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$$\frac{n!}{(n-1)!} p^{m-1} (1-p)^{n-m} = p \sum_{\ell=0}^{n-1} \frac{\ell+1}{n} \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell}$$
$$= p \frac{n-1}{n} \sum_{\ell=0}^{n-1} \left[\frac{\ell}{n-1} + \frac{1}{n-1} \right] \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p^2 \frac{n-1}{n} +$$

$$\frac{\ell!}{(n-1)!} p^{m-1} (1-p)^{n-m} = p \sum_{\ell=0}^{n-1} \frac{\ell+1}{n} \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p \frac{n-1}{n} \sum_{\ell=0}^{n-1} \left[\frac{\ell}{n-1} + \frac{1}{n-1} \right] \frac{(n-1)!}{(n-1-\ell)! \ell!} p^{\ell} (1-p)^{n-1-\ell} = p^2 \frac{n-1}{n} +$$

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Bibliographic information:

Jansky P. and Laznicka J. (2019): "Tax Treaties Worldwide: Estimating Elasticities and Revenue Foregone" IES Working Papers 33/2019. IES FSV. Charles University.

This paper can be downloaded at: <http://ies.fsv.cuni.cz>

Tax Treaties Worldwide: Estimating Elasticities and Revenue Foregone

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November 2019

Abstract:

Much of the foreign direct investment worldwide is affected by one of more than 3000 bilateral tax treaties. There is an agreement that dividend and interest payments respond to these tax treaties' provisions, but evidence is scarce as to the magnitude of this response. We aim to fill in this gap for as many countries as possible by estimating the elasticities of dividend and interest income with respect to withholding tax rates, and the associated revenue foregone, exploiting the best available cross-country datasets. We collect information on withholding tax rates from the International Bureau of Fiscal Documentation; this includes information on EU directives, which imply zero withholding rates among all the EU member states and Switzerland, in addition to standard bilateral tax treaties. We combine this detailed information on withholding tax rates with foreign direct investment data from the International Monetary Fund, which we use to approximate bilateral dividend and interest flows; this results in a large panel data set of around 65,000 annual country-pair observations. While also observing heterogeneity in elasticities across countries, we estimate dividend flows to be highly elastic in a cross-country regression: a 1% increase in the applicable withholding tax is associated with a 2.3% - 2.6% decrease in dividend flows. We apply the elasticities to estimate potential tax revenue foregone. We estimate the largest annual revenue foregone for the United States (2.3 - 2.9 billion USD) and Canada (1.4 - 3.2 billion USD), while the investor country behind the largest revenue foregone is the Netherlands (2.9 - 3.3 billion USD). We arrive at somewhat lower and less robust estimates for interest income. Although our headline revenue estimates are, as expected, lower than static estimates that do not reflect elasticities, we nevertheless show that the revenue foregone of tax treaties remain non-negligible for some countries.

JEL: F21, F23, H25, H26, H32

Keywords: Foreign direct investment, multinational enterprise, tax treaty, double taxation agreement, elasticity, withholding tax

Acknowledgements: We are grateful for useful related discussions and comments on earlier versions of this research from Martin Hearson, Tomáš Křehlík, Jan Loeprick, Markus Meinzer, Miroslav Palanský, Kunka Petkova, Andrzej Stasio, Marek Šedivý and Martin Zagler. Both authors acknowledge support from Czech Science Foundation (P403/18-21011S) and Petr Janský acknowledges the support from the Charles University Research Centre program (UNCE/HUM/035).

1 Introduction

Tax is the most important source of government revenue for countries worldwide; when tax is avoided less money is available for public expenditures such as education and health. There are various means available to multinational enterprises (MNEs) by which they may avoid paying taxes on their profits; these can be grouped into three general types according to the level at which the taxes are avoided. The first type, perhaps the best documented by economists, is known as profit shifting: MNEs can shift their profits – via transfer pricing, debt shifting or strategic location of intellectual property – from the country of operation to another country, in some cases a tax haven, to reduce their tax base for corporate income tax (this has recently been documented by, for example, Dharmapala, 2014, Dowd, Landefeld, & Moore, 2017, or Tørsløv, Wier, & Zucman, 2018). Second, on the profits remaining in the country of operation after any such profit shifting, MNEs can lower the effective corporate income tax rate applicable to them by, for example, increasing tax deductibles or reaching an advantageous tax agreement with the tax authority (as in the case of LuxLeaks, e.g. ICIJ, 2014, Huesecken & Overesch, 2015). The withholding tax rates on dividend and interest income are often reduced from the standard levels given in domestic law by tax treaties or double taxation agreements signed between particular pairs of countries. This paper looks at the elasticity of these income flows to withholding taxation and their government revenue implications.

There is an ongoing research discussion focused on the extent to which tax treaties accomplish one of their stated objectives, namely supporting cross-border investment, which has no conclusive outcome yet. What is certain is that tax treaties lead to lower withholding tax rates on dividends and interest payments, and that MNEs exploit this in order to avoid such taxes. This practice lowers government revenues from these taxes worldwide. There are now more than 3000 bilateral tax treaties, but little is known about the scale of potential tax revenue foregone associated with the lower taxation they facilitate. What little is known is mostly based on static estimates, which unrealistically assume that dividends and interest payments are not influenced by the tax treaties. In this paper we overturn this assumption by estimating the extent to which dividend and interest flows react to changes in withholding rates, and we reflect these elasticities in new estimates of potential tax revenue foregone.

Our two main research questions are: first, what the elasticities of withholding tax rates are on dividends and interests and, second, what the revenue foregone of tax treaties are. We aim to answer these questions for as many countries as possible by exploiting the best available cross-country datasets: we use data from the International Monetary Fund (IMF) to approximate bilateral dividend and interest flows and combine them with detailed information on withholding tax rates from the International Bureau of Fiscal Documentation (IBFD). By answering these questions for as many countries as possible we hope to contribute to the rapidly developing economics literature on tax treaties. As far as we know, the only existing rigorous, in-depth study of both elasticities and tax treaties is for a single country, Ukraine (Balabushko, Beer, Loeprick, & Vallada, 2017). We build our empirical model on the basis of that work and add our cross-country estimates to the results for Ukraine. While it is not possible to achieve such rigorous, comparable estimates for many other countries due to the unavailability of sufficiently detailed data, we aim to provide as rigorous estimates as possible for a large number of countries. Indeed, our objective in this paper is to estimate elasticity of dividend and interest taxation and the revenue foregone of tax treaties for as many countries as possible.

The two existing studies that have calculated cross-country estimates of potential revenue foregone have both focused on developing countries. Beer & Loeprick (2018) find that for 41 African countries between 1985 and 2015 signing treaties with investment hubs was associated with nonnegligible revenue foregone, but not associated with additional investments. Their unique empirical strategy exploits a

difference-in-difference framework and the role of Mauritius, which is a tax treaty hub that has treaties with only some of the sub-Saharan African countries. They suggest that treaty shopping – the practice of MNEs diverting cross-border payments through the country with the lowest withholding tax rate - drives some of the observed flows and we believe that the same is true in our data, although we are not able to investigate empirically which of the estimated foregone result from treaty shopping. In contrast to Beer & Loeprick’s focus on sub-Saharan Africa, we cover as many countries worldwide as have available data. While they evaluate both costs and benefits, our sole focus is on the tax revenue costs (or revenue foregone, which we use interchangeably in this paper). While they do not present country-level estimates, we do; providing information about the most costly bilateral tax treaty relationships might empower regulators in the affected countries. This could influence cooperative bargaining with the investor country and could result in higher tax rates, in particular if the FDI relationship is asymmetric, as suggested by earlier studies for US and OECD tax treaties (Chisik & Davies, 2004a) and for German tax treaties (Rixen & Schwarz, 2009).

Another recent cross-country study has identified non-negligible revenue costs for a sample of developing countries. Janský & Šedivý (2019) find that among 14 developing countries in sub-Saharan Africa and Asia the highest potential tax revenue foregone are within hundreds of millions USD and around 0.1% of GDP, with the Philippines incurring the highest revenue foregone both in USD and relative to GDP. Indeed, some countries in these regions are beginning to realise how costly tax treaties can be and the authorities there are taking action: one well-documented case is the government of Mongolia’s cancellation of the Netherlands-Mongolia tax treaty in 2014 (Redhead & Mihalyi, 2018) and, more recently, Kenya’s High Court annulled its tax treaty with Mauritius (Fitzgibbon, 2019, Hearson, 2019). Janský & Šedivý (2019) further find that a vast majority of the revenue foregone are due to dividends rather than interests and that only four investor countries - Japan, Netherlands, Switzerland, and Singapore – are responsible for the majority of the revenue foregone. While they acknowledge that their results are likely overestimates, because they assume that FDI is not influenced by the existence of tax treaties, we explicitly control for this effect by estimating and reflecting the elasticities.

Six other studies have provided potential revenue cost estimates for single tax treaty partners individually; most of these have been developed countries. Weyzig (2013) and McGauran (2013) with colleague Fernandez provide estimates for the Netherlands, while the IMF (2014) and Van de Poel (2016) study the case of Belgium and the United States, respectively. Only two single-country studies deal with non-members of the OECD: ActionAid (2016) for Bangladesh and the above-mentioned study by Balabushko, Beer, Loeprick, & Vallada (2017) for Ukraine. With the exception of this last one, none of the other studies estimate or use elasticities for their revenue estimates. A further set of single-country studies have provided useful discussions of tax treaties without any revenue estimates at all, such as Bürgi & Meyer (2013) for Switzerland, IBFD (2013) for the Netherlands, Kusters, Kool, Groenewegen, Weyzig, & Bardadin (2015) for Ireland. By estimating country-level potential revenue foregone due to tax avoidance and foreign direct investment for numerous countries worldwide, we join other recent studies - such as UNCTAD (2015), Janský & Palanský (forthcoming), Crivelli et al. (2016), Cobham & Janský (2018), Clausing (2016), Johansson, Skeie, Sorbe, & Menon (2017), Tørsløv, Wier, & Zucman (2018), Cobham & Janský (2019) - that have done so for corporate income tax rather than withholding tax as we do here for the first time.

We focus only on the costs of tax treaties, specifically government tax revenue costs. However, its focus relates also to existing research on their benefits, or on both benefits and costs, which we now briefly discuss. There is a relatively well-developed literature on what, if any, the benefits of tax treaties are in terms of increased FDI, but the evidence is inconclusive. Some papers suggest tax treaties have a positive impact on FDI - e.g. Neumayer (2007), Barthel, Busse, & Neumayer (2010), Egger & Merlo (2011) or

Blonigen, Oldenski, & Sly, 2014 - whereas other do not find much support for this - e.g. Blonigen & Davies (2002), Hallward-Driemeier (2003), Blonigen & Davies (2004), Egger, Larch, Pfaffermayr, & Winner (2006), Coupé, Orlova, & Skiba (2009), Baker (2014), with Davies (2004) providing an earlier overview. In a recent addition to this discussion, van 't Riet & Lejour (2018) consider international corporate tax system a network and estimate how MNEs repatriating profits can minimise their taxes (including corporate income tax rates, withholding taxes on dividends, double tax treaties, as well as double taxation relief methods). They find that treaty shopping leads to an average potential reduction of the tax burden on repatriated dividends of about 6% points and find the UK, Luxembourg, and the Netherlands to be the most important conduit countries. In a paper that extends the approach of van 't Riet & Lejour (2018) and another paper treating tax treaties as a network by Hong (2018), Petkova, Stasio, & Zagler (2018) differentiate between relevant, neutral and irrelevant tax treaties according to whether they offer investors a financial advantage or not. They find that only relevant and neutral tax treaties increase bilateral FDI, whereas irrelevant ones do not. They quantify the increase in FDI due to a relevant tax treaty at around 22% and they argue that significant tax reductions due to treaty benefits will lead to an increase in FDI.

The recent study by Beer & Loeprick (2018) discussed above is another recent addition to this more general research area on the effects of tax treaties, and finds no effect on FDI. Furthermore, Beer & Loeprick (2018) speculate that the inconclusive empirical findings on the importance of tax treaties for FDI might be partly due to a secondary role that tax plays in FDI decisions and due to MNEs pursuing a variety of strategies (Carr, Markusen, & Maskus, 2001, Bergstrand & Egger, 2007), including between those making greenfield investments and mergers and acquisitions (Head & Ries, 2008). While Chisik & Davies (2004b) provide a model-based explanation for the decreasing trends in withholding tax rates under tax treaties, a more recent contribution by Azémar & Dharmapala (2019) finds that so-called tax sparing provisions (which aim to prevent host country tax incentives being nullified by residence country taxation and which have been studied in the past, for example, by Azémar, Desbordes, & Mucchielli, 2007) in tax treaties are associated with up to 97 % higher FDI. Since we are not able to provide new evidence to answer this question conclusively, we do not explicitly address the question of the benefits of tax treaties for increased FDI; we focus instead only on elasticities and revenue foregone.

Another more general body of literature to which our paper relates is the extensive literature on dividend taxation. The various theories of dividend taxation, reviewed and extended e.g. by Chetty & Saez (2010), produce differing predictions of elasticity and associated efficiency costs, including two traditional views – positive elasticity and thus non-zero efficiency costs in the so-called old view and zero elasticity and no efficiency costs in the so-called new view. Based on the new view of dividend taxation, Hartmann and Sinn's theoretical result (Hartman, 1985, Sinn, 1993) implies that tax is neutral and that investors have the same preferences for the shares of repatriated and reinvested profits regardless the scale of withholding taxes on dividends. In practice there might be non-tax preferences for distributed rather than reinvested earnings. As Griffith, Hines Jr, & Sørensen (2010, p. 958) sum up, if the new view of dividend taxation is correct, the repatriation taxes collected under existing systems of worldwide corporate income taxes are essentially lump-sum taxes, generating revenue at zero efficiency cost, while if the old view comes closer to the truth, the revenue comes at the cost of distortions to foreign investment and repatriations. From other, one-country theories, it is not straightforward to draw implications for our international setting with many countries, but most existing studies on tax treaties, including our present contribution, seem to be carried out in line with the old view and suggest that the elasticities are mostly positive and therefore that there are efficiency costs associated with these taxes. Also, the related empirical literature focuses on individual countries: while earlier studies (Poterba & Summers, 1984, Poterba, 2004) use observational approach similar to our cross-country analysis, more recent studies (Chetty & Saez, 2005, Yagan, 2015) use more credible quasi-experimental research

designs (similar as recently applied for tax treaties by Beer & Loeprick, 2018). While we do not use a quasi-experimental research design, we rely on the best available data and exploit variation across countries and over years to estimate elasticities for many countries.

