rather than below it.

Moving to the last year in our sample, 2012, 13 out of 146 countries have no unilateral method of double tax relief; 7 countries apply the deduction method; 35 offer direct credit for host withholding taxes; 14 credit also the underlying corporate tax, while 77 countries exempt foreign dividends. Leaving again the effect of tax treaties aside, about 11% of all country pairs have no relief for foreign taxes; 5.5% use deduction as the only relief method; 27% apply direct credit; approximately 10% offer indirect credit; and 46.5% apply exemption. Taking into account bilateral DTTs, the share of the no relief method drops below 10% and that of the deduction method below 5%. At the same time, the shares of all other methods increase to 27.5% in the case of direct credit; 10.5% in the case of indirect credit; and 47.3% for the exemption method.

Focusing again on the cheapest connections in the network, we see that now only 52.5% of the cheapest connections occurs on the direct route. This suggests that treaty shopping has gained in importance over the last decade. The use of indirect routes with one conduit company increases to above 36%, whereas indirect routes with two conduits increases to almost 11%. Overall, 9,116 out of 21,170 country pairs have a zero tax distance. Among these, 4,289 country pairs have a direct tax distance of 0%; 3,941 country pairs have a zero tax distance on an indirect route with one intermediate country; while the remaining 886 zero tax distances are achieved on an indirect route with two intermediates.

Finally, in 2012, 4,539 country pairs had an effective DTT. 2,152 of them are of the *RelevantDomestic* treaties and 2,387 of the *IrrelevantDomestic* treaties. Similarly to 2005, about half, 1,064, of *RelevantDomestic* treaties turn irrelevant once accounted for the possibility of treaty shopping. More country pairs are now at a disadvantage of indirect routes involving two intermediate countries (80 out of 1,064) and the number of country pairs with a *WeaklyRelevant* treaty, 732, increases more than the number of country pairs with a *StrictlyRelevant* DTT, 356. Table 2 gives an overview of the summary statistics.

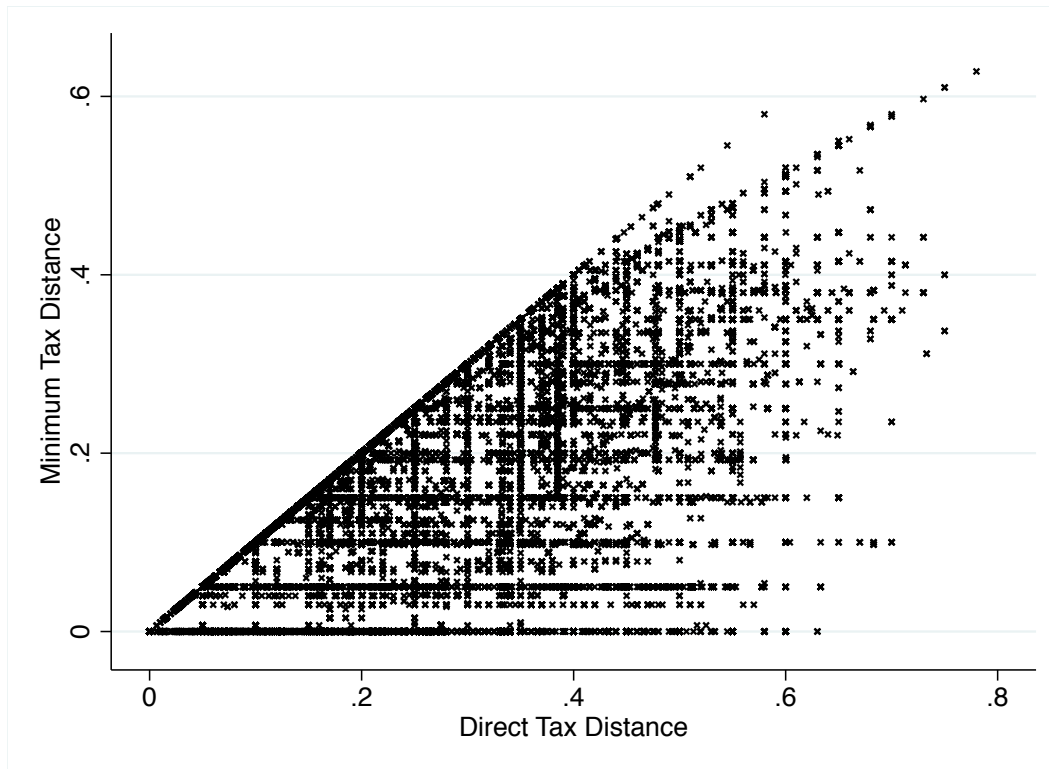
Figure 1 describes the economic consequences of treaty shopping. On the horizontal axis, we plot for every single observation in our panel the direct tax distance in the absence of treaty shopping, *DirectTaxDistance*. On the vertical axis, we show effective taxes paid if instead an indirect route via one or two conduits is chosen. Points along the diagonal exhibit no gains of treaty shopping. All countries where the direct distance is the cheapest route will be along this line. The greater the vertical distance from the diagonal, the bigger the saving due to treaty shopping. We show ample possibilities for treaty shopping, in many cases reducing the actual tax burden to zero.

