Estimating the Scale of Profit Shifting and Tax Revenue Losses Related to Foreign Direct Investment

Petr Janský[1], Miroslav Palanský[1]

Abstract

Governments' revenues are lower when multinational enterprises avoid paying corporate income tax by shifting their profits to tax havens. In this paper, we ask which countries' tax revenues are affected most by this tax avoidance and how much. To estimate the scale of profit shifting, we start by observing that the higher is the share of foreign direct investment from tax havens, the lower is the reported rate of return on this investment. Similarly to the 2015 World Investment Report of the United Nations Conference on Trade and Development, we assume that the reported rate of return is lower due to profit shifting. Unlike the report, however, we provide illustrative country-level estimates of profit shifting related to foreign direct investment which enable us to study the distributional impact of international corporate tax abuse. We find that, on average, higher-income countries lose least and lower-income countries lose most corporate tax revenue relative to their GDP. On the basis of these estimates, we conclude that profit shifting thus deepens the existing income inequalities and the differences in government revenues between countries. Furthermore, we compare our results with three other recent studies that use different methodologies to derive country-level estimates of tax revenue losses that can be related to profit shifting. In a first such comparison made, we find that every study identifies differences across income groups, but the nature of these differences varies across the four studies.

Keywords: foreign direct investment; corporate income tax; tax avoidance; base erosion; profit shifting; inequality

JEL classification: F21, F23, H25

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[1] Institute of Economic Studies, Faculty of Social Sciences, Charles University, Prague, Czech Republic. Corresponding author: Petr Janský (jansky.peta@gmail.com). This research has been supported by the European Union's Horizon 2020 program through the COFFERS project (No. 727145). Miroslav Palanský gratefully acknowledges support from the GAUK under the project no. 848517. The authors are grateful to Bruno Casella, Kim Clausing, Alex Cobham, Caroline Schimanski and conference and seminar participants at UNU-WIDER, the International Institute of Public Finance, the University of Lisbon, the University of Oslo and Charles University for comments.

1 Introduction

Governments' revenues are lower when multinational enterprises (MNEs) avoid paying corporate income tax by shifting their profits to tax havens. Profit shifting and tax havens represent a crucial issue for the world economy. As we show in this paper's conservative estimates, globally, around 290 billion USD in profits from foreign direct investment (FDI)—or almost half a per cent of the world's GDP—may be shifted to avoid tax, which implies a global lower-bound estimate of tax revenue lost due to profit shifting of around 80 billion USD per year. Our methodology enables us to go beyond these global figures and present estimates of the scale of profit shifting for the 89 individual countries in our sample. While the estimated dollar losses are relatively evenly divided between developing and developed countries, the developing ones incur higher losses relative to their economic size (measured by their GDP), as well as their corporate and total tax revenue.

Tax havens and the profit shifting of MNEs have been receiving increasing attention from the media, policymakers and academics alike, as documented by the recent studies cited in this paper. The reason seems to be that it has become rather easy for MNEs to avoid paying corporate tax, but also, thanks to recent leaks of confidential documents and thorough investigative case studies, it has become relatively easy for the public to learn about this trend and for researchers to provide evidence of it. Yet, the exact scale of tax losses remains uncertain due to the inherent difficulties of estimating tax avoidance and due to gaps in the availability of relevant data, some of which are being addressed by recent proposals of the European Union (EU) and the Organisation for Economic Co-operation and Development (OECD) and some of which are being overcome by innovative researchers. For example, Habu (2017) uses the United Kingdom's confidential corporate tax returns to learn how aggressively foreign MNEs reduce their corporate tax liability, whereas Alstadsæter, Johannesen, & Zucman (2017) use audit and leaked data from tax haven institutions to study tax evasion by wealthy individuals. While these studies provide rigorous evidence, they are limited in their scope and provide revenue loss estimates for only one or a handful of countries.

In this paper, in contrast, we aim to provide estimates of the scale of profit shifting and the consequent tax implications for as many countries as possible, which naturally requires us to sacrifice rigour to some extent for the sake of improved scope. Specifically, we aim to estimate the scale of profit shifting and tax revenue losses related to FDI. Our two most important data sources are the International Monetary Fund's (IMF) Coordinated Direct Investment Survey (CDIS), which contains country-by-country bilateral FDI data for around 100 countries between 2009 and 2015, and the United Nations Conference on Trade and Development's (UNCTAD) FDI unilateral database with an even wider coverage. We begin by observing that a higher share of investment from tax havens (or offshore financial centres (OFCs) – terms that we use interchangeably in this paper) is associated with a lower reported rate of return on inward FDI. We assume, in line with UNCTAD's (2015) World Investment Report, that this

pattern is due to profit shifting, and estimate its scale and the resulting tax revenue losses. For the first time, we provide detailed country-level estimates of profit shifting related to FDI, which enables us to study the impact on individual countries' government revenues and thus also the distributional impact of international corporate profit shifting. Indeed, our main research question in this paper is which countries' tax revenues are affected most.