None of the reviewed tax treaty studies have so far estimated elasticities and revenues for many countries worldwide; we aim to fill a gap by doing so. We contribute to the literatures on withholding tax elasticities and the revenue foregone of tax treaties and, more generally, to the literature on the effects of tax treaties and tax policies on FDI and government revenues (Paolini et al., 2016, Hearson, 2016). Our paper is novel in three aspects, each of which represents one stage in our empirical analysis. First, we create the largest and most detailed dataset of bilateral FDI flows and related withholding tax rates, both domestic and those detailed in tax treaties. In addition to tax treaties we include the effects of the EU's Parent-Subsidiary and Interest and Royalties Directives, which effectively imply zero withholding rates among all the EU member states and Switzerland, a group of countries for which we reveal the estimated related revenue foregone due to these directives to be substantial.

The second and perhaps most important novel aspect of our paper is that we use the detailed data set to estimate the withholding tax rate elasticities of dividend and interest flows. The economic theory and most existing literature agrees that dividend and interest payments respond to tax treaties' provisions, but the evidence is scarce on the magnitude of this response and we expand that substantially. For example, we estimate dividend flows to be highly elastic: a 1% increase in the applicable withholding tax is associated with their decrease by 2.3% - 2.6%. And, finally, we estimate the potential revenue costs of withholding tax rates included in tax treaties for the largest set of countries around the world so far. For example, for dividends we estimate the largest annual revenue foregone for the United States and Canada, while the investor country behind the largest revenue foregone is the Netherlands. We incorporate the estimated elasticities into the calculations of our headline revenue foregone estimates, which are substantially lower than static estimates that do not reflect the elasticities, underscoring the importance of using elasticities. We thus provide estimates of potential tax revenue foregone due to dividend and interest outflows for the largest sample of countries so far.

The rest of the paper is structured as follows. In section 2 we describe the data sources, the creation of our final data set and its limitations. In section 3 we outline the methodology that we use for estimating the elasticities and revenue effects. In section 4 we present our results. The final section concludes with lessons for policy makers and further research.

2 Data

We now describe the data needed for our estimations of elasticities and revenue costs. To obtain estimates for as many countries as possible, we aim to have a panel dataset that covers bilateral dividend and interest flows as comprehensively as possible, together with bilateral withholding tax rates on these types of income. To create such a data set we combine multiple sources, each of which offers the best available information of its kind. We primarily rely on the IBFD for tax rates and the IMF for financial flows.

The IBFD contains rich information on country-pair-specific tax rates set in tax treaties. We collect information about the tax treaties' withholding tax rates for dividends and interest (using the rate applicable for qualifying companies, when distinct from the portfolio investment tax rate) as well as the domestic withholding rates used when no tax treaty is in place between a given pair of countries. There are many tables available from the IBFD and sometimes there is more than one potentially applicable tax rate; in these cases we follow the additional information available in notes to the tables and economic logic to choose the most suitable rate. For example, when there is more than one table with tax rates available for a given year and country, we use the one applicable for the largest part of the year in case

various versions of the treaties were in force during that year, otherwise we use the one with the earliest effective date as likely the most representative for the given year. The data includes 176 source countries and more than 200 recipient countries. While the data are available for the years between 2008 and 2017 for most countries, the coverage of countries differs across years and so the final data set is unbalanced.

There are additional sources of information on withholding rates and we use these to make adjustments. A case in point are the special rules that apply to withholding rates due to the EU's Parent-Subsidiary and Interest and Royalties Directives. Companies are exempt from paying withholding taxes on dividends, interest and royalties, when both the country of residence of the distributing company and the country of residence of the recipient are members of the EU (let us note that we consider the United Kingdom to be an EU member state throughout this paper) or Switzerland and when other conditions are met (mainly owning a sizable stake in the dividend or interest distributing company). We thus input a 0% domestic rate for all pairs in which both the source and recipient countries are EU member states or Switzerland and in doing so we assume that all the dividend and interest flows qualify for these directives. We thus consider the EU directives in the same way as tax treaties and, in our empirical analysis, we estimate their joint effects. For other country pairs we use the applicable rates from the IBFD tables or notes to them, as well as accountancy firms' reports by PwC (2017), Deloitte (2017) and KPMG (2016).

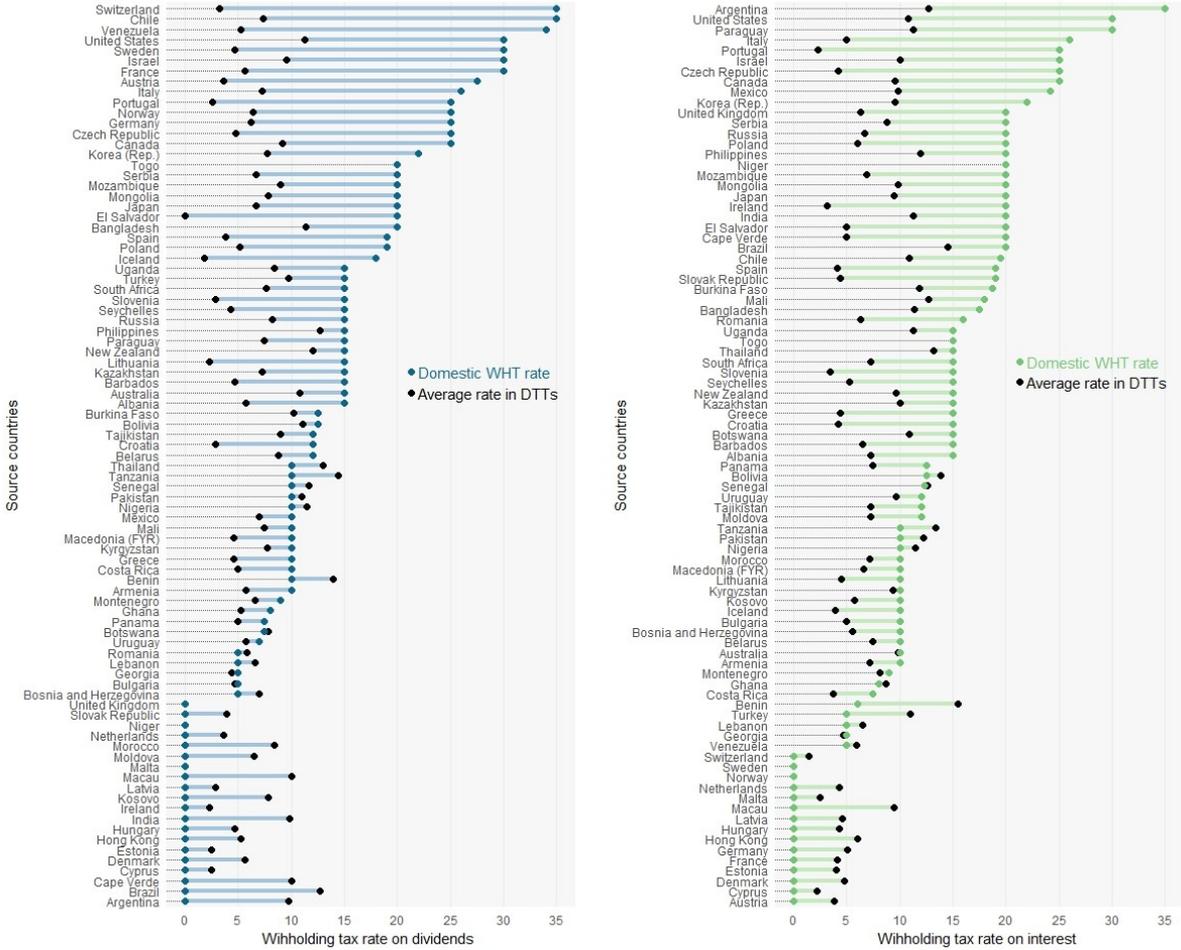
When the IBFD presents multiple rates, we do our best to choose the most suitable tax rate. Our approach differs depending on whether these withholding tax rates are from the country-specific domestic law (there are not so many of these cases, and there are alternative sources of data on them) or from country-pair-specific tax treaties (there are many more of these cases and no comparable sources, perhaps with the exception of some from accountancy firms such as PwC (2018), which covers 155 countries in comparison with the IBFD's 215 countries). We discuss these two separately. For country-specific domestic law, we check the IBFD information on the applicable rates in the absence of tax treaties against PwC (2017), Deloitte (2017) and KPMG (2016) one by one. When we find a difference, we study it in more detail and adjust the rate if we deem it necessary on the basis of the available information (i.e. another rate likely covers the majority of dividend or interest outflows). When we are not able to choose one rate in the absence of tax treaties, we create an average of the most likely rates and use this average as the rate for our estimations.

Similarly, the IBFD also presents multiple rates for many tax treaties. Since checking the tax treaties thoroughly one by one is almost impossible due to the amount of information they contain (there are 185,545 observations on withholding tax rates, which we reduce to 65,199 after combining with IMF data as we describe below), we consider all the tax treaty rates available in the IBFD. From these rates we create three different versions of our data set: first a set using the lowest withholding tax rate (minimum), second a set using the average of all withholding tax rates (average) and third a set using the highest rate (maximum) automatically selected from the available rates for every pair of countries. This leads to three sets of estimates but seems to be the most appropriate approach and also a way of checking the robustness of the results. The three versions of the data set are represented in histograms of dividend and interest withholding tax rates in Figures A1 and A2 in the Appendix, respectively. The differences in the distribution of tax rates across the three datasets seem to warrant the use of all three of them but are generally not large. Therefore, we present some results for all three versions as a robustness check, but when we do not specify otherwise, we use the average ones in our headline results.

Tax treaty rates are usually lower than domestic ones and the average differences are large for some countries. Figure 1 shows a comparison of domestic and average tax treaty withholding tax rates on dividends and interest, in the left and right panels, respectively, for the most recent year. The domestic rates on dividends range from 0% to 35%. Switzerland and Chile have the highest rates, but their average

tax treaty rates are much lower at below 10% (for Switzerland this is driven down by the EU’s directives, as discussed above). On the other hand, a few countries have their domestic rate set to 0%, e.g. India, Cyprus, the United Kingdom. The highest average tax treaty rates are in Brazil, New Zealand, the Philippines or Thailand, ranging between 12% and 15% (while the USA’s average is also above 10%). As expected, due to the EU directives the tax treaty averages are low for many EU member states; they are also low for Georgia, Macedonia, Panama, the Seychelles and Venezuela. The picture is generally quite similar for interest, but the specific countries’ tax rates differ relatively as well as absolutely. For example, the highest domestic rate related to interest is in Argentina at 35%, followed by the USA and Paraguay with 30%. Also, for both dividends and interest Figure 1 shows that in a minority of cases the tax rate stipulated in a tax treaty is higher than the otherwise applicable one. This might be due to reductions in domestic rates in recent years while the original tax treaty rates remain in place. In these cases, we use the lower, domestically legislated, rate instead of the tax treaty rate for our follow-up estimations, as that lower rate is the tax rate applied in practice.

Figure 1. Domestic and average tax treaty withholding tax rates on dividends and interest, the most recent year



Source: Authors on the basis of the IBCD and other data sources.

For our objective of estimating dividend and interest elasticities, it is important to have changes in the rates in the data. Figures A3 and A4 in the Appendix show the countries ranked by the number of changes in the applicable withholding rates on dividends and interest, respectively, from the perspective of source countries. In each of the figures, the left panel shows countries that experienced changes in

domestic and possibly also tax treaty rates, whereas the right panel shows countries that experienced changes only in tax treaty rates. The differences between these two groups are substantial. Using the example of dividends, Iceland, a country with certain development in the domestic withholding tax rate on dividends, exhibits more than 275 changes in dividend rate in our sample. The country with the most changes without any development in its domestic rate in our sample is Korea, with more than 25 changes. These graphs show us how resetting the domestic rate may be projected into the actual applicable rates for numerous partner countries. However, large numbers of changes might not actually affect dividend flows that much, as partners with tax treaties in force might remain subject to the same lower rates as before the change and, frequently, those partner countries might be those with large FDI stocks in the source country. Their position thus remains often unchanged. A similar observation and logic apply in the case of interest. Altogether, the extent of changes to withholding tax rates over time seems to be satisfactory for the purposes of our analysis.

The IMF provides information on foreign direct investment payments and stocks in its Balance of Payments (BoP) and the Coordinated Direct Investment Survey (CDIS), respectively. The IMF's BoP includes country-level information on dividend and interest outflows from foreign direct investment by a recipient country (i.e. investor) in a source country (i.e. location of investment). From the IMF's CDIS we use information for stocks of inward foreign direct investment at the country-pair-level. We use these two sources together to estimate bilateral dividend and interest flows, since neither IMF nor other sources include this information at the bilateral level for many countries worldwide. For each country we compute the share of FDI stock it receives from all its investor countries and we use this share to divide the unilateral dividend and interest outflows into bilateral ones. In doing this we assume, similarly to Janský & Šedivý (2019), that the dividend and interest outflows from a source country to an investor country are proportional to the FDI stock of that investor country in the source country. This assumption is an important one and the approximation will not reflect reality perfectly (FDI income differs according to origin country as shown, for example, by Bolwijn, Casella, & Rigo, 2018), but in the absence of observed bilateral dividend and interest flows, we see this approximation with bilateral FDI stocks as the most reasonable approach. We thus arrive at a large cross-country panel data set of bilateral withholding tax rates and bilateral dividend and interest flows, which amounts to 65,199 country-pair-year observations, with 87 source and 188 recipient countries for the years 2009 - 2016.

The data set thus created is the largest data set obtainable for estimation of withholding tax elasticities and tax treaty revenue costs. Still, the data set has its limitations, many of them shared with other FDI datasets, discussed recently, for example, by Haberly & Wójcik (2015), Blanchard & Acalin, (2016), Damgaard & Elkjaer (2017), or Casella (2019). The IMF data on FDI provides the best cross-country information of its kind, but these data are not available at all for some countries, or are only partially available for example due to confidential reasons; this means that our estimates are lower bound estimates of overall worldwide potential revenue foregone since we are not able to provide estimates for all country pairs. Furthermore, we focus only on dividend and interest income and we do not include other FDI incomes, such as those related to royalties or capital gains, which are also affected by tax treaties, but for which there is no comparable FDI income data. A case in point is Zain's indirect sale of various assets in Africa – discussed in a draft toolkit by the Platform for Collaboration on Tax (2017) – the revenue costs at stake are large and affected by tax treaties, but not reflected in our paper's estimates due to the unavailability of suitable data.

Another important characteristic and limitation of the FDI data is that we only have information about the immediate investor, whose tax treaties apply. As described in detail in the Coordinated Direct Investment Survey Guide (2015) and the Benchmark Definition of Foreign Direct Investment (2008), IMF uses the immediate investor approach to create its data. This implies that we are not able to distinguish conduit investor countries from countries where investments originate. Due to the nature of

the data, we are not able to shed much light on mapping the phenomenon of treaty shopping, in which companies adjust their FDI and ownership structures as to avoid taxes.¹ Relatedly, the IMF data do not include decomposition into income attributed to special purpose entities and pass-throughs (Benchmark Definition of Foreign Direct Investment, 2008), which could provide an indication of treaty shopping. In contrast, Weyzig (2013) exploits the detailed Dutch data for special purpose entities and, more recently, Petkova, Stasio, & Zagler (2018) explicitly account for treaty shopping and calculate the shortest tax distance between any two countries, allowing corporate income to be channelled through intermediate jurisdictions. Also, Mintz and Weichenrieder (2010) and Lejour (2014) include empirical analysis related to treaty shopping. Furthermore, so called round-tripping might lead to overestimation of FDI flows (Ledyeva et al, 2015). More generally, Haberly and Wójcik (2015) question the representativity of the FDI data and argue that rather than being a robust indicator the data can be considered representative within an order of magnitude. While we are aware of these limitations, we use this data since there are no better data of a similar kind available. As a result, rather than precise quantifications, we consider our results to be estimates of the effects of tax treaties.