Figure 1 reveals two interesting patterns. We find a series of vertical lines, which typically reflect individual country pairs, where neither domestic tax regulation nor the DTT have changed, and hence the tax burden along the direct route remains unchanged. However, subsequent treaties signed with or between third countries have reduced the

Table 2: Summary Statistics

Variable	n	Mean	S.D.	Min	Max
<i>FDI stocks</i> (in US dollars)	34,233	3586.61	20605.24	0	592273.2
<i>BIT</i>	162,536	0.1759	0.3807	0	1
<i>DirectTaxDistance</i>	162,536	0.1805	0.1393	0	.78
<i>Treaty</i>	162,536	0.1975	0.3981	0	1
... <i>IrrelevantDomestic</i>	162,536	0.1106	0.3136	0	1
... <i>RelevantDomestic</i>	162,536	0.0869	0.2817	0	1
... .. <i>RelevantNetwork</i>	162,536	0.0449	0.2071	0	1
... .. <i>StrictlyRelevant</i>	162,536	0.0166	0.1278	0	1
... .. <i>WeaklyRelevant</i>	162,536	0.0283	0.1659	0	1
... .. <i>IrrelevantNetwork</i>	162,536	0.0420	0.2006	0	1
... .. <i>IrrelevantNetwork1</i>	162,536	0.0388	0.1932	0	1
... .. <i>IrrelevantNetwork2</i>	162,536	0.0032	0.0564	0	1

Figure 1: Potential gains from treaty shopping



tax burden along the indirect route, demonstrating how the international DTT network undermines national policy. We also observe that a great deal of our observations occurs along the 5%, 10% and 15% effective tax rates, which reflect the withholding tax rates usually agreed on in DTTs. Under the exemption system applied by the majority of countries in our sample, the actual tax burden is brought back from the level of domestic withholding tax rates to these common treaty withholding tax rates. Moreover, a significant number of observations is concentrated along the 25%, 30% and 35% direct tax distance, which coincides with the corporate tax rates of many countries. These points comprise all instances where the home country unilaterally offers a foreign tax credit - thereby setting the direct tax distance equal to the domestic corporate tax rate - but the MNEs benefit from tax treaties with a more generous method of double tax relief.

5 Estimation methodology and main results

The standard procedure to infer DTT effects on bilateral FDI flows employs a gravity model and accounts for the presence of a DTT with a dummy variable equal to 1 when a tax treaty is effective between two countries in year t and 0 otherwise. We include the variables derived from the network analysis and adopt a Poisson estimator (Pseudo-Maximum Likelihood Estimation - PPML). We resort to the PPML estimator as proposed by Santos-Silva and Tenreyro (2006) to account for zero FDI flows and, more importantly, heteroskedasticity in FDI data. In particular, Santos-Silva and Tenreyro (2006) argue that the standard log-linear OLS approach results in inconsistent coefficient estimates. Mainly because of doubts about the exclusion restriction (Anderson & Yotov, 2016), we decide not to follow the formal model of selection proposed by Helpman, Melitz and Rubinstein (2008). Given the large number of fixed effects, we use the `ppml_panel_sg` STATA command (Larch, Wanner, Yotov, & Zylkin, 2017) and estimate the following equation:

$$FDI_{ps,t} = \exp[\beta_1 T_{sp,t} + \beta_2 D_{sp,t} + \beta_3 X_{sp,t} + \eta_{s,t} + \theta_{p,t} + \gamma_{sp}] + \epsilon_{s,t} \quad (11)$$

where $T_{sp,t}$ is a vector of tax rates or tax differentials, composed of *DirectTaxDistance* and its interaction terms; $D_{sp,t}$ is a vector of tax treaty dummies that describe the international tax network; and $X_{sp,t}$ is a vector of control variables, in our case only *BIT*. Finally, $\eta_{s,t}$ and $\theta_{p,t}$ denote the time-varying host-country, respectively home-country fixed effects, γ_{sp} captures country-pair fixed effects and $\epsilon_{s,t}$ is the Poisson error term. If the dependent variable is in levels, the coefficient can be interpreted analogous to a log-linear estimation. A unit increase in the regressor will lead to a $100(e^\beta - 1)$ percentage increase in the dependent variable.

Time varying, host- and home-country fixed effects control for the multilateral resistances as well as the economic mass of both countries. Similarly to Baier and Bergstrand (2007) and Anderson and Yotov (2016), we use country-pair fixed effects, as described by Wooldridge (2002), to address DTT endogeneity and control for the physical distance between the host and the home country.