3 Methodology

We now explain the methodological approach that we apply to the data set in order to shed more light on foreign direct investment and tax treaties. We estimate the withholding tax rate elasticities of dividend and interest outflows, which enables us to observe differences in the elasticities for different source countries worldwide. We then calculate potential tax revenue foregone arising from tax treaties for the source countries in our dataset, incorporating the elasticities' estimates into the calculation.

A gravity equation is one general way to think about the framework for estimating the withholding tax rate elasticities of dividend and interest outflows. Gravity equations in economics have been used most intensively in international trade in goods, but their uses go well beyond this, including doing a good job fitting stocks of FDI, as discussed in a recent review by Head & Mayer (2014). Their first definition of a gravity equation of bilateral trade for our case of FDI and dividend and interest outflows is:

$$X_{ij} = GS_j M_i \phi_{ij}$$

where X_{ij} is the dependent variable, the outflow of dividends (or interest) from source country i to recipient country j . S_j represents the capabilities of source country j that are relevant to all investor countries (e.g. its GDP). M_i captures all the characteristics of investor country i that affect dividends from all source countries. Bilateral accessibility of source country i to investor country j is captured by $0 \leq \phi_{ij} \leq 1$, which captures the characteristics specific to these countries including, importantly, the withholding rates implied by their tax treaties. Lastly, G can be termed the gravitational constant, which is however held constant only in the cross-section and this can be linked to the inclusion of time dummies, which are the same across countries, but differ over years. While we base our methodology on this gravity equation, our particular specification is based on a recent paper by Balabushko, Beer, Loeprick, & Vallada (2017), who estimate a similar equation for Ukraine, which we now adopt for our cross-country analysis.

¹ We do capture the effects of treaty shopping in our estimates, but we are not able to distinguish it from other factors. In other words, we are not able to capture the counterfactual FDI relationship that would be in place without treaties or treaty shopping: for example, we may observe the Netherlands-US FDI relationship in the data, while the underlying relationship might be actually between Germany and the US, with the Netherlands serving as a treaty shopping intermediary. Unfortunately, we are not able to control for these directly unobserved relationships or approximate the potential effects this might have on our estimates.

We estimate the following equation:

$$\begin{aligned} \log(\text{dividend outflow})_{ijt} & \\ &= \alpha + \beta_1 \text{dividend rate}_{ijt} + \beta_2 d_{ijt} + \beta_3 (\text{dividend rate}_{ijt} \times \text{source dummies}) \\ &+ \gamma \text{Year} + \delta \text{FE} + e_{ijt} \end{aligned}$$

where the left-hand side is the logarithm of dividend (we construct an equivalent equation for interest) outflow from source country i to recipient country j in year t . β_1 is the coefficient of main interest, the withholding tax elasticity of dividends. In line with Balabushko, Beer, Loeprick, & Vallada (2017), the logic behind the inclusion of variable d , the weighted average of withholding tax rates with other partner countries, is that an increase in withholding tax rates with other partners should re-route some dividend flows through the given partner country. The term β_3 represents the coefficient for interaction terms between the dividend rate and country source dummies and it captures the differences between effects on various source countries. In line with economic logic, we expect the coefficients to be negative for β_1 , positive for β_2 and varied for β_3 . The model also includes year dummy variables and various sets of fixed effects, depicted by FE , e_{ijt} then stands for the error term. The interpretation of the estimation results is standard for a log-linear regression model: a 1% increase in applicable withholding tax rate on dividends results in a $((\beta_1 + \beta_3) \times 100)\%$ change in dividend outflows.

There might not be enough variation in the data set to estimate source-country-specific elasticities for every single source country. To obtain relevant elasticity estimates for these source countries, we estimate a slightly simplified regression model, which is not so data-demanding. While all countries are included in this model, it does not result in source-country-specific estimates but in one elasticity estimate for all countries. Specifically, we estimate the above equation without the term $\beta_3(\text{dividend rate}_{ijt} \times \text{source dummies})$ and therefore the equation has the following form:

$$\log(\text{dividend outflow})_{ijt} = \alpha + \beta_1 \text{dividend rate}_{ijt} + \beta_2 d_{ijt} + \gamma \text{Year} + \delta \text{FE} + e_{ijt}$$

The interpretation is slightly different: a 1% increase in the applicable withholding tax rate on dividends results in a $(\beta_1 \times 100)\%$ change in dividend outflows. For the source countries, for which we cannot estimate the original equation and thus obtain a country-specific elasticity estimate, this adjusted equation provides a proxy, which we employ in the potential revenue foregone estimates below.

The specific equations we estimate differ by the fixed effects used, and the existing literature provides some guidance on the most appropriate selection of these, as summarised by Bergstrand & Egger (2013). For example, Mátyás (1997) proposes using separate, in our case, source, investor, and time fixed effects, while Cheng & Wall (2004) prefer country-pair fixed effects to take care of unobserved heterogeneity within pairs of countries. Baltagi, Egger, & Pfaffermayr (2003) add fixed exporter-year and importer-year effects to the country-pair fixed effects and this specification seems to suit our case best. We are estimating our gravity equation on panel data, which calls for the use of time-varying country-effects capturing time-variant determinants such as GDP. Moreover, we need to leave our country-pair effects without a time dimension, allowing us to input bilateral tax rate variables into our model. So, we use exporter-year, importer-year and country-pair fixed effects in the preferred specification. In addition, we run other regressions to check the robustness of the results to the choice of specification. These include, for example, interactions with the World Bank's region and income group dummies to test for any differences between these broader groups of countries.

We use the Poisson pseudo-maximum-likelihood (PPML) method as the preferred method to estimate the equation, in contrast with the ordinary least squares (OLS). PPML, applied recently in the tax treaty context by Braun & Zagler (2018), helps us address the issue of a large number of zeros in the observations of our dependent variable, the outflow of dividends or interest. Since we want to interpret

our results as elasticities, the standard way to do this is to use logarithms of our dependent variable. However, this would mean dropping all our zero flows and it is very probable, that the zeros in our sample are not randomly distributed and that they contain valuable information. PPML enables us to use the dependent variable in non-linear form and still interpret the coefficients as elasticities. Furthermore, Silva & Tenreyro (2006) show that under heteroscedasticity, common in panel data such as ours, OLS leads to biased estimates and PPML outperforms this classic approach.

In the second part of our empirical analysis we estimate the potential tax revenue foregone stemming from withholding tax rates set in tax treaties that are lower than the standard, domestic rates in the absence of tax treaties. We estimate potential tax revenue foregone L_i for source country i over all its investor countries j in the following way:

$$R_{it} = \sum_j (adjusted\ dividend\ outflow_{ijt} \times domestic\ dividend\ rate_{it} - dividend\ outflow_{ijt} \times dividend\ rate_{ijt})$$

where $adjusted\ dividend\ outflow_{ijt} = dividend\ outflow_{ijt} - dividend\ outflow_{ijt} \times dividend\ elasticity_{it} \times (domestic\ dividend\ rate_{it} - dividend\ rate_{ijt})$.

In addition, we estimate these revenue foregone without the use of the estimated elasticities and we thus arrive at so-called static estimates of the potential revenue foregone. These static estimates are equivalent to setting all the elasticities above to zero, assuming $adjusted\ dividend\ outflow_{ijt} = dividend\ outflow_{ijt}$. We do this to reveal the differences between these two approaches, with and without the use of elasticities. The results should also indicate how biased the results without taking elasticities into account might be, as presented both in the existing research and in the Appendix to this paper. Again, we follow the approach described for dividends equivalently also for interest and we report results for both in the following section.

4 Results

In this section we present our estimates of elasticities and then use them to estimate revenue foregone. We first present the estimates of elasticities without source country interactions in Tables 1 and 2, which are based on all countries in our data. Tables 1 and 2 show estimates of the withholding tax elasticity of dividend and interest outflows, respectively, for a number different specifications and estimation methods. The first three columns of Tables 1 and 2 show our preferred estimates based on the PPML baseline specification with time dummies, source-time, recipient-time and country-pair fixed effects. The first three columns differ only in terms of the data sets used: the first column is based on the average withholding tax rate data set, the second on the minimum rate set and the third on the maximum rate set. In addition, we present other specifications as a robustness check only on the basis of the average withholding tax rate data set. The other columns show OLS estimates and three sets of PPML estimates with different sets of fixed effects. The estimated scales of elasticities differ across the specifications, but they all point in a similar direction and the interpretation is similar across the specifications; we therefore discuss only our baseline results below.

We find both dividend and interest outflows to be elastic. The baseline results are of a similar scale across the three data sets for dividends. In Table 1 we estimate dividend flows to be highly elastic: a 1% increase in the applicable withholding tax is associated with a 2.3% - 2.6% decrease in dividend flows (the range is given by the lowest and highest estimated elasticity across the three datasets). We find a broader interval for interest flows, 0.4% - 3.3%. The baseline results for interest in Table 2 differ quite substantially across the three data sets, but they do so in the way we would expect: lowest for the

minimum data set and highest for the maximum data set (i.e. higher withholding tax rates lead to higher estimated elasticities). In any case, for both dividend and interest estimates we use the lowest and highest of the three baseline estimates that differ by data sets to provide the lower and upper bounds of our potential revenue foregone estimates below, to show the sensitivity of the results.

We now present our estimates with source country interactions, which cover only a sub-sample of countries for which sufficient data is available. Tables 3 and 4 show estimates of the withholding tax elasticity of dividend and interest outflows, respectively. The estimates are based on the baseline specification equivalent to the one used in Tables 1 and 2 above. The tables show baseline estimates on the basis of all three data sets and we report the range for the lowest and highest estimated elasticity across all three. For example, we estimate dividend flows from Albania to be highly elastic: a 1% increase in the applicable withholding tax is associated with a 2.9% - 3.9% decrease in dividend flows. The results imply highly elastic outflows for many countries, for dividends the highest are for Barbados (17.7% - 20.6%) and Kazakhstan (22.0% - 22.3%) and for interest the highest are for Iceland (20.0% - 20.1%) and Morocco (10.9% - 22.8%). For some countries the estimates are not statistically different from zero, while for other countries the elasticities are, unexpectedly, positive. Overall, we observe substantial heterogeneity across the estimated elasticities. However, even with the best data available, it is hard to explain the observed heterogeneity. For example, the elasticities do not seem to differ systematically across regional or income groups of countries, as highlighted in Tables A1-A4 in the Appendix, where we estimate our models using interactions with region and income groups of countries. There are hardly any statistically significant elasticities for dividends and only some – and some of these positive – for interest.

Table 1. Withholding tax elasticity of dividend outflows

Dividend outflow – div_out	PPML (avg rates)	PPML (min. rates)	PPML (max. rates)	OLS (1)	PPML (1)	PPML (2)	PPML (3)
WHT rate – div_real	-0.0258*** (0.00785)	-0.0247*** (0.00813)	-0.0230*** (0.00682)	-0.0119*** (0.00426)	-0.170*** (0.00808)	-0.0213*** (2.38e-05)	-0.124*** (7.54e-06)
WHT rate with other countries - d	-0.318*** (0.0510)	-0.263*** (0.0462)	-0.364*** (0.0528)	-0.696*** (0.0509)	-0.815*** (0.0376)	-0.0328*** (4.17e-05)	-0.464*** (2.96e-05)
Observations	26,987	26,987	26,987	20,936	59,803	27,731	65,199
Source-t FE	YES	YES	YES	YES	YES	-	-
Recipient -t FE	YES	YES	YES	YES	YES	-	-
Pairs FE	YES	YES	YES	YES	-	YES	YES
Source FE	-	-	-	-	-	-	YES
Recipient FE	-	-	-	-	-	-	YES

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$. Standard errors in parentheses.

Table 2. Withholding tax elasticity of interest outflows

Dividend outflow – int_out	PPML (avg rates)	PPML (min. rates)	PPML (max. rates)	OLS (1)	PPML (1)	PPML (2)	PPML (3)
WHT rate – ir_real	-0.0165* (0.00992)	-0.00392 (0.00879)	-0.0330*** (0.00998)	-0.0187*** (0.00512)	-0.0464*** (0.00598)	-0.0270*** (5.30e-05)	-0.0239*** (0.00266)
WHT rate with other countries - i	-0.426*** (0.0554)	-0.227*** (0.0482)	-0.521*** (0.0588)	-1.049*** (0.132)	-0.632*** (0.0253)	0.111*** (5.89e-05)	-0.1336*** (0.00803)
Observations	26,429	26,429	26,429	20,566	57,930	27,530	65,199
Source-t FE	YES	YES	YES	YES	YES	-	YES
Recipient-t FE	YES	YES	YES	YES	YES	-	-
Pairs FE	YES	YES	YES	YES	-	YES	-
Source FE	-	-	-	-	-	-	YES
Recipient FE	-	-	-	-	-	-	YES

*Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$. Standard errors in parentheses.*

There are not many existing studies with which to compare our results. Our estimated elasticities are in line with Balabushko, Beer, Loeprick, & Vallada (2017), who estimated comparable elasticities for Ukraine at 2.3% for dividends and 7.1% for interest. The estimate for dividends is within our own general interval, but their sensitivity estimate for interest flows is higher. As we do not have Ukraine as a source country in our dataset, we are unfortunately unable to directly compare the country-specific estimates. Other than that pioneering one-country study, we are unaware of any other work that provides estimates of withholding tax elasticities of dividend and interest outflows and we believe that our work presents the first cross-country analysis of this issue. Overall, both our general and country-specific estimates show clear evidence that dividend and interest flows are sensitive to changes in applicable withholding tax rates and they should thus be taken into account when estimating the revenue costs of tax treaties.

Table 3. Dividend outflow elasticities, cross-country analysis

Source country	Country specific effect		
	Minimum-	Average-rate	Maximum-
Albania	-3.93%***	-2.93%***	-2.90%*
Armenia	-6.01%	-6.34%*	-6.38%**
Australia	4.15%***	4.55%***	4.90%***
Austria	-2.27%	-2.53%	-2.41%
Barbados	-17.65%***	-20.55%***	-20.51%***
Belarus	-11.47%	-15.38%	-18.83%*
Bosnia	13.91%	13.84%	13.89%
Canada	0.17%***	-0.17%**	-0.22%
Costa Rica	0.43%***	0.39%***	0.33%
Croatia	-13.10%*	-11.26%	-13.07%*
Germany	-4.98%	-3.22%	-
Greece	-9.09%	-9.58%	-9.91%
Israel	-0.20%	-2.72%	-6.12%
Japan	-	-5.23%	-
Kazakhstan	-21.99%***	-22.14%***	-22.31%***
Korea (Rep.)	-2.25%	-2.45%	-2.34%
Macedonia	-8.17%	-8.15%*	-8.14%**
Mongolia	-2.22%	-2.51%	-2.70%
Mozambique	-12.41%	-12.88%	-13.27%*
New Zealand	-10.55%	-11.38%*	-10.26%**
Norway	3.38%	3.95%	4.34%
Pakistan	-10.29%	-9.92%	-9.17%
Paraguay	22.48%	25.89%	28.57%
Philippines	-4.05%	-6.69%	31.83%
Poland	-3.86%	-3.91%	-3.94%
Romania	4.64%***	4.65%***	4.70%***
Slovenia	8.00%***	7.90%***	7.84%**
Sweden	0.37%	-7.55%	-3.84%
Switzerland	-8.22%	-10.97%	-16.44%
Turkey	-3.32%	-3.73%	-4.02%
USA	-4.83%	-6.64%	-12.77%
Venezuela	-3.62%	-3.72%	-3.81%

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

Table 4. Interest outflow elasticities, cross-country analysis

Source country	Country specific effect		
	Minimum-rate	Average-rate	Maximum-rate
Albania	0.01%	0.00%	-4.46%
Argentina	-0.67%	-1.40%	-1.54%
Armenia	-8.06%**	-9.84%**	-10.25%**
Australia	6.60%***	12.30%***	44.19%
Barbados	-6.63%***	-6.73%*	-6.84%
Belarus	-0.59%	15.19%	13.87%***
Bosnia	-5.35%**	-8.68%***	-10.22%***
Bulgaria	0.50%	-2.40%	-3.87%
Canada	-0.33%	-0.62%	-0.39%
Costa Rica	-44.19%	3.76%	7.88%*
Croatia	-	-3.56%	-6.46%
Greece	-4.17%**	-10.16%***	-
Iceland	-20.00%***	-20.14%***	-20.14%***
Israel	8.99%***	11.21%***	15.43%***
Kazakhstan	-7.90%**	-16.89%*	34.92%***
Korea (Rep.)	0.04%	-0.36%	-0.54%
Macedonia	2.83%	2.45%	2.24%
Moldova	-3.16%**	-4.03%*	-4.06%
Mongolia	-1.06%	-2.61%	3.23%
Morocco	-10.94%*	-19.81%***	-22.82%***
New Zealand	-7.71%***	-11.34%***	-11.93%*
Philippines	-5.87%	-6.29%*	-2.49%
Poland	-0.80%	-2.70%	-4.97%
Romania	-2.52%**	-2.94%	-2.56%
Slovakia	-3.84%**	-4.22%*	-3.93%
United Kingdom	-2.76%*	-3.52%	-4.13%
USA	-2.58%*	-4.51%	-13.03%

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

We now present our estimates of the potential tax revenue foregone resulting from tax treaties' lower withholding tax rates on dividend and interest flows. As with the elasticities, we estimate three sets of potential revenue lo foregone ss estimates following the three versions of our data set: minimum, average, maximum. Of these three estimates we consider the lowest and the highest estimates (either of which could arise from any of the three estimated elasticities) for each pair of countries and we consider them as approximate lower and upper bounds of the estimated effects. We present the results from the point of view of both source and investor countries, so as to learn which countries have the largest revenue foregone and which countries are responsible for the revenue foregone. In addition to thousand-dollar values, we express the estimated revenue foregone as shares of GDP to provide a relative perspective for each of the economies comparable across countries (we use GDP for this purpose rather than tax revenues since the former has better data coverage than the latter). We also present the share of

each country's revenue foregone related to relationships with EU member states. Due to the important role the EU's Parent-Subsidiary and Interest and Royalties Directives play for the EU member states and Switzerland, the EU share is bound to be substantial for these countries, but will also be important for other countries not directly affected by these directives. The presented results provide estimates of tax revenue foregone for the widest possible range of countries.

Our results suggest substantial revenue costs due to both interest and dividend payments for a number of countries. The revenue foregone intervals (between the lower and upper bound estimates) are significantly wider for interest payments, which is in line with the estimated elasticities. Tables 5 and 6 show the annual potential revenue foregone associated with dividends and interest by source country, while Tables 7 and 8 do so by investor country. Let us illustrate the aggregate scale of the estimated revenue foregone - if we sum all the potential revenue foregone across countries, the ranges are 15.7 to 21.5 billion USD for dividends and 3.0 to 15.2 billion USD for interest, or 18.7 to 36.7 billion USD altogether, which is approximately 0.02-0.05% of world's total GDP. Approximately half of these estimated revenue foregone incur to EU member states, most of which is a result of the EU directives rather than standard tax treaties. The biggest revenue foregone relative to GDP related to dividends is estimated for the Czech Republic (0.47% - 0.56%), where most of the revenue foregone is related to the EU directives (95%) rather than tax treaties (and in this respect it is similar to other EU member states as reported for each country in Tables 5 and 6 below). The highest costs resulting from tax treaties alone relative to GDP are estimated for Canada (0.09% - 0.2%), South Africa (0.12% - 0.13%) and Serbia (0.11% - 0.12%). Where interest is concerned, the highest revenue foregone relative to GDP is estimated for Mongolia (0.07% - 0.23%).

The source countries with the largest estimated revenue foregone in absolute values are some of the biggest economies. For example, the United States' estimated revenue foregone are relatively large for both dividends (2.3 - 2.9 billion USD) and interest (0.1 billion USD - 6.2 billion USD). From the opposite point of view, we find that Netherlands is the recipient country responsible for the largest share of potential revenue foregone worldwide, 2.9 - 3.3 billion USD for dividends and 0.7 - 1.9 billion USD for interest, with a large share of both related to the EU directive. The Netherlands comes out as an important country in similar analysis by McGauran & Fernandez (2013), Weyzig (2012), Garcia-Bernardo, Fichtner, Takes, & Heemskerk (2017) and Janský & Šedivý (2019). The results in Tables 5-8 show the country-level sums for country-pair-level information on which we carry out the estimation. Our results are presented in full in the online appendix due to space constraints. Tables A5 and A6 in the Appendix show potential revenue foregone by source country for the 3 recipient countries related to the greatest revenue foregone for dividends and interest, respectively. For the United States, for example, for dividends those three countries are the United Kingdom, Japan and Luxembourg, which together account for almost half of the USA's overall revenue foregone.

We demonstrate the significance of reflecting elasticities in our headline potential tax revenue foregone estimates by comparing them with so-called static estimates that do not take into account the estimated elasticities. Tables A7 and A8 report our static estimates of the potential revenue foregone by source country for dividends and interest, respectively. As expected, the static estimates imply substantially higher tax revenue foregone than our elastic estimates. A case in point is Bangladesh, for which our static revenue foregone estimate related to dividends is 79 million USD (equivalent static estimates by ActionAid (2016) and Janský & Šedivý (2019), respectively, were 75 million USD and 85 million USD), whereas our elastic estimate puts the potential revenue foregone at only 38 - 42 million USD - i.e. when the behavioural reaction is reflected through the inclusion of elasticities, the revenue foregone estimate is circa halved. We find comparable differences for the majority of countries and altogether confirm the notion that static estimates tend to overestimate potential tax revenue foregone.

5 Conclusion

Tax treaties are intended to support cross-border investment and trade and to avoid double taxation, but they are often used in tax avoidance strategies by MNEs that lead to lower tax revenues for the governments of the countries that host investments. These costs are acknowledged in the existing literature, but how much revenue is at stake has remained unknown for many countries worldwide. How much lower this estimated revenue foregone is due to the sensitivity of income flows to withholding tax rates has also remained unknown. In this paper we have filled in these gaps and provided approximate estimates of elasticities and the potential revenue foregone as a result of tax treaties for many countries at different levels of income with the help of the most suitable cross-country data sets.

While we rely on the best available sources of cross-country information for withholding tax rates, FDI income flows and standard econometric methods, our methodological approach is naturally not without its limitations and there are opportunities for further research to refine our estimates of both elasticities and revenue foregone. One such opportunity is to better reflect so-called tax treaty shopping, perhaps by applying network analysis methods or more complex data on FDI flows when they become available, including a clear distinction between investor, conduit and host countries. Even better coverage of countries in the FDI data that we used would be a welcome change, since the FDI data are available for far fewer countries than the withholding tax information and this leads to sample selection bias. For example, high-income countries are more likely to be present in the data than low-income countries and the estimated revenue foregone should be interpreted with this in mind. While we estimate elasticities and revenue foregone for both dividend and interest income, we model each of them separately and future research should investigate how their potential interdependence influences the estimates. Also, we only focus on revenue foregone, rather than benefits or other costs, such as effects incorporation in the host countries, on foreign investment or on reinvestment in the host economy.

In terms of results, we found that reflecting elasticities renders the estimated revenue foregone substantially lower than static estimates, which tend to overestimate the revenue foregone. Nevertheless, we show that even if the revenue foregone are considerably lower than static estimates have previously suggested, the amounts at stake are not negligible. Some countries appear to be losing significant tax revenues as a result of tax treaties. We believe that the identified countries' governments should inspect the effects using their detailed information on passive income outflows and possibly renegotiate the provisions of their tax treaties, in particular concerning the withholding taxation of dividend and interest flows.

Table 5. Potential revenue foregone, source countries - dividends

Source country	Year	Lower bound estimate			Upper bound estimate		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
Canada	2015	1 353 282.05	37.51	0.09	3 185 623.85	37.51	0.20
United States	2016	2 270 967.34	72.66	0.01	2 939 117.09	72.41	0.02
Germany	2016	1 647 892.04	87.16	0.05	1 946 706.57	88.32	0.06
Switzerland	2016	764 680.04	86.30	0.11	1 536 538.33	86.34	0.23
France	2016	1 130 629.48	86.48	0.05	1 535 814.14	87.33	0.06
Japan	2016	1 224 603.78	49.83	0.02	1 404 774.10	50.08	0.03
Russia	2016	1 084 877.90	91.48	0.08	1 141 266.92	91.69	0.09
Czech Republic	2016	913 019.89	94.88	0.47	1 093 005.79	94.88	0.56
Poland	2016	889 415.90	96.34	0.19	982 230.58	96.34	0.21
Spain	2016	793 181.74	89.16	0.06	872 700.00	89.49	0.07
Australia	2016	435 281.27	24.77	0.04	797 525.12	20.28	0.07
Korea (Rep.)	2016	536 582.18	37.32	0.04	612 985.11	37.32	0.04
Austria	2016	483 361.15	80.37	0.12	611 480.90	80.37	0.16
Portugal	2016	311 940.68	95.70	0.15	373 450.11	95.70	0.18
South Africa	2016	345 746.86	75.75	0.12	369 369.32	75.76	0.13
Norway	2016	279 587.43	93.87	0.08	334 683.65	93.88	0.09
Italy	2016	265 078.63	96.45	0.01	323 698.66	96.45	0.02
New Zealand	2015	0.00	0.00	0.00	300 350.55	0.00	0.17
Mexico	2015	186 088.51	40.45	0.02	222 348.20	51.17	0.02
Romania	2016	165 472.99	99.98	0.09	165 493.14	99.97	0.09
Slovenia	2014	105 742.07	98.95	0.21	105 743.63	98.95	0.21
Chile	2016	34 790.15	49.59	0.01	68 243.41	50.82	0.03
Turkey	2016	59 411.40	62.67	0.01	62 532.42	63.58	0.01
Greece	2014	57 980.71	97.45	0.02	60 168.67	97.45	0.03
Venezuela	2016	33 425.99	59.83	-	59 330.72	59.83	-
Lithuania	2014	53 555.36	92.02	0.11	57 224.73	92.02	0.12
Philippines	2016	31 533.29	26.77	0.01	50 281.59	55.86	0.02
Serbia	2016	42 817.39	89.75	0.11	47 771.47	89.75	0.12
Bangladesh	2014	38 333.98	38.83	0.02	42 769.32	38.83	0.02
Israel	2016	27 763.98	50.52	0.01	36 258.38	48.05	0.01
Bulgaria	2016	28 572.34	98.39	0.05	29 205.76	96.86	0.05
Croatia	2016	0.00	0.00	0.00	21 108.67	98.58	0.04
Mongolia	2016	9 755.76	7.27	0.09	10 884.53	7.27	0.10
Georgia	2016	1 969.39	33.23	0.01	10 078.75	80.21	0.07
Azerbaijan	2016	9 394.51	89.96	0.02	9 794.60	90.23	0.03
Belarus	2015	0.00	0.00	0.00	9 312.84	94.64	0.02
Macedonia (FYR)	2016	2 033.15	91.03	0.02	9 165.15	91.94	0.08
Panama	2013	5 668.76	67.63	0.01	9 048.36	80.03	0.02
Bolivia	2016	7 215.87	100.00	0.02	8 211.70	100.00	0.02
Ghana	2015	6 740.09	83.42	0.02	6 930.33	83.42	0.02
Nigeria	2016	6 656.11	0.00	0.00	6 907.28	0.00	0.00
Pakistan	2015	2 601.13	0.25	0.00	5 756.29	0.22	0.00
Thailand	2016	5 448.30	0.00	0.00	5 653.90	0.00	0.00
Sri Lanka	2016	2 468.65	0.36	0.00	4 758.94	0.18	0.01
Albania	2016	3 012.87	86.21	0.03	3 934.68	85.58	0.03
Costa Rica	2016	2 750.91	100.00	0.00	3 572.62	100.00	0.01
Zambia	2015	3 146.57	59.99	0.01	3 362.16	59.99	0.02
Botswana	2015	2 717.62	66.50	0.02	2 788.39	66.50	0.02
Armenia	2016	1 027.22	45.15	0.01	2 380.56	50.77	0.02
El Salvador	2013	2 022.87	100.00	0.01	2 256.92	100.00	0.01
Mozambique	2014	0.00	0.00	0.00	2 007.42	8.56	0.01
Lebanon	2011	1 798.58	37.39	0.00	1 827.49	37.39	0.00
Seychelles	2016	1 115.76	34.91	0.08	1 192.21	34.91	0.08
Iceland	2016	656.37	97.62	0.00	718.13	97.62	0.00
Uganda	2011	568.24	35.64	0.00	637.48	44.86	0.00
Montenegro	2015	433.11	51.47	0.01	443.40	51.92	0.01
Kyrgyzstan	2011	260.43	93.41	0.00	270.26	93.41	0.00

Source country	Year	<u>Lower bound estimate</u>			<u>Upper bound estimate</u>		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
Tajikistan	2016	157.14	27.03	0.00	164.76	27.02	0.00
Paraguay	2011	25.60	-	0.00	27.35	-	0.00
Bosnia and Herzegovina	2015	4.84	100.00	0.00	4.92	100.00	0.00

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table 6. Potential revenue foregone, source countries - interest