In presence of FDI diversion via a third country, the bilateral FDI flows are not independent of each other. For a given capital stock, the availability of a shorter (cheaper) indirect route leads to lower FDI flows on the direct route and vice versa. Ideally, we want to observe what fraction of bilateral FDI flows is diverted via a conduit country to an ultimate host destination. However, the available FDI data do not allow for that degree of identification. Instead, we cluster our standard errors by total inward FDI of the host country.

We present our main results in Table 3. First, we replicate results of the prior literature in column (1), using just a *BIT* and a *Treaty* dummy, as well as the direct tax distance to measure the tax burden on FDI, alongside our host, home, and country-pair-fixed effects. All variables are statistically insignificant, and given the previous literature, this comes as no surprise.

The results change dramatically, once we replace the *Treaty* dummy with our measures of relevance in columns (2) - (6). Whilst the variables of the previous specification (1) remain insignificant, we now observe several interesting effects. Whereas the generic *Treaty* dummy did not have a statistically significant effect on bilateral FDI, this effect differs between *IrrelevantDomestic* and *RelevantDomestic* DTTs. As shown in column (2), only tax treaties that offer investors a financial advantage over the conditions under domestic law, i.e. reduce the direct tax distance, exhibit a statistically significant impact on bilateral FDI at the 5% significance level (*). A *RelevantDomestic* DTT increases FDI by about 16%, whilst *IrrelevantDomestic* DTTs show no effect.

The results of the dummies derived from the network analysis reveal an even more complex mechanism behind the effects of tax treaties on bilateral FDI. We allow for the possibility of treaty shopping in column (3) and find that among the group of *Relevant-Domestic* DTTs, only tax treaties that are also relevant against the network lead to more FDI (by almost 20%). Tax treaties can only have an impact on foreign investment if they reduce the tax burden with respect to the existing global network of double tax treaties, i.e when they are relevant. Any treaty between third countries can affect the relevance of a national treaty network, which implies that countries loose some of their capabilities to set tax policy due to treaty shopping. With fairly identical results between *StrictlyRelevant* and *WeaklyRelevant* dummies, column (4) suggests no difference between the impact of relevant tax treaties on the extensive and intensive margin.

Column (5) uncovers the importance of accounting for the potential costs to treaty shopping. The effects of tax treaties irrelevant in the network differ depending on the number of conduit countries needed to achieve the tax minimising indirect route. In particular, if a bilateral DTT is at the disadvantage of an indirect route with only one intermediate jurisdiction, *IrrelevantNetwork1*, this treaty shows no effect on home to host country FDI. It may very well be that a structure of one conduit is typical for the reference category (absence of a treaty), and thus this case cannot be distinguished from a case of an *IrrelevantNetwork1* treaty. Tax treaties that are at the disadvantage only against an indirect route with two intermediate jurisdictions show strongly significant positive effect on FDI.

Table 3: Regression results: effects of double tax treaties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>BIT</i>	-0.0116 (0.0777)	-0.0096 (0.0747)	-0.0074 (0.0742)	-0.0073 (0.0740)	-0.0046 (0.0742)	-0.0050 (0.0740)	-0.0004 (0.0727)
<i>DirectTaxDistance</i>	0.0415 (0.2153)	0.1549 (0.2175)	0.2490 (0.2267)	0.2483 (0.2322)	0.3242 (0.2191)	0.3295 (0.2235)	0.4284 (0.2451)
<i>Treaty</i>	0.0642 (0.0556)						
<i>IrrelevantDomestic</i>		-0.0025 (0.0541)	-0.0022 (0.0546)	-0.0023 (0.0542)	-0.0049 (0.0541)	-0.0045 (0.0538)	-0.0268 (0.0607)
<i>RelevantDomestic</i>		0.1457* (0.0578)					
<i>RelevantNetwork</i>			0.1788** (0.0635)		0.1709** (0.0621)		
<i>StrictlyRelevant</i>				0.1782** (0.0647)		0.1753** (0.0642)	0.3520** (0.0865)
<i>WeaklyRelevant</i>				0.1790** (0.0652)		0.1697** (0.0637)	0.1857** (0.0662)
<i>IrrelevantNetwork</i>			0.1136 (0.0606)	0.1137 (0.0614)			
<i>IrrelevantNetwork1</i>					0.0652 (0.0597)	0.0646 (0.0603)	0.1000 (0.0859)
<i>IrrelevantNetwork2</i>					0.2297** (0.0702)	0.2294** (0.0708)	0.4348** (0.1034)
<i>DTD*IrrDomestic</i>							0.1596 (0.3168)
<i>DTD*StrictlyRel</i>							-1.5468** (0.5358)
<i>DTD*WeaklyRel</i>							0.1193 (0.6367)
<i>DTD*IrrNetwork1</i>							-0.4285 (0.6606)
<i>DTD*IrrNetwork2</i>							-3.1217** (0.9745)
<i>Observations</i>	32,785	32,785	32,785	32,785	32,785	32,785	32,785
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9925	0.9926	0.9925	0.9925	0.9927	0.9927	0.9928

Note: Dependent variable: FDI (2005-2012). Robust clustered (by total inward FDI of the host country) standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

Structures that are complicated and costly may thus be avoided against a simpler direct route, once a DTT becomes available. While the coefficient of *IrrelevantNetwork2* is higher than the one of *RelevantNetwork*, this difference is statistically insignificant.