Source country	Year	Lower bound estimate			Upper bound estimate		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
United States	2016	123 368.77	77.18	0.00	6 238 028.82	77.09	0.03
United Kingdom	2016	783 258.99	54.16	0.03	1 574 103.08	53.10	0.06
Spain	2016	377 025.15	91.15	0.03	1 073 410.90	85.84	0.09
Russia	2016	333 000.86	93.36	0.03	982 009.40	93.37	0.08
Italy	2016	131 068.92	97.01	0.01	936 296.08	95.65	0.05
Belgium	2016	441 158.81	98.58	0.09	881 353.74	97.71	0.19
Canada	2015	95 067.63	37.16	0.01	681 336.40	48.67	0.04
Ireland	2016	189 825.57	59.52	0.06	559 651.24	59.38	0.18
Poland	2016	181 893.69	96.08	0.04	537 239.15	95.67	0.11
Portugal	2016	49 623.83	96.57	0.02	285 992.83	95.75	0.14
Brazil	2013	51 726.75	80.03	0.00	276 412.28	85.76	0.01
Kazakhstan	2016	0.00	0.00	0.00	164 554.15	63.41	0.12
Czech Republic	2016	28 795.68	94.90	0.01	164 552.25	94.90	0.08
Romania	2016	69 970.15	98.03	0.04	109 180.31	97.96	0.06
Argentina	2016	0.00	0.00	0.00	103 757.74	84.54	0.02
Indonesia	2016	32 292.24	31.02	0.00	96 566.49	32.15	0.01
Chile	2016	12 263.70	48.49	0.00	90 798.15	59.20	0.04
Japan	2016	13 435.09	48.08	0.00	68 446.34	52.19	0.00
Korea (Rep.)	2016	17 288.04	36.35	0.00	67 432.66	40.02	0.00
Australia	2016	0.00	-	0.00	61 013.04	13.00	0.01
Mexico	2015	3 336.82	50.92	0.00	28 590.00	45.52	0.00
Bulgaria	2016	17 269.52	97.75	0.03	26 416.54	95.38	0.05
Mongolia	2016	8 127.47	7.26	0.07	25 845.28	7.58	0.23
Slovak Republic	2016	12 397.97	95.56	0.01	23 325.53	95.58	0.03
Croatia	2016	11 231.77	98.44	0.02	22 248.86	98.40	0.04
Philippines	2016	0.00	0.00	0.00	19 031.09	38.32	0.01
South Africa	2016	8 007.93	84.16	0.00	15 982.17	83.50	0.01
Israel	2016	10 228.63	49.44	0.00	14 839.76	46.86	0.00
Slovenia	2014	6 164.40	99.20	0.01	12 222.00	99.07	0.02
Serbia	2016	4 133.86	92.40	0.01	12 158.42	92.40	0.03
Greece	2014	0.00	0.00	0.00	9 522.03	94.28	0.00
Lithuania	2014	6 344.27	100.00	0.01	9 469.06	100.00	0.02
India	2015	2 098.81	47.43	0.00	8 784.54	43.07	0.00
Thailand	2016	170.26	30.18	0.00	8 463.53	21.12	0.00
Georgia	2016	2 861.49	85.89	0.02	3 537.38	83.50	0.02
Venezuela	2016	0.00	-	-	2 366.63	67.77	-
Macedonia (FYR)	2016	733.98	99.78	0.01	1 723.12	99.86	0.02
Tajikistan	2016	737.88	29.31	0.01	1 639.35	47.32	0.02
Belarus	2015	982.97	93.19	0.00	1 252.16	93.60	0.00
Albania	2016	357.79	91.24	0.00	867.23	92.84	0.01
Bosnia and Herzegovina	2015	0.00	0.00	0.00	378.78	99.70	0.00
Burkina Faso	2014	0.00	-	0.00	354.39	100.00	0.00
Armenia	2016	0.00	0.00	0.00	354.04	35.58	0.00
Moldova	2015	227.75	52.03	0.00	300.12	55.24	0.00
Costa Rica	2016	12.40	100.00	0.00	223.25	100.00	0.00
Kosovo	2015	81.74	100.00	0.00	122.01	100.00	0.00
Ghana	2015	0.00	-	0.00	113.72	28.96	0.00
Nigeria	2016	61.24	0.00	0.00	91.40	0.00	0.00
Bangladesh	2014	19.35	40.07	0.00	65.80	39.29	0.00
Uganda	2011	32.28	22.71	0.00	63.92	22.71	0.00
Seychelles	2016	23.55	35.02	0.00	46.64	35.02	0.00

Source country	Year	<u>Lower bound estimate</u>			<u>Upper bound estimate</u>		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
Mozambique	2014	5.12	15.90	0.00	19.13	25.01	0.00
Lebanon	2011	3.55	37.39	0.00	4.25	37.39	0.00
Kyrgyzstan	2011	1.96	99.72	0.00	3.58	99.77	0.00
Pakistan	2015	0.35	100.00	0.00	0.53	100.00	0.00

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table 7. Potential revenue foregone, recipient country - dividends

Recipient	<u>Lower-bound estimate</u>		<u>Upper-bound estimate</u>	
	Lower bound	% EU	Upper bound	% EU
Netherlands	2 864 950.73	58.17	3 284 706.75	67.66
United States	2 081 181.41	25.89	3 178 560.76	15.57
Luxembourg	1 899 516.83	69.05	2 303 607.76	75.33
United Kingdom	1 625 085.96	36.92	1 834 265.96	36.24
Germany	1 123 128.04	62.85	1 308 593.80	65.78
France	996 820.87	49.27	1 145 178.36	46.50
Switzerland	1 000 492.37	43.70	1 109 390.00	42.88
Japan	718 729.52	11.17	965 717.32	7.75
Cyprus	649 579.95	15.67	698 736.35	16.72
Austria	384 252.19	85.56	464 583.61	87.33
Belgium	365 621.19	74.42	443 618.11	76.77
Canada	322 121.61	3.50	420 361.31	3.09
Italy	355 729.44	85.56	418 196.20	86.11
Spain	345 858.74	66.73	412 191.02	68.50
Australia	87 761.04	5.55	319 535.75	1.44
Sweden	257 468.76	39.96	304 539.01	41.85
Singapore	210 422.96	4.11	235 944.52	3.95
Ireland	148 581.64	34.55	164 773.33	37.13
Hong Kong	117 565.68	13.63	159 084.62	8.78
China (People's Rep.)	122 657.76	13.05	151 277.70	9.38
Denmark	96 910.97	66.52	114 599.47	67.53
Russia	95 323.24	81.39	113 554.92	82.81
Korea (Rep.)	92 534.39	26.61	104 445.70	30.35
Finland	73 827.95	57.95	87 105.91	62.36
United Arab Emirates	49 928.44	48.07	74 460.13	28.75
Brazil	42 246.27	26.30	66 435.61	18.44
Norway	55 601.65	0.00	60 187.37	0.00
Malta	43 397.62	37.67	49 102.97	37.86
Hungary	47 890.95	36.46	49 043.91	32.90
Poland	36 252.93	74.48	39 306.78	62.78
Malaysia	37 393.20	4.30	39 264.43	4.99
Mexico	33 973.90	40.13	38 144.35	37.67
Slovak Republic	29 015.78	99.18	34 585.49	99.23
Taiwan	30 379.12	1.67	33 494.85	1.92
Portugal	28 930.75	93.02	32 716.60	93.10
Czech Republic	23 531.19	94.13	26 541.29	94.46
South Africa	23 242.75	49.21	25 787.28	55.79
India	15 150.47	6.05	17 908.86	4.64
New Zealand	12 757.22	1.53	17 504.42	1.05
Saudi Arabia	12 251.92	13.91	13 511.39	16.23
Kuwait	7 649.11	28.17	13 081.11	15.38
Greece	11 587.53	71.63	12 177.16	69.05
Qatar	9 346.07	60.92	11 645.35	66.49
Uruguay	10 036.48	97.72	11 068.63	97.86
Israel	9 003.07	33.12	10 744.56	38.26
Lebanon	7 878.35	89.36	10 436.28	92.37

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table 8. Potential revenue foregone, recipient country - interest

Recipient	Lower-bound estimate		Upper-bound estimate	
	Lower bound	% EU	Upper bound	% EU
Netherlands	665 487.58	71.98	1 942 661.85	61.42
Luxembourg	374 254.09	87.38	1 529 570.83	42.51
United Kingdom	171 324.95	67.18	1 403 684.77	18.40
France	326 914.85	84.05	1 081 461.04	49.22
United States	499 422.10	81.10	1 075 372.83	68.21
Germany	196 256.93	81.93	939 846.10	34.89
Switzerland	172 584.97	78.53	917 116.50	27.97
Japan	63 259.93	40.29	672 784.56	10.28
Canada	30 564.68	26.30	672 433.10	3.36
Cyprus	179 106.42	10.61	515 058.75	8.45
Spain	77 844.85	81.71	336 196.16	52.99
Belgium	61 710.26	89.90	276 531.76	41.60
Ireland	29 753.61	59.00	217 607.39	15.45
Italy	60 443.68	92.35	168 211.30	81.47
Sweden	38 260.23	80.01	156 893.70	34.78
Austria	45 579.15	82.83	124 816.47	75.28
Singapore	33 436.44	20.44	92 955.75	14.74
Australia	5 997.06	48.60	73 902.50	11.68
Norway	11 014.68	0.00	72 546.89	0.00
Korea (Rep.)	10 943.47	31.06	63 323.97	9.82
Denmark	13 707.90	88.71	62 810.42	40.74
China (People's Rep.)	23 757.33	8.57	61 681.09	7.81
Hungary	11 441.47	80.01	40 758.44	35.34
Hong Kong	7 590.81	40.61	39 166.97	39.89
Mexico	4 060.79	41.74	37 243.77	57.18
Portugal	11 638.35	93.36	33 510.32	91.70
Finland	11 130.59	53.35	32 539.95	38.97
Brazil	4 781.60	30.36	23 304.42	37.08
Russia	10 503.92	43.41	22 378.28	74.75
United Arab Emirates	6 587.66	56.16	18 873.97	55.43
Chile	1 457.12	3.84	14 243.26	1.20
Iceland	580.44	0.00	14 221.92	0.00
Czech Republic	8 406.77	94.31	13 636.69	90.01
Malta	4 726.34	81.81	12 713.76	77.91
Poland	3 084.67	67.12	12 377.11	42.90
India	1 270.18	33.00	12 040.62	10.37
Colombia	1 616.72	63.34	11 130.09	52.07
South Africa	1 791.68	86.59	10 324.91	29.52

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

6 References

- ActionAid. (2016a). *Mistreated: The tax treaties that are depriving the world's poorest countries of vital revenue*. Retrieved from ActionAid website: <http://www.actionaid.org/publications/mistreated-tax-treaties-are-depriving-worlds-poorest-countries-vital-revenue>
- ActionAid. (2016b). *Mistreated: The tax treaties that are depriving the world's poorest countries of vital revenue*. Retrieved from ActionAid website: <http://www.actionaid.org/publications/mistreated-tax-treaties-are-depriving-worlds-poorest-countries-vital-revenue>
- Azémar, C., Desbordes, R., & Mucchielli, J.-L. (2007). Do tax sparing agreements contribute to the attraction of FDI in developing countries? *International Tax and Public Finance*, 14(5), 543–562. <https://doi.org/10.1007/s10797-006-9005-9>
- Azémar, C., & Dharmapala, D. (2019). Tax sparing agreements, territorial tax reforms, and foreign direct investment. *Journal of Public Economics*, 169, 89–108. <https://doi.org/10.1016/j.jpubeco.2018.10.013>
- Baker, P. L. (2014). An Analysis of Double Taxation Treaties and their Effect on Foreign Direct Investment. *International Journal of the Economics of Business*, 21(3), 341–377. <https://doi.org/10.1080/13571516.2014.968454>
- Balabushko, O., Beer, S., Loepnick, J., & Vallada, F. (2017). *The direct and indirect costs of tax treaty policy: evidence from Ukraine* (Policy Research Working Paper Series No. 7982). The World Bank.
- Baltagi, B. H., Egger, P., & Pfaffermayr, M. (2003). A generalized design for bilateral trade flow models. *Economics Letters*, 80(3), 391–397.
- Barthel, F., Busse, M., & Neumayer, E. (2010). The impact of double taxation treaties on foreign direct investment: evidence from large dyadic panel data. *Contemporary Economic Policy*, 28(3), 366–377.
- Beer, S., & Loepnick, J. (2018). The Cost and Benefits of Tax Treaties with Investment Hubs: Findings from Sub-Saharan Africa. *IMF Working Paper*, 18(227), 1–38.
- Benchmark Definition of Foreign Direct Investment*. (2008). OECD.
- Bergstrand, J. H., & Egger, P. (2007). A knowledge-and-physical-capital model of international trade flows, foreign direct investment, and multinational enterprises. *Journal of International Economics*, 73(2), 278–308.
- Bergstrand, J. H., & Egger, P. (2013). Gravity equations and economic frictions in the world economy. In *Palgrave handbook of international trade* (pp. 532–570). Springer.
- Blanchard, O., & Acalin, J. (2016). *What Does Measured FDI Actually Measure?* Peterson Institute for International Economics.
- Blonigen, B. A., & Davies, R. B. (2002). *Do bilateral tax treaties promote foreign direct investment?* National Bureau of Economic Research.
- Blonigen, B. A., & Davies, R. B. (2004). The Effects of Bilateral Tax Treaties on US FDI Activity. *International Tax and Public Finance*, 11(5), 601–622.
- Blonigen, B. A., Oldenski, L., & Sly, N. (2014). The Differential Effects of Bilateral Tax Treaties. *American Economic Journal: Economic Policy*, 6(2), 1–18. <https://doi.org/10.1257/pol.6.2.1>
- Bolwijn, R., Casella, B., & Rigo, D. (2018). An FDI-driven approach to measuring the scale and economic impact of BEPS. *Transnational Corporations*, 25(2), 107.
- Braun, J., & Zagler, M. (2018). The true art of the tax deal: Evidence on aid flows and bilateral double tax agreements. *The World Economy*. <https://doi.org/10.1111/twec.12628>
- Bürgi, E., & Meyer, S. (2013). *Schweizer Doppelbesteuerungsabkommen: Aktuelle Politik und Entwicklungsrelevanz*.
- Carr, D. L., Markusen, J. R., & Maskus, K. E. (2001). Estimating the knowledge-capital model of the multinational enterprise. *American Economic Review*, 91(3), 693–708.
- Casella, B. (2019). Looking through conduit FDI in search of ultimate investors—a probabilistic approach. *Transnational Corporations*, 26(1), 109.
- Cheng, I.-H., & Wall, H. (2004). *Controlling for heterogeneity in gravity models of trade and integration*. Federal Reserve Bank of St. Louis.

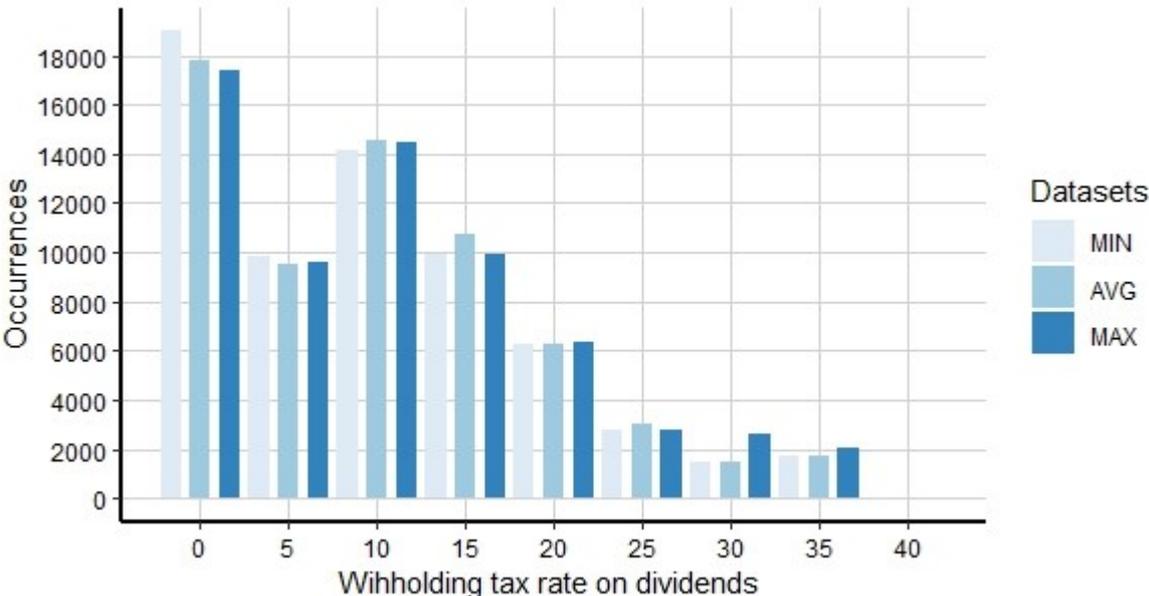
- Chetty, R., & Saez, E. (2005). Dividend taxes and corporate behavior: Evidence from the 2003 dividend tax cut. *The Quarterly Journal of Economics*, 120(3), 791–833.
- Chetty, R., & Saez, E. (2010). Dividend and corporate taxation in an agency model of the firm. *American Economic Journal: Economic Policy*, 2(3), 1–31.
- Chisik, R., & Davies, R. B. (2004a). Asymmetric FDI and tax-treaty bargaining: theory and evidence. *Journal of Public Economics*, 88(6), 1119–1148.
- Chisik, R., & Davies, R. B. (2004b). Gradualism In Tax Treaties With Irreversible Foreign Direct Investment*. *International Economic Review*, 45(1), 113–139. <https://doi.org/10.1111/j.1468-2354.2004.00119.x>
- Clausing, K. A. (2016). The Effect of Profit Shifting on the Corporate Tax Base in the United States and Beyond. *National Tax Journal*, 69(4), 905–934. <https://doi.org/10.17310/ntj.2016.4.09>
- Cobham, A., & Janský, P. (2018). Global distribution of revenue loss from corporate tax avoidance: re-estimation and country results. *Journal of International Development*, 30(2), 206–232. <https://doi.org/10.1002/jid.3348>
- Cobham, A., & Janský, P. (2019). Measuring misalignment: The location of US multinationals' economic activity versus the location of their profits. *Development Policy Review*, 37(1), 91–110. <https://doi.org/10.1111/dpr.12315>
- Coordinated Direct Investment Survey Guide*. (2015). IMF.
- Coupé, T., Orlova, I., & Skiba, A. (2009). The effect of tax and investment treaties on bilateral FDI flows to transition countries. In *The Effect of Treaties on Foreign Direct Investment*. Oxford University Press.
- Crivelli, E., de Mooij, R., & Keen, M. (2016). Base Erosion, Profit Shifting and Developing Countries. *FinanzArchiv: Public Finance Analysis*, 72(3), 268–301. <https://doi.org/10.1628/001522116X14646834385460>
- Damgaard, J., & Elkjaer, T. (2017). The Global FDI Network: Searching for Ultimate Investors. *IMF Working Paper*, 17(258).
- Davies, R. B. (2004). TaxTreaties and Foreign Direct Investment: Potential versus Performance. *International Tax and Public Finance*, 11, 775–802.
- Dharmapala, D. (2014). What Do We Know about Base Erosion and Profit Shifting? A Review of the Empirical Literature. *Fiscal Studies*, 35(4), 421–448. <https://doi.org/10.1111/j.1475-5890.2014.12037.x>
- Dowd, T., Landefeld, P., & Moore, A. (2017). Profit shifting of U.S. multinationals. *Journal of Public Economics*, 148, 1–13. <https://doi.org/10.1016/j.jpubeco.2017.02.005>
- Egger, P., Larch, M., Pfaffermayr, M., & Winner, H. (2006). The impact of endogenous tax treaties on foreign direct investment: theory and evidence. *Canadian Journal of Economics/Revue Canadienne d'économique*, 39(3), 901–931. <https://doi.org/10.1111/j.1540-5982.2006.00375.x>
- Egger, P., & Merlo, V. (2011). Statutory Corporate Tax Rates and Double-Taxation Treaties as Determinants of Multinational Firm Activity. *FinanzArchiv: Public Finance Analysis*, 67(2), 145–170.
- Fitzgibbon, W. (2019, March 18). Treaty to 'dodge Kenyan tax' deemed unconstitutional. Retrieved May 16, 2019, from ICIJ website: <https://www.icij.org/blog/2019/03/treaty-to-dodge-kenyan-tax-deemed-unconstitutional/>
- Garcia-Bernardo, J., Fichtner, J., Takes, F. W., & Heemskerk, E. M. (2017). Uncovering Offshore Financial Centers: Conduits and Sinks in the Global Corporate Ownership Network. *Scientific Reports*, 7(1), 6246. <https://doi.org/10.1038/s41598-017-06322-9>
- Griffith, R., Hines Jr, J. R., & Sørensen, P. B. (2010). *International Capital Taxation*.
- Haberly, D., & Wójcik, D. (2015a). Regional Blocks and Imperial Legacies: Mapping the Global Offshore FDI Network. *Economic Geography*, 91(3), 251–280. <https://doi.org/10.1111/ecge.12078>
- Haberly, D., & Wójcik, D. (2015b). Tax havens and the production of offshore FDI: an empirical analysis. *Journal of Economic Geography*, 15(1), 75–101. <https://doi.org/10.1093/jeg/lbu003>
- Hallward-Driemeier, M. (2003). *Do Bilateral Investment Treaties Attract FDI?: Only a Bit... and They Could Bite* (World Bank Policy Research Paper No. WPS 3121). Washington DC: World Bank, Development Research Group, Investment Climate.

- Hartman, D. G. (1985). Tax policy and foreign direct investment. *Journal of Public Economics*, 26(1), 107–121.
- Head, K., & Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In *Handbook of international economics* (Vol. 4, pp. 131–195). Elsevier.
- Head, K., & Ries, J. (2008). FDI as an Outcome of the Market for Corporate Control: Theory and Evidence. *Journal of International Economics*, 74(1), 2–20.
- Hearson, M. (2016). Measuring Tax Treaty Negotiation Outcomes: The ActionAid Tax Treaties Dataset. *ICTD Working Paper*, 2016(47), 1–45.
- Hearson, M. (2019, March 18). Unprecedented: Kenya-Mauritius tax treaty ratification struck down in court. Retrieved March 25, 2019, from Martin Hearson website: <https://martinhearson.net/2019/03/18/kenya-mauritius/>
- Hong, S. (2018). Tax treaties and foreign direct investment: a network approach. *International Tax and Public Finance*, 25(5), 1277–1320. <https://doi.org/10.1007/s10797-018-9489-0>
- Huesecken, B., & Overesch, M. (2015). *Tax Avoidance through Advance Tax Rulings - Evidence from the LuxLeaks Firms* (SSRN Scholarly Paper No. ID 2664631). Retrieved from Social Science Research Network website: <http://papers.ssrn.com/abstract=2664631>
- IBFD. (2013). *Onderzoek belastingverdragen met ontwikkelingslanden* (pp. 1–75).
- ICIJ. (2014). *Luxembourg leaks: Global companies' secrets exposed*. Retrieved from International Consortium of Investigative Journalists website: <http://www.icij.org/project/luxembourg-leaks>
- International Monetary Fund. (2014). *Spillovers in international corporate taxation*. Retrieved from <http://www.imf.org/external/np/pp/eng/2014/050914.pdf>
- Janský, P., & Palanský, M. (forthcoming). Estimating the scale of profit shifting and tax revenue losses related to foreign direct investment. *International Tax and Public Finance*. <https://doi.org/10.1007/s10797-019-09547-8>
- Janský, P., & Šedivý, M. (2019). Estimating the revenue costs of tax treaties in developing countries. *The World Economy*, 42(6), 1828–1849. <https://doi.org/10.1111/twec.12764>
- Johansson, A., Skeie, O. B., Sorbe, S., & Menon, C. (2017). Tax planning by multinational firms: Firm-level evidence from a cross-country database. *OECD Economics Department Working Papers*, 2017(1355), 64. <http://dx.doi.org/10.1787/9ea89b4d-en>
- Kosters, L., Kool, C. J. M., Groenewegen, J., Weyzig, F., & Bardadin, A. (2015). *IBFD Spillover Analysis: Possible Effects of the Irish Tax System for Developing Economies*. IBDF.
- Ledyaeva, S., Karhunen, P., Kosonen, R., & Whalley, J. (2015). Offshore foreign direct investment, capital round-tripping, and corruption: Empirical analysis of Russian regions. *Economic Geography*, 91(3), 305–341.
- Lejour, A. (2014). The foreign investment effects of tax treaties. *Oxford University Centre for Business Taxation, Working Paper Series, WP*, 14(03), 2–21.
- Mátyás, L. (1997). Proper econometric specification of the gravity model. *World Economy*, 20(3), 363–368.
- McGauran, K. (2013). Should the Netherlands Sign Tax Treaties with Developing Countries? Available at SSRN. Retrieved from http://www.somo.nl/publications-en/Publication_3958/at_download/fullfile
- Mintz, J. M., & Weichenrieder, A. J. (2010). *The Indirect Side of Direct Investment: Multinational Company Finance and Taxation*. MIT press.
- Neumayer, E. (2007). Do Double Taxation Treaties Increase Foreign Direct Investment to Developing Countries? *Journal of Development Studies*, 43(8), 1501–1519.
- Paolini, D., Pistone, P., Pulina, G., & Zagler, M. (2016). Tax treaties with developing countries and the allocation of taxing rights. *European Journal of Law and Economics*, 42(3), 383–404.
- Petkova, K., Stasio, A., & Zagler, M. (2018). *On the Relevance of Double Tax Treaties* (SSRN Scholarly Paper No. ID 3126593). Retrieved from Social Science Research Network website: <https://papers.ssrn.com/abstract=3126593>
- Poterba, J. (2004). Taxation and corporate payout policy. *American Economic Review*, 94(2), 171–175.
- Poterba, J. M., & Summers, L. H. (1984). *The economic effects of dividend taxation*. National Bureau of Economic Research Cambridge, Mass., USA.
- PwC. (2018). *Worldwide Tax Summaries. Corporate Taxes 2017/18*. Retrieved from <https://www.pwc.com/taxsummaries>

- Redhead, A., & Mihalyi, D. (2018). A withhold up in Mongolia? Thoughts on the renewed tax debate around Oyu Tolgoi – The International Centre for Tax and Development (ICTD). Retrieved June 7, 2018, from The International Centre for Tax and Development (ICTD) website: <http://www.ictd.ac/blog/a-withhold-up-in-mongolia-thoughts-on-the-renewed-tax-debate-around-oyu-tolgoi/>
- Rixen, T., & Schwarz, P. (2009). Bargaining over the avoidance of double taxation: Evidence from German tax treaties. *FinanzArchiv: Public Finance Analysis*, 65(4), 442–471.
- Silva, J. S., & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and Statistics*, 88(4), 641–658.
- Sinn, H.-W. (1993). Taxation and the Birth of Foreign Subsidiaries. Trade, Welfare, and Economic Policies. Essays in Honor of Murray C. Kemp. H. Herberg and L. van Ngo. *Ann Arbor, University of Michigan Press*.
- The Platform for Collaboration on Tax. (2017). *Discussion draft: The Taxation of Offshore Indirect Transfers - A Toolkit*. Retrieved from <http://documents.worldbank.org/curated/en/689091501488467178/pdf/117797-REVISED-Consultation-Draft-Indirect-Offshore-Transfers-July28-003.pdf>
- Tørsløv, T., Wier, L., & Zucman, G. (2018). The Missing Profits of Nations. *National Bureau of Economic Research*, (24071). <https://doi.org/10.3386/w24701>
- UNCTAD. (2015). *World Investment Report 2015 - Reforming International Investment Governance*. Geneva: United Nations.
- van de Poel, J. (2016). In search of a new balance. The impact of Belgian tax treaties on developing countries. *The Impact of Belgian Tax Treaties on Developing Countries. Brussels*.
- van 't Riet, M., & Lejour, A. (2018). Optimal tax routing: network analysis of FDI diversion. *International Tax and Public Finance*, 25(5), 1321–1371. <https://doi.org/10.1007/s10797-018-9491-6>
- Weyzig, F. (2012). Tax treaty shopping: structural determinants of Foreign Direct Investment routed through the Netherlands. *International Tax and Public Finance*, 1–28. <https://doi.org/10.1007/s10797-012-9250-z>
- Weyzig, F. (2013). *Taxation and development: Effects of Dutch tax policy on taxation of multinationals in developing countries*.
- Yagan, D. (2015). Capital tax reform and the real economy: The effects of the 2003 dividend tax cut. *American Economic Review*, 105(12), 3531–63.