The results change when we disentangle the effects of tax treaties on the extensive and intensive margin by interacting our DTT dummies and the measure of bilateral taxes, *DirectTaxDistance*, in column (7). Here, the extensive margin, identified by the respective DTT dummy, should capture shifts of foreign direct investment from indirect routes to the now cheaper direct route. The intensive margin, identified by the interaction term, should capture an increase in FDI, as the tax burden has been lowered.

Finally, we disentangle the effect of DTTs along the extensive and the intensive margin. We do this with the introduction of interaction terms between our treaty dummies¹⁶ and the direct tax distance (*DTD*), column (7). The *StrictlyRelevant* and *WeaklyRelevant* treaty dummies remain statistically significant, as does the treaty dummy controlling for a cheaper route that involves two conduits. In particular, *WeaklyRelevant* DTTs increase FDI on the extensive margin by about 20%, whereas the effect is between 42% and 54% for *StrictlyRelevant* and *IrrelevantNetwork2* DTTs. In addition, we now observe a statistically significant coefficient for the interaction term of the direct tax distance with *StrictlyRelevant* and the *IrrelevantNetwork2* dummy. In these two cases, a new DTT would increase FDI both on the extensive margin as well as on the intensive margin. The interaction terms expose a further 8% and 9.5% increase in FDI for a 10 percentage points decrease for *StrictlyRelevant*, respectively *IrrelevantNetwork2* DTTs - an effect on the intensive margin. The coefficient on the latter interaction term is actually higher, as firms may tolerate slightly more expensive direct routes, but as the direct tax distance increases, they have a stronger incentive to reorganise their investment structure.

Overall, we believe that our results have shed some light on the so far empirically mixed results in the prior literature. Specifically, we are confident that our results highlight the importance of recognising the international tax system as a network and allowing for distinct effects of tax treaties through distinguishing their position in the network.

6 Robustness tests

Tables 4 to 8 report several robustness checks to gain additional insights and confirm our main results. In Table 4, we add two further variables to our analysis. Similarly to Hong (2017), we create a dummy variable that indicates if an indirect route exhibits a shorter tax distance than the direct route, labeled *NetworkConnection*. The use of a conduit obviously identifies treaty shopping and this is irrespective of a potential DTT between the home and the host country. If the indirect route is the cheapest one, we measure the reduction in the tax burden due to treaty shopping, *NetworkBenefit*. Noteworthy, *NetworkBenefit* measures the tax benefit in an international setting. In particular, MNEs face a complex investment

¹⁶We abbreviate irrelevant tax treaties by *Irr* in the interaction terms.

decision and the choice of the investment channel depends also on other non-tax factors. In this regard, *NetworkBenefit* captures the opportunity cost of not using the tax-preferred indirect path relative to a direct investment. If firms react to higher relative tax cost of investing directly from home to host country, we expect the bilateral FDI to decrease with the size of *NetworkBenefit*.

We extend each of our models (1) to (7) with the two network variables. The significant and negative coefficient of *NetworkConnection* in column (2) suggests that country-pairs with a cheaper indirect route have less immediate home to host country bilateral FDI. However, this effect disappears, once we acknowledge the relevance of DTTs in the network in columns (3) to (7). All of our main variables continue to show the same significance levels as before.

It may come as a surprise that the variables summarising the network do not turn out significant. However, since *NetworkConnection* measures the within country-pair variation over time due to a change in the shortest investment channel from a direct route to an indirect one, it captures just the opposite effect of our *StrictlyRelevant* and *WeaklyRelevant* dummies, but independent of a country-pair having a DTT or not. With this variable turning insignificant, once we account for the heterogeneous impact of tax treaties, we can actually confirm that the FDI increases due to *StrictlyRelevant* and *WeaklyRelevant* DTTs. Firms do not disinvest when an indirect route becomes cheaper, but increase investment following a *StrictlyRelevant* or *WeaklyRelevant* DTT. The fact that *NetworkBenefit* also turns out insignificant may be due to inertia, as the optimal route may often change, whereas firms will not tax optimise on a yearly basis.

We continue with the robustness tests in Tables 5 to 8 focusing on the full model presented in Table 3 column (5) and the model with interaction terms presented in Table 3 column (6). Each time, we present both models in columns (1) and (4) for the ease of comparing the results.

We conduct our initial tests clustering the standard errors by total inward FDI of the host country to address the concern that bilateral FDI flows are not independent between the country-pairs. Table 5, columns (2) and (5) show that clustering by total outward FDI of the home country yields fairly identical results. Whereas clustering by total outward FDI addresses our concern of dependent FDI flows between the country pairs, this is not true for clustering by country-pair. Nevertheless, we present those results in columns (3) and (6) and confirm all results.

As pointed out by Cheng and Wall (2005), “Fixed-effects estimations are sometimes criticised when applied to data pooled over consecutive years on the grounds that dependent and independent variables cannot fully adjust in a single year’s time.” (p.8). To address this concern, we follow Anderson and Yotov (2016) and estimate our model using either only the years 2005, 2007, 2009 and 2011, or only the years 2006, 2008, 2010 and 2012, which is comparable to the 3-years interval in Treffer (1993). We present these results in Table 6. While the results differ between the different intervals, especially the *StrictlyRelevant* dummy and its interaction term with *DirectTaxDistance* are consistently robust.

Table 4: Network variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>BIT</i>	-0.0093 (0.0775)	-0.0073 (0.0744)	-0.0075 (0.0741)	-0.0074 (0.0739)	-0.0047 (0.0741)	-0.0050 (0.0740)	-0.0006 (0.0728)
<i>DirectTaxDistance</i>	0.0632 (0.2869)	0.1442 (0.2903)	0.1394 (0.2896)	0.1342 (0.3286)	0.2291 (0.2799)	0.2408 (0.3160)	0.3830 (0.3412)
<i>Treaty</i>	0.0580 (0.0553)						
<i>IrrelevantDomestic</i>		-0.0104 (0.0538)	-0.0062 (0.0545)	-0.0063 (0.0542)	-0.0083 (0.0543)	-0.0081 (0.0540)	-0.0360 (0.0623)
<i>RelevantDomestic</i>		0.1425* (0.0568)					
<i>RelevantNetwork</i>			0.1664** (0.0646)		0.1604* (0.0641)		
<i>StrictlyRelevant</i>				0.1649** (0.0640)		0.1637** (0.0638)	0.3365** (0.0887)
<i>WeaklyRelevant</i>				0.1675* (0.0715)		0.1581* (0.0711)	0.1641* (0.0727)
<i>IrrelevantNetwork</i>			0.1259* (0.0621)	0.1259* (0.0621)			
<i>IrrelevantNetwork1</i>					0.0767 (0.0609)	0.0765 (0.0610)	0.1277 (0.0902)
<i>IrrelevantNetwork2</i>					0.2379** (0.0711)	0.2380** (0.0710)	0.4557** (0.1059)
<i>DTD*IrrDomestic</i>							0.2086 (0.3234)
<i>DTD*Dominant</i>							-1.4972** (0.5529)
<i>DTD*Neutral</i>							0.1026 (0.6397)
<i>DTD*IrrNetwork1</i>							-0.5699 (0.6821)
<i>DTD*IrrNetwork2</i>							-3.2327** (0.9846)
<i>NetworkConnection</i>	-0.0689 (0.0369)	-0.0732* (0.0368)	-0.0414 (0.0519)	-0.0405 (0.0573)	-0.0354 (0.0511)	-0.0371 (0.0567)	-0.0544 (0.0601)
<i>NetworkBenefit</i>	0.3393 (0.3183)	0.4266 (0.3066)	0.3640 (0.3277)	0.3668 (0.3379)	0.3111 (0.3213)	0.3049 (0.3299)	0.2820 (0.3466)
<i>Observations</i>	32,785	32,785	32,785	32,785	32,785	32,785	32,785
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9924	0.9925	0.9925	0.9925	0.9927	0.9927	0.9928

Note: Dependent variable: FDI (2005-2012). Robust clustered (by total inward FDI of the host country) standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

Table 5: Standard errors clustered by total host inward FDI: (1) and (4); total home outward FDI: (2) and (5); and country-pair: (3) and (6)