7 Appendix

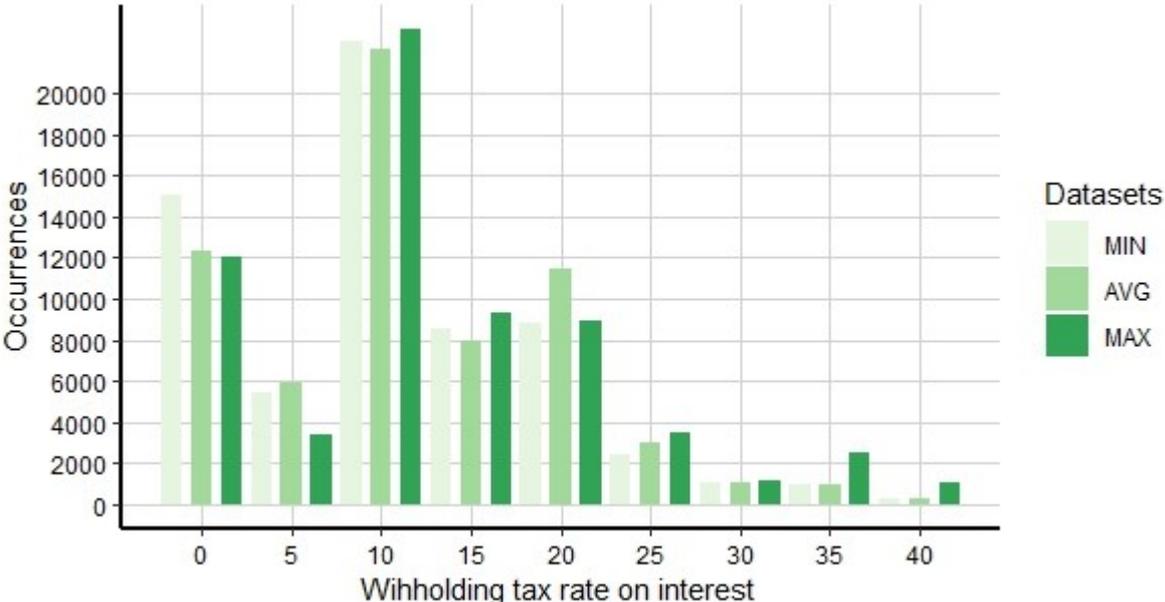
Figure A1. Withholding tax rates on dividends - occurrences according to three versions of the dataset



Source: Authors on the basis of the IBFD and other data sources.

Notes: The bins of this histogram are of 5% width centred always on the values presented on the x axis.

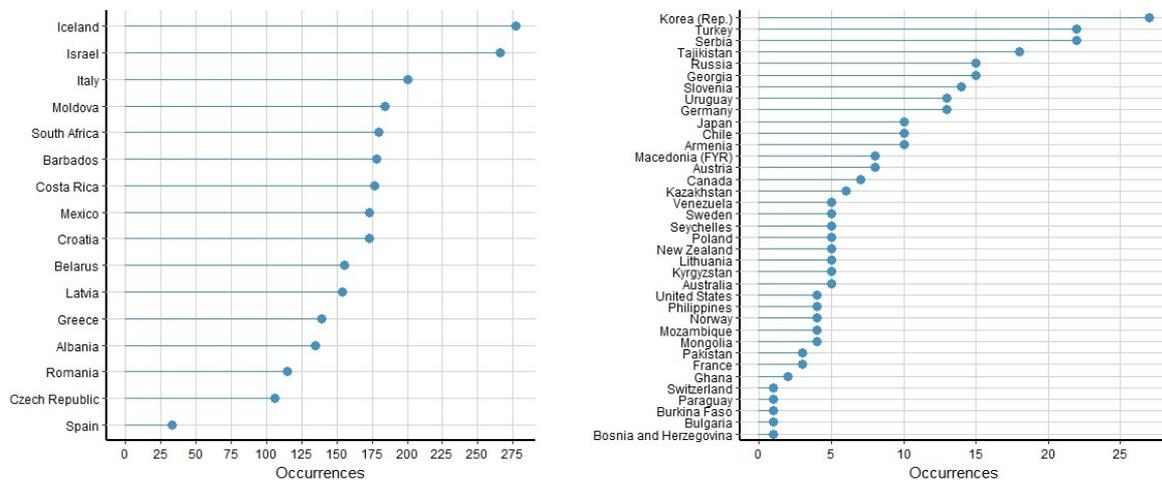
Figure A2. Withholding tax rates on interest - occurrences according to three versions of the dataset



Source: Authors on the basis of the IBFD and other data sources.

Notes: The bins of this histogram are of 5% width centred always on the values presented on the x axis.

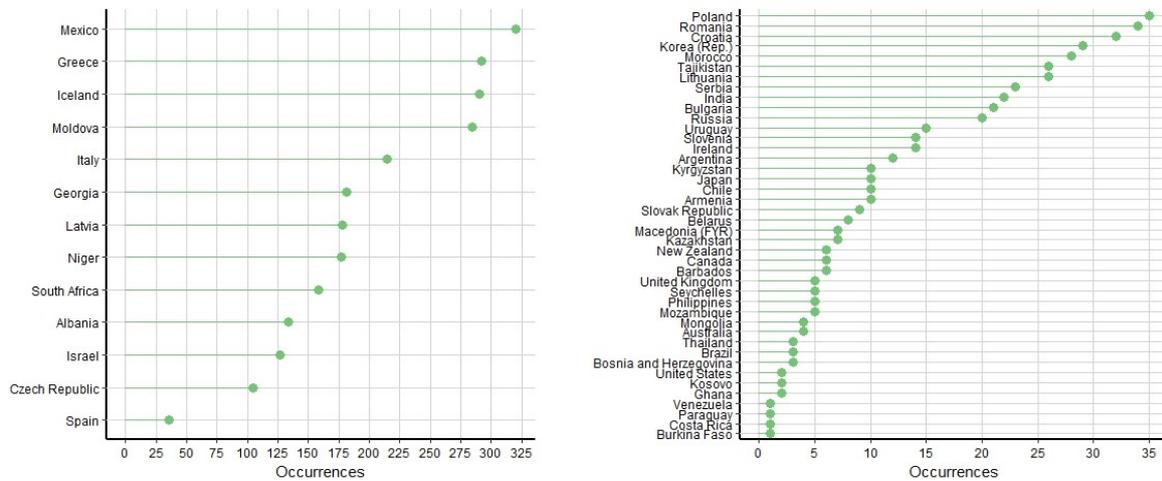
Figure A3. Number of changes in the applicable withholding rates on dividends - by source country



Source: Authors on the basis of the IBFD and other data sources.

Note: The left panel shows countries that experienced changes in domestic and possibly also tax treaty rates, whereas the right panel shows countries that experienced changes only in tax treaty rates.

Figure A4. Number of changes in the applicable withholding rates on interest - by source country



Source: Authors on the basis of the IBFD and other data sources.

Note: The left panel shows countries that experienced changes in domestic and possibly also tax treaty rates, whereas the right panel shows countries that experienced changes only in tax treaty rates.

Table A1: Dividend outflow elasticities - income groups

Income group	Minimum-rate	Average-rate	Maximum-rate
Low	-0.125*	-0.130*	-0.133*
Lower middle	-0,022	-0.025	-0.025
Upper middle	-0.0416	-0.0358	-0.025
High	-0.019	-0.023	-0.022

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

Table A2: Dividend outflow elasticities - regions

Income group	Minimum-rate	Average-rate	Maximum-rate
South Asia	0.193	0.191	-0.093*
Europe & Central Asia	-0,032	-0,031	-0,025
Middle East & North Africa	-0,001	-0,026	-0,06
East Asia, Pacific	-0,029	-0,039	-0,044
Subs-Saharan Africa	0,011	0,022	0,03*
Latin America & Caribbean	-0,016	-0,01	-0,006
North America	-0,016	-0,012	-0,005

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

Table A3: Interest outflow elasticities - income groups

Income group	Minimal-rate	Average-rate	Maximal-rate
Low	0,287***	0,335***	0,401*
Lower middle	-0,015***	-0,029***	-0,038*
Upper middle	-0,024***	-0,039***	-0,045*
High	0,002***	-0,006***	-0,026*

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

Table A4: Interest outflow elasticities - regions

Income group	Minimum-rate	Average-rate	Maximum-rate
South Asia	-0,023	-0,051	0,149
Europe & Central Asia	0,001	-0,015	-0,033
Middle East & North Africa	0,036	0,041	0,03
East Asia, Pacific	-0,022	-0,042	-0,061
Subs-Saharan Africa	-0,01	-0,013	-0,012
Latin America & Caribbean	-0,009	-0,009	-0,013
North America	-0,004	-0,008	-0,008

Notes: *** $p < 0.01\%$, ** $p < 0.05\%$, * $p < 0.1\%$.

Table A5. Potential revenue foregone, source countries & 3 recipient countries related to the most revenue foregone, dividends

Source country	1st recipient	Lower Bound	Upper Bound	2nd recipient	Lower Bound	Upper Bound	3rd recipient	Lower Bound	Upper Bound
Albania	Greece	0.85	1.17	Netherlands	0.72	0.90	Switzerland	0.42	0.58
Armenia	Russia	0.47	0.99	Cyprus	0.23	0.47	United Kingdom	0.07	0.31
Australia	United States	252.85	379.27	Japan	0.00	176.75	United Kingdom	88.03	132.04
Austria	Germany	139.21	176.11	Netherlands	83.78	105.99	Luxembourg	56.40	71.35
Azerbaijan	Netherlands	3.63	3.77	Switzerland	2.16	2.24	Germany	1.74	1.80
Bangladesh	United Kingdom	7.79	8.69	Korea (Rep.)	4.79	5.34	Netherlands	4.53	5.05
Bolivia	Sweden	5.57	5.86	Spain	1.64	1.73	-	-	-
Botswana	United Kingdom	1.80	1.85	Mauritius	0.91	0.93	France	0.00	0.00
Bulgaria	Netherlands	5.82	5.91	Austria	3.67	3.73	Greece	2.33	2.36
Canada	United States	671.57	1 580.18	Netherlands	160.47	377.57	Luxembourg	101.27	238.27
Costa Rica	Spain	2.29	2.98	Germany	0.46	0.60	-	-	-
Czech Republic	Netherlands	212.20	254.04	Germany	134.60	161.14	Luxembourg	120.09	143.77
El Salvador	Spain	2.02	2.26	-	-	-	-	-	
France	Luxembourg	241.32	331.01	Netherlands	156.70	214.95	United Kingdom	138.07	189.38
Germany	Netherlands	334.51	400.47	Luxembourg	328.88	393.74	United States	154.19	184.60
Ghana	France	4.06	4.17	South Africa	1.12	1.15	Switzerland	0.57	0.59
Greece	Luxembourg	14.00	14.52	Germany	13.25	13.75	Netherlands	10.68	11.08
Iceland	Luxembourg	0.40	0.44	Netherlands	0.12	0.14	Switzerland	0.03	0.04
Italy	Luxembourg	53.71	65.59	Netherlands	53.65	65.51	France	49.46	60.40
Japan	United States	361.23	451.31	France	193.60	241.88	Netherlands	153.79	192.14
Korea (Rep.)	Japan	160.51	183.38	United States	82.76	94.55	United Kingdom	51.97	59.37
Kyrgyzstan	Germany	0.12	0.12	Switzerland	0.08	0.08	Latvia	0.04	0.05
Lebanon	United Arab Emirates	0.77	0.78	France	0.67	0.68	Kuwait	0.36	0.36
Lithuania	Sweden	13.42	14.34	Netherlands	6.87	7.34	Germany	5.27	5.63
Macedonia (FYR)	Austria	0.50	2.04	United Kingdom	0.23	1.87	Netherlands	0.37	1.52
Mexico	United States	86.32	89.58	Netherlands	38.52	75.33	Spain	22.71	23.57
Mongolia	China (People's Rep.)	3.81	4.25	Canada	3.35	3.73	Singapore	1.44	1.60

Source country	1st recipient	Lower Bound	Upper Bound	2nd recipient	Lower Bound	Upper Bound	3rd recipient	Lower Bound	Upper Bound
Montenegro	Russia	0.18	0.18	Netherlands	0.05	0.05	Slovenia	0.05	0.05
New Zealand	Australia	0.00	209.54	United States	0.00	33.28	Hong Kong	0.00	21.29
Nigeria	China (People's Rep.)	4.54	4.71	South Africa	2.11	2.19	Belgium	0.00	0.00
Norway	Sweden	71.34	85.41	Netherlands	50.29	60.20	Luxembourg	29.41	35.21
Pakistan	Japan	2.36	4.61	Saudi Arabia	0.00	0.90	Iran	0.21	0.22
Panama	Spain	1.76	5.20	Netherlands	1.63	1.67	Mexico	0.79	0.81
Paraguay	Chile	0.03	0.03	Taiwan	0.00	0.00	-	-	-
Philippines	Japan	18.98	20.28	Netherlands	0.00	18.71	Switzerland	4.45	4.75
Poland	Netherlands	173.99	192.14	Germany	149.13	164.70	Luxembourg	119.61	132.09
Portugal	Netherlands	84.79	101.51	Spain	76.27	91.30	Luxembourg	61.59	73.73
Romania	Netherlands	42.78	42.78	Germany	23.21	23.21	Austria	20.90	20.90
Russia	Cyprus	535.67	572.37	Netherlands	158.86	169.74	Switzerland	49.67	71.61
Serbia	Netherlands	10.45	11.66	Austria	6.12	6.82	Slovenia	3.05	3.41
Seychelles	Mauritius	0.66	0.70	Cyprus	0.39	0.41	United Arab Emirates	0.04	0.04
Slovenia	Austria	37.15	37.15	Switzerland	12.64	12.64	Germany	11.57	11.57
South Africa	United Kingdom	139.55	149.11	Netherlands	77.77	83.09	United States	24.87	26.58
Spain	Netherlands	188.47	208.14	Luxembourg	118.06	130.38	United Kingdom	110.89	122.46
Switzerland	Netherlands	301.30	605.71	Luxembourg	181.04	363.95	United States	99.37	199.77
Tajikistan	China (People's Rep.)	0.08	0.08	Russia	0.03	0.03	United Kingdom	0.02	0.02
Thailand	Taiwan	5.45	5.65	Armenia	0.00	0.00	Australia	0.00	0.00
Turkey	Germany	11.85	12.66	Spain	9.00	9.62	Russia	6.46	6.90
United States	United Kingdom	374.87	468.66	Japan	284.08	355.15	Luxembourg	255.97	351.11
Venezuela	United States	7.43	13.19	Netherlands	6.38	11.33	Spain	4.05	7.18
Zambia	United Kingdom	1.28	1.36	China (People's Rep.)	0.91	0.97	Ireland	0.45	0.48

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table A6. Potential revenue foregone, source countries & 3 recipient countries related to the most revenue foregone, interest