	(1)	(2)	(3)	(4)	(5)	(6)
<i>BIT</i>	-0.0050 (0.0740)	-0.0050 (0.0623)	-0.0050 (0.0915)	-0.0004 (0.0727)	-0.0004 (0.0625)	-0.0004 (0.0906)
<i>DirectTaxDistance</i>	0.3295 (0.2235)	0.3295 (0.2479)	0.3295 (0.3213)	0.4284 (0.2451)	0.4284 (0.2641)	0.4284 (0.3503)
<i>IrrelevantDomestic</i>	-0.0045 (0.0538)	-0.0045 (0.0661)	-0.0045 (0.0678)	-0.0268 (0.0607)	-0.0268 (0.0725)	-0.0268 (0.0792)
<i>StrictlyRelevant</i>	0.1753** (0.0642)	0.1753** (0.0651)	0.1753* (0.0768)	0.3520** (0.0865)	0.3520** (0.0887)	0.3520** (0.1078)
<i>WeaklyRelevant</i>	0.1697** (0.0637)	0.1697** (0.0639)	0.1697** (0.0658)	0.1857** (0.0662)	0.1857** (0.0722)	0.1857* (0.0773)
<i>IrrelevantNetwork1</i>	0.0646 (0.0603)	0.0646 (0.0613)	0.0646 (0.0769)	0.1000 (0.0859)	0.1000 (0.0891)	0.1000 (0.1187)
<i>IrrelevantNetwork2</i>	0.2294** (0.0708)	0.2294** (0.0747)	0.2294* (0.1109)	0.4348** (0.1034)	0.4348** (0.1002)	0.4348** (0.1550)
<i>DTD*IrrDomestic</i>				0.1596 (0.3168)	0.1596 (0.3303)	0.1596 (0.4608)
<i>DTD*Dominant</i>				-1.5468** (0.5358)	-1.5468** (0.4409)	-1.5468* (0.7646)
<i>DTD*Neutral</i>				0.1193 (0.6367)	0.1193 (0.6988)	0.1193 (0.8668)
<i>DTD*IrrNetwork1</i>				-0.4285 (0.6606)	-0.4285 (0.6834)	-0.4285 (0.8946)
<i>DTD*IrrNetwork2</i>				-3.1217** (0.9745)	-3.1217** (0.7613)	-3.1217* (1.3682)
<i>Observations</i>	32,785	32,785	32,785	32,785	32,785	32,785
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9927	0.9927	0.9927	0.9928	0.9928	0.9928

Note: Dependent variable: FDI (2005-2012). Robust clustered standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

Table 6: Intervals: from '05 (2) and (5); and from '06 (3) and (6)

	(1)	(2)	(3)	(4)	(5)	(6)
<i>BIT</i>	-0.0050 (0.0740)	0.0386 (0.1008)	-0.0467 (0.1122)	-0.0004 (0.0727)	0.0403 (0.0992)	-0.0399 (0.1098)
<i>DirectTaxDistance</i>	0.3295 (0.2235)	-0.0615 (0.3144)	0.7260* (0.2905)	0.4284 (0.2451)	0.0661 (0.3363)	0.8065* (0.3233)
<i>IrrelevantDomestic</i>	-0.0045 (0.0538)	0.0189 (0.0920)	-0.0198 (0.0564)	-0.0268 (0.0607)	-0.0100 (0.1053)	-0.0376 (0.0630)
<i>StrictlyRelevant</i>	0.1753** (0.0642)	0.1176 (0.1050)	0.2691** (0.0796)	0.3520** (0.0865)	0.3201* (0.1329)	0.4353** (0.1173)
<i>WeaklyRelevant</i>	0.1697** (0.0637)	0.1289 (0.0919)	0.2436** (0.0839)	0.1857** (0.0662)	0.1538 (0.1002)	0.2377** (0.0835)
<i>IrrelevantNetwork1</i>	0.0646 (0.0603)	0.0122 (0.0917)	0.1519 (0.0820)	0.1000 (0.0859)	-0.0434 (0.1206)	0.2392* (0.1121)
<i>IrrelevantNetwork2</i>	0.2294** (0.0708)	0.1561 (0.1224)	0.2962** (0.1077)	0.4348** (0.1034)	0.2991 (0.1829)	0.4346** (0.1560)
<i>DTD*IrrDomestic</i>				0.1596 (0.3168)	0.3045 (0.4485)	0.0448 (0.4468)
<i>DTD*Dominant</i>				-1.5468** (0.5358)	-1.5740* (0.6826)	-1.6764* (0.8437)
<i>DTD*Neutral</i>				0.1193 (0.6367)	-0.7298 (0.8598)	1.1918 (0.7639)
<i>DTD*IrrNetwork1</i>				-0.4285 (0.6606)	0.8514 (0.7789)	-1.3220 (0.8769)
<i>DTD*IrrNetwork2</i>				-3.1217** (0.9745)	-2.2510 (1.4541)	-1.9294 (1.6031)
<i>Observations</i>	32,785	15,665	15,746	32,785	15,665	15,746
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9927	0.9931	0.9933	0.9928	0.9932	0.9934

Note: Dependent variable: FDI (2005-2012). Robust clustered (by total inward FDI of the host country) standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

Because the PPML estimator does not allow for negative values of FDI stocks, we treat these observations as missing in our main model. Whilst negative FDI flows are economically meaningful and represent disinvestments in the host economy, negative FDI stocks are generally the consequence of accounting methods (Gouel, Guimbard, & Laborde, 2012). We confirm our results replacing the negative FDI stocks with a zero in Table 7 columns (2) and (5).

As explained by Braun and Weichenrieder (2015), firms may invest in tax havens not only because of low tax rates, but also for non-tax reasons, such as secrecy. Schjeldrup (2016) provides complementary reasons for the demand for secrecy by multinational enterprises. However, as pointed out by Van 't Riet and Lejour (2017) tax havens are not crucial in treaty shopping structures. Moreover, our set of time-varying host- and home-country fixed effects should capture any unobservable reasons to invest in tax haven jurisdictions. To confirm that our results are not biased by the presence of tax havens, we conduct a separate analysis excluding all tax havens. We present the results in Table 7, columns (3) and (6). Except for the model without interaction terms, all of our variables remain significant. On the whole, we conclude that our findings are robust to the presence of tax havens.

In all of our baseline estimations, we follow the standard practice in the empirical literature on the effects of DTTs and use FDI stocks as the dependent variable. In case there were a lot of inertia in foreign direct investment, changes in the treaty network might only affect new FDI, suggesting to use FDI flows instead. We do this by including one-year and two-year lagged FDI as a dependent variable in Table 8. In particular, we add one-year lagged FDI in columns (2) and (5) and two-year lagged FDI in columns (3) and (6) of Table 8 and continue to show robust results. Finally, the results hold also when including three-year and four-year lagged FDI.¹⁷

7 Conclusions

This paper has investigated the effects of taxes on foreign direct investment. Despite the growing number of contributions in the literature, the empirical evidence on the effects of double tax treaties on bilateral FDI has so far been inconclusive. This paper provides evidence that this may be due to the fact that many tax treaties are irrelevant. In order to avoid high host country withholding taxes on outgoing passive income, many multinational companies divert FDI via a third country with a more favourable tax treaty. Nevertheless, the vast majority of the existing literature treats DTTs as a binary variable, thereby ignoring their complexity and their domestic and international interactions. Our study addresses this gap in the literature and analyses the effects of double tax treaties allowing for treaty shopping and for a differential effect of DTTs. We differentiate DTTs with respect to their relevance in terms of reduction of the overall tax burden to or below the

¹⁷Results not presented in the paper.

Table 7: FDI sample zero (2) and (5); and Tax Havens (3) and (6)

	(1)	(2)	(3)	(4)	(5)	(6)
<i>BIT</i>	-0.0050 (0.0740)	0.0159 (0.0742)	-0.0111 (0.0783)	-0.0004 (0.0727)	0.0200 (0.0731)	-0.0073 (0.0767)
<i>DirectTaxDistance</i>	0.3295 (0.2235)	0.3305 (0.2231)	-0.1425 (0.3102)	0.4284 (0.2451)	0.4183* (0.2450)	0.3604 (0.3161)
<i>IrrelevantDomestic</i>	-0.0045 (0.0538)	-0.0031 (0.0538)	-0.0621 (0.0671)	-0.0268 (0.0607)	-0.0249 (0.0608)	-0.0541 (0.0817)
<i>StrictlyRelevant</i>	0.1753** (0.0642)	0.1780** (0.0642)	0.1298 (0.0765)	0.3520** (0.0865)	0.3456** (0.0863)	0.3604** (0.1116)
<i>WeaklyRelevant</i>	0.1697** (0.0637)	0.1720** (0.0636)	0.0911 (0.0707)	0.1857** (0.0662)	0.1828** (0.0661)	0.1739* (0.0836)
<i>IrrelevantNetwork1</i>	0.0646 (0.0603)	0.1680 (0.1603)	-0.0155 (0.0683)	0.1000 (0.0859)	0.0796 (0.0858)	0.1451 (0.1012)
<i>IrrelevantNetwork2</i>	0.2294** (0.0708)	0.2331** (0.0707)	-0.0220 (0.0704)	0.4348** (0.1034)	0.4310** (0.1039)	0.2730** (0.0958)
<i>DTD*IrrDomestic</i>				0.1596 (0.3168)	0.1626 (0.3166)	-0.0981 (0.3722)
<i>DTD*Dominant</i>				-1.5468** (0.5358)	-1.4771** (0.5364)	-1.7613** (0.5481)
<i>DTD*Neutral</i>				0.1193 (0.6367)	0.1690 (0.6286)	-0.3265 (0.6000)
<i>DTD*IrrNetwork1</i>				-0.4285 (0.6606)	-0.1214 (0.6635)	-1.7491** (0.7109)
<i>DTD*IrrNetwork2</i>				-3.1217** (0.9745)	-3.0341** (0.9992)	-3.5289** (0.8509)
<i>Observations</i>	32,785	33,455	22,515	32,785	33,455	22,515
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9927	0.9927	0.9944	0.9927	0.9928	0.9946