Source country	1st recipient	Lower Bound	Upper Bound	2nd recipient	Lower Bound	Upper Bound	3rd recipient	Lower Bound	Upper Bound
Albania	Greece	0.13	0.25	Netherlands	0.04	0.23	Switzerland	0.06	0.13
Argentina	Spain	0.00	36.54	Netherlands	0.00	25.36	Chile	0.00	9.49
Australia	Japan	0.00	47.18	Switzerland	0.00	4.92	New Zealand	0.00	3.75
Belarus	Cyprus	0.48	0.57	Austria	0.11	0.13	Germany	0.06	0.12
Belgium	Netherlands	125.93	249.37	France	118.39	234.43	Luxembourg	103.73	205.42
Brazil	Netherlands	20.11	118.32	Spain	7.88	46.35	Luxembourg	5.90	34.68
Bulgaria	Netherlands	3.49	5.21	Austria	2.20	3.29	Greece	1.40	2.09
Burkina Faso	France	0.00	0.35	Tunisia	0.00	0.00	-	-	-
Canada	United States	46.46	265.48	Netherlands	11.10	105.72	Luxembourg	7.01	66.72
Croatia	Austria	2.36	4.68	Netherlands	2.19	4.34	Italy	1.23	2.44
Czech Republic	Netherlands	6.69	38.25	Germany	4.25	24.26	Luxembourg	3.79	21.65
Georgia	United Kingdom	0.75	0.90	Netherlands	0.69	0.83	United Arab Emirates	0.31	0.37
India	United States	0.33	1.91	Singapore	0.21	1.21	Switzerland	0.00	1.06
Indonesia	Singapore	9.37	27.55	Netherlands	4.91	14.43	United Kingdom	3.42	10.07
Ireland	United States	74.86	220.17	Netherlands	35.13	103.33	Luxembourg	22.19	65.26
Israel	United States	2.69	5.38	Netherlands	2.56	3.84	Singapore	1.50	1.50
Italy	Luxembourg	26.71	188.11	Netherlands	26.68	187.88	France	24.60	173.22
Japan	United States	3.95	23.23	France	2.12	12.45	Netherlands	1.68	9.89
Korea (Rep.)	Japan	4.72	17.21	United States	2.87	10.48	Netherlands	1.11	6.96
Kosovo	Germany	0.04	0.06	Netherlands	0.02	0.03	Slovenia	0.02	0.02
Lithuania	Sweden	1.73	2.58	Netherlands	0.88	1.32	Germany	0.68	1.01
Macedonia (FYR)	Austria	0.29	0.43	United Kingdom	0.00	0.39	Netherlands	0.22	0.32
Mexico	United States	1.25	13.00	Netherlands	0.83	5.56	Spain	0.33	3.40
Moldova	Russia	0.10	0.12	Netherlands	0.03	0.05	Spain	0.02	0.03
Mongolia	China (People's Rep.)	3.09	9.10	Canada	2.72	8.00	Singapore	1.17	5.15
Mozambique	United Arab Emirates	0.00	0.01	South Africa	0.00	0.00	-	-	-
Nigeria	China (People's Rep.)	0.04	0.06	South Africa	0.02	0.03	Belgium	0.00	0.00

Source country	1st recipient	Lower Bound	Upper Bound	2nd recipient	Lower Bound	Upper Bound	3rd recipient	Lower Bound	Upper Bound
Poland	Netherlands	35.48	104.37	Germany	30.42	89.46	Luxembourg	24.39	71.75
Portugal	Netherlands	13.61	77.79	Spain	12.24	69.96	Luxembourg	9.89	56.50
Romania	Netherlands	17.73	27.65	Germany	9.62	15.00	Austria	8.67	13.51
Russia	Cyprus	158.93	467.45	Netherlands	47.13	138.63	Germany	19.14	56.29
Serbia	Netherlands	1.33	3.92	Germany	0.41	1.22	Austria	0.39	1.15
Seychelles	Mauritius	0.01	0.03	Cyprus	0.01	0.02	United Arab Emirates	0.00	0.00
Slovak Republic	Netherlands	3.12	5.88	Austria	2.02	3.80	Czech Republic	1.47	2.77
Slovenia	Austria	2.17	4.30	Switzerland	0.74	1.46	Germany	0.68	1.34
South Africa	United Kingdom	3.79	7.51	Netherlands	2.11	4.18	United States	0.68	1.34
Spain	Netherlands	91.59	245.55	Luxembourg	57.37	153.82	United Kingdom	53.89	144.47
Tajikistan	China (People's Rep.)	0.40	0.66	United Kingdom	0.05	0.50	Cyprus	0.13	0.21
Uganda	Mauritius	0.02	0.04	Netherlands	0.01	0.01	India	0.00	0.01
United Kingdom	United States	311.43	613.70	Netherlands	111.64	219.99	Luxembourg	68.81	135.59
United States	United Kingdom	21.08	1 064.41	Luxembourg	15.83	799.49	Netherlands	13.47	680.46
Venezuela	United States	0.00	0.71	Netherlands	0.00	0.52	Spain	0.00	0.33

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table A7. Potential revenue foregone, static estimates, source countries - dividends

Source country	Year	Lower bound estimate			Upper bound estimate		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
United States	2016	9 481 022.87	72.41	0.05	10 616 033.20	72.88	0.06
Switzerland	2016	7 879 683.72	86.34	1.18	7 886 915.10	86.27	1.18
France	2016	4 954 239.15	87.33	0.20	5 051 331.44	85.65	0.20
Germany	2016	4 580 486.06	88.32	0.13	4 703 412.79	86.02	0.14
Canada	2015	3 184 193.06	37.51	0.20	3 185 623.85	37.51	0.20
Japan	2016	2 284 112.82	49.52	0.05	2 776 233.40	50.08	0.06
Czech Republic	2016	2 571 778.34	94.88	1.32	2 571 995.69	94.88	1.32
Russia	2016	1 726 595.34	91.27	0.13	1 812 973.67	91.69	0.14
Poland	2016	1 744 636.92	96.34	0.37	1 744 636.92	96.34	0.37
Austria	2016	1 663 893.60	80.37	0.43	1 663 894.04	80.37	0.43
Spain	2016	1 550 088.82	89.49	0.13	1 561 648.10	88.83	0.13
Korea (Rep.)	2016	1 240 860.55	37.32	0.09	1 241 018.17	37.32	0.09
Portugal	2016	878 706.15	95.70	0.43	878 706.15	95.70	0.43
Italy	2016	805 220.55	96.45	0.04	805 220.72	96.45	0.04
Australia	2016	435 281.27	24.77	0.04	797 525.12	20.28	0.07
Norway	2016	787 490.94	93.88	0.21	787 649.52	93.86	0.21
South Africa	2016	563 922.63	75.76	0.19	564 125.86	75.73	0.19
New Zealand	2015	337 269.01	0.00	0.19	477 125.57	0.00	0.27
Chile	2016	349 966.18	50.82	0.14	367 356.59	48.42	0.15
Kazakhstan	2016	257 198.01	67.19	0.19	323 898.28	73.95	0.24
Mexico	2015	241 673.39	40.45	0.02	295 283.13	51.17	0.03
Venezuela	2016	272 159.27	59.83	-	272 237.90	59.82	-
Romania	2016	165 472.99	99.98	0.09	165 493.14	99.97	0.09
Israel	2016	116 962.53	48.05	0.04	128 743.95	52.75	0.04
Slovenia	2014	105 742.07	98.95	0.21	105 743.63	98.95	0.21
Turkey	2016	94 501.54	61.72	0.01	99 336.65	63.58	0.01
Serbia	2016	88 465.68	89.75	0.23	88 465.68	89.75	0.23
Lithuania	2014	87 366.00	92.02	0.18	87 366.00	92.02	0.18
Philippines	2016	48 142.42	26.77	0.02	79 875.45	55.86	0.03
Bangladesh	2014	79 202.44	38.83	0.05	79 202.44	38.83	0.05
Greece	2014	78 141.12	97.45	0.03	78 141.12	97.45	0.03
Bulgaria	2016	32 287.24	99.96	0.06	33 320.89	96.86	0.06
Croatia	2016	30 574.55	98.58	0.06	30 574.55	98.58	0.06
Mongolia	2016	20 156.53	7.27	0.18	20 156.53	7.27	0.18
Belarus	2015	7 578.38	93.12	0.01	13 235.99	94.64	0.02
Azerbaijan	2016	12 314.70	89.68	0.03	13 007.44	90.23	0.03
Macedonia (FYR)	2016	10 930.90	91.03	0.10	12 171.51	91.94	0.11
Bolivia	2016	10 650.73	100.00	0.03	11 879.50	100.00	0.04
Georgia	2016	2 225.30	33.23	0.02	11 498.86	80.21	0.08
Panama	2013	6 850.47	67.63	0.02	11 105.69	80.03	0.02
Nigeria	2016	8 970.49	0.00	0.00	8 970.49	0.00	0.00
Ghana	2015	8 493.06	83.42	0.02	8 493.06	83.42	0.02
Pakistan	2015	3 378.09	0.25	0.00	7 644.48	0.22	0.00
Thailand	2016	7 342.73	0.00	0.00	7 342.73	0.00	0.00

Source country	Year	<u>Lower bound estimate</u>			<u>Upper bound estimate</u>		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
Albania	2016	6 700.39	84.90	0.06	7 339.50	86.21	0.06
Sri Lanka	2016	3 206.04	0.36	0.00	6 319.97	0.18	0.01
Zambia	2015	5 133.06	59.99	0.02	5 133.06	59.99	0.02
El Salvador	2013	4 179.48	100.00	0.02	4 179.48	100.00	0.02
Mozambique	2014	3 885.89	8.74	0.02	3 967.24	8.56	0.02
Costa Rica	2016	3 572.62	100.00	0.01	3 572.62	100.00	0.01
Botswana	2015	3 369.65	66.50	0.02	3 369.65	66.50	0.02
Armenia	2016	2 837.62	45.15	0.03	3 161.43	50.77	0.03
Lebanon	2011	2 064.96	37.39	0.01	2 064.96	37.39	0.01
Seychelles	2016	1 820.17	34.91	0.13	1 820.17	34.91	0.13
Iceland	2016	1 225.49	97.62	0.01	1 225.49	97.62	0.01
Uganda	2011	867.55	35.64	0.00	1 012.68	44.86	0.01
Montenegro	2015	559.14	51.92	0.01	569.05	51.02	0.01
Kyrgyzstan	2011	350.98	93.41	0.01	350.98	93.41	0.01
Tajikistan	2016	227.57	27.02	0.00	227.65	27.04	0.00
Paraguay	2011	41.76	-	0.00	41.76	-	0.00
Bosnia and Herzegovina	2015	5.56	100.00	0.00	5.56	100.00	0.00

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

Table A8. Potential revenue foregone, static estimates, source countries - interest

Source country	Year	Lower bound estimate			Upper bound estimate		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
United States	2016	12 336 876.91	77.18	0.07	12 524 741.85	76.03	0.07
United Kingdom	2016	2 303 702.92	54.16	0.09	2 395 178.23	52.09	0.09
Spain	2016	1 010 791.30	91.15	0.08	1 073 410.90	85.84	0.09
Russia	2016	979 414.30	93.36	0.08	982 009.40	93.37	0.08
Italy	2016	923 020.57	97.01	0.05	936 296.08	95.65	0.05
Belgium	2016	873 581.80	98.58	0.19	881 353.74	97.71	0.19
Canada	2015	543 243.57	37.16	0.03	681 336.40	48.67	0.04
Ireland	2016	558 310.49	59.52	0.18	559 651.24	59.38	0.18
Poland	2016	534 981.44	96.08	0.11	537 239.15	95.67	0.11
Portugal	2016	283 564.76	96.57	0.14	285 992.83	95.75	0.14
Brazil	2013	152 137.49	80.03	0.01	276 412.28	85.76	0.01
Kazakhstan	2016	164 554.15	63.41	0.12	164 554.15	63.41	0.12
Czech Republic	2016	164 546.72	94.90	0.08	164 552.25	94.90	0.08
Romania	2016	148 241.84	98.03	0.08	148 448.07	97.89	0.08
Argentina	2016	71 476.71	85.24	0.01	103 757.74	84.54	0.02
Indonesia	2016	94 977.17	31.02	0.01	96 566.49	32.15	0.01
New Zealand	2015	36 675.53	10.81	0.02	96 395.13	4.11	0.05
Chile	2016	34 400.29	48.49	0.01	90 798.15	59.20	0.04
Japan	2016	39 514.96	48.08	0.00	68 446.34	52.19	0.00
Korea (Rep.)	2016	63 095.05	36.35	0.00	67 432.66	40.02	0.00
Slovak Republic	2016	62 534.93	95.58	0.07	62 570.02	95.53	0.07
Australia	2016	0.00	-	0.00	61 013.04	13.00	0.01
Iceland	2016	36 514.59	97.64	0.18	36 514.59	97.64	0.18
Mexico	2015	16 568.12	50.92	0.00	28 590.00	45.52	0.00
Bulgaria	2016	25 775.40	97.75	0.05	26 416.54	95.38	0.05
Mongolia	2016	23 904.34	7.26	0.21	25 845.28	7.58	0.23
Croatia	2016	22 241.12	98.44	0.04	22 248.86	98.40	0.04
Philippines	2016	12 847.93	34.58	0.00	19 031.09	38.32	0.01
Greece	2014	18 855.50	94.28	0.01	18 856.01	94.28	0.01
South Africa	2016	15 857.29	84.16	0.01	15 982.17	83.50	0.01
Israel	2016	10 228.63	49.44	0.00	14 839.76	46.86	0.00
Slovenia	2014	12 206.73	99.20	0.02	12 222.00	99.07	0.02
Serbia	2016	12 158.42	92.40	0.03	12 158.42	92.40	0.03
Lithuania	2014	9 469.06	100.00	0.02	9 469.06	100.00	0.02
India	2015	6 172.96	47.43	0.00	8 784.54	43.07	0.00
Thailand	2016	337.14	30.18	0.00	8 463.53	21.12	0.00
Georgia	2016	3 426.93	85.89	0.02	3 537.38	83.50	0.02
Venezuela	2016	0.00	-	-	2 366.63	67.77	-
Armenia	2016	1 499.45	21.80	0.01	1 824.95	35.58	0.02
Macedonia (FYR)	2016	1 095.50	99.78	0.01	1 723.12	99.86	0.02
Tajikistan	2016	1 221.66	29.31	0.02	1 639.35	47.32	0.02
Belarus	2015	1 102.25	92.73	0.00	1 252.16	93.60	0.00
Morocco	2016	0.00	-	0.00	1 041.18	5.41	0.00
Albania	2016	708.49	91.24	0.01	867.23	92.84	0.01

Source country	Year	<u>Lower bound estimate</u>			<u>Upper bound estimate</u>		
		Lower bound	% EU	% GDP	Upper bound	% EU	% GDP
Bosnia and Herzegovina	2015	674.15	99.63	0.00	814.58	99.70	0.01
Moldova	2015	398.64	48.14	0.01	483.45	55.24	0.01
Burkina Faso	2014	0.00	-	0.00	354.39	100.00	0.00
Costa Rica	2016	12.40	100.00	0.00	223.25	100.00	0.00
Kosovo	2015	122.01	100.00	0.00	122.01	100.00	0.00
Ghana	2015	0.00	-	0.00	113.72	28.96	0.00
Nigeria	2016	91.40	0.00	0.00	91.40	0.00	0.00
Bangladesh	2014	45.79	40.07	0.00	65.80	39.29	0.00
Uganda	2011	63.92	22.71	0.00	63.92	22.71	0.00
Seychelles	2016	46.64	35.02	0.00	46.64	35.02	0.00
Mozambique	2014	15.05	15.90	0.00	19.13	25.01	0.00
Lebanon	2011	4.25	37.39	0.00	4.25	37.39	0.00
Kyrgyzstan	2011	2.93	99.72	0.00	3.58	99.77	0.00
Pakistan	2015	0.53	100.00	0.00	0.53	100.00	0.00
Paraguay	2011	0.22	-	0.00	0.29	-	0.00

Notes: Thousands USD, sorted decreasingly by the upper bound, EU member countries in bold.

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