Note: Dependent variable: FDI (2005-2012). Robust clustered (by total inward FDI of the host country) standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

Table 8: Lagged FDI: one-year (2) and (5); and two-year (3) and (6)

	(1)	(2)	(3)	(4)	(5)	(6)
<i>BIT</i>	-0.0050 (0.0740)	-0.0259 (0.0773)	-0.0487 (0.0741)	-0.0004 (0.0727)	-0.0215 (0.0760)	-0.0499 (0.0736)
<i>DirectTaxDistance</i>	0.3295 (0.2235)	0.4441* (0.2264)	0.3974 (0.2478)	0.4284 (0.2451)	0.4852* (0.2449)	0.3876 (0.2613)
<i>IrrelevantDomestic</i>	-0.0045 (0.0538)	0.0231 (0.0543)	-0.0103 (0.0533)	-0.0268 (0.0607)	-0.0066 (0.0598)	-0.0332 (0.0576)
<i>StrictlyRelevant</i>	0.1753** (0.0642)	0.2326** (0.0745)	0.2032** (0.0743)	0.3520** (0.0865)	0.3944** (0.0947)	0.3549** (0.0982)
<i>WeaklyRelevant</i>	0.1697** (0.0637)	0.2208** (0.0768)	0.2099** (0.0679)	0.1857** (0.0662)	0.2178** (0.0750)	0.2312** (0.0690)
<i>IrrelevantNetwork1</i>	0.0646 (0.0603)	0.1226* (0.0740)	0.0889 (0.0696)	0.1000 (0.0859)	0.1453 (0.1013)	0.1036 (0.1092)
<i>IrrelevantNetwork2</i>	0.2294** (0.0708)	0.2022* (0.0943)	0.2351* (0.0945)	0.4348** (0.1034)	0.4108** (0.1278)	0.4906** (0.1241)
<i>DTD*IrrDomestic</i>				0.1596 (0.3168)	0.2660 (0.3196)	0.4419 (0.3231)
<i>DTD*Dominant</i>				-1.5468** (0.5358)	-1.4004* (0.5794)	-0.9765 (0.6631)
<i>DTD*Neutral</i>				0.1193 (0.6367)	0.8787 (0.7058)	0.1720 (0.7508)
<i>DTD*IrrNetwork1</i>				-0.4285 (0.6606)	-0.3352 (0.7650)	0.0395 (0.8395)
<i>DTD*IrrNetwork2</i>				-3.1217** (0.9745)	-3.0341** (1.1087)	-4.0042** (1.0958)
<i>LagFDI1year</i>		1.21e-06** (3.12e-07)	1.64e-06** (3.19e-07)		1.17e-06** (3.07e-07)	1.60e-06** (3.15e-07)
<i>LagFDI2years</i>			-1.01e-06* (3.96e-07)			-1.03e-06** (3.92e-07)
<i>Observations</i>	32,785	27,074	21,759	32,785	27,074	21,759
<i>Home-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Host-year FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Country-pair FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.9927	0.9936	0.9946	0.9928	0.9937	0.9947

Note: Dependent variable: FDI (2005-2012). Robust clustered (by total inward FDI of the host country) standard errors in parentheses. ** and * denote significance at the 1 and 5 percent confidence level.

one under domestic law and to and below the minimum one in the network. We define as irrelevant a DTT that will not provide investors with a financial benefit, and distinguish whether the indirect route involves one or more conduits.

Our main result is that only relevant DTTs will lead to an increase in direct bilateral FDI, and we can estimate the effect around 20%. Treaties that are irrelevant with respect to domestic law and treaties that are irrelevant with respect to an alternative indirect route that involves only one conduit do not alter direct bilateral FDI. We can attribute the latter result to the power of treaty shopping. Whereas the direct effective tax rate between two countries has no direct effect on direct bilateral FDI, we find that an increase in the tax burden will reduce FDI for strictly relevant DTTs. We can therefore distinguish an impact on the extensive margin as investors shift FDI from previously cheaper indirect routes to direct routes once a relevant DTT is in place, as well as an effect on the intensive margin, as a lower tax burden increases FDI if the direct route is cheapest.

We also observe both an extensive and an intensive effect on direct bilateral FDI in cases where the alternative involves two conduits and the indirect route is thus complicated and more costly. In this case, firms apparently prefer a slightly more expensive direct route. But a strong reaction to an increase in the tax burden indicates that firms will tolerate only modest premium.

We demonstrate that tax treaties can only impact foreign investment if they reduce the tax burden with respect to the existing global network of double tax treaties, i.e when they are relevant. Any treaty between third countries can affect the relevance of a national treaty network, which implies that countries lose some of their capabilities to set tax policy.

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