We estimate tax revenue losses at the country level, to understand who is losing and who is gaining the most from the current practice of international corporate profit shifting related to FDI. For example, are all developing countries or all EU members losing tax revenue? Are the estimates consistent with the notion that, for example, Mauritius or Luxembourg exploit the current international tax system loopholes at the expense of Mozambique or Latvia? In line with some previous studies, we find that lower-income countries lose more corporate tax revenue than higher-income countries, relative to their GDP or their tax revenues. We conclude that profit shifting thus deepens the existing income inequalities and the differences in government revenues between countries. We further reinforce our conclusions by making comparisons with three other similar studies with country-level tax revenue loss estimates. Specifically, we compare our estimates with perhaps the most comprehensive study of the global losses due to base erosion and profit shifting by the IMF's Crivelli *et al.* (2015), as re-estimated by Cobham and Janský (2018) with country-level results, and with the results of Cobham and Janský (2017), who estimate for US-headquartered MNEs how much additional tax payments countries would collect if MNEs' reported profits were fully aligned with their economic activity. The fourth source of profit-shifting estimates is Clausing (2016), with main results for the United States, but a speculative extension to a number of big economies worldwide. Across the four methodological approaches and sets of estimates, we establish characteristics that are associated with countries being more likely to suffer from higher losses due to the MNEs' profit-shifting activities.

The paper's empirical contribution is presented in the following four stages. First, using new and updated data sources, we re-estimate and critically review the work of UNCTAD (2015), in what we call the baseline model. Second, we develop an extended model and improve on the baseline model in a number of aspects. Third, for the first time, we provide country-level results of the estimated tax revenue losses and discuss the distributional impact of corporate profit shifting. Fourth, we compare our results with three other similar studies with country-level tax revenue loss estimates. These four specific stages altogether contribute to the expanding body of literature on profit shifting and tax havens. There are at least two specific areas in which we make a contribution to the existing research. First, we contribute to the ongoing collective attempt to arrive at estimates of the scale of profit shifting. Despite the inherent difficulties in such estimation, discussed for example by Fuest and Riedel (2012), a growing number of studies do make credible estimates of the scale of profit shifting, as our literature review below documents. However, a number of them focus on one country only, such as Gumpert *et al.* (2016) on Germany or Zucman (2014) on the United States. Indeed, one of our contributions to the literature is

that we develop estimates for a wide range of countries - in practice for all countries for which we have available data. We see this study also as a contribution to international policy debates, since there is only a limited number of similar estimates for a similar number of countries, and we make a comparison with the three that do exist.

We also contribute to the study of the heterogeneous impacts of international corporate tax avoidance. So far, most research looks at individual countries or, in the case of an international focus, often concentrates only on the division between the developing and developed countries. For example, Fuest, Hebous and Riedel (2011) find that the effect of the host country corporate tax rate on the debt ratio of multinational affiliates in developing economies is larger than for affiliates in developed economies. Similar division is used by Johannesen, Tørsløv and Wier (2017), who link the tax aggressiveness of MNEs with the economic development of their host countries, but they also estimate models that exploit the cross-country variation in economic and institutional development. This more granular approach is needed and similar studies should reflect the country-specific characteristics. In this paper's extended model, we perform our regression analysis using regional and income groups and carry out the rest of the estimation at the country level at which we also present the results and discuss their implications for differences in the effects of international profit shifting across income groups.

The remainder of this paper is structured as follows. We begin with a literature review of previous similar estimates in Section 2 and an overview of the data used and basic descriptive statistics in Section 3. We describe our empirical methodology in Section 4 and present the detailed results in Section 5, in which we also compare our estimates with those reached by some previous studies. Finally, Section 6 provides a discussion of the implications of the results and concludes.

2 Literature review

In this section, we first discuss the main channels through which MNEs may effectively shift profits out of high-tax jurisdictions and explore which of these channels could be quantified using the available data. Second, we briefly review recent literature related to the quantification of corporate profit shifting and the resulting tax revenue losses. Third, we sum up the results of a pioneering report by UNCTAD (2015) in which they developed the FDI-driven approach that we build upon in this paper. Last, and before moving to the data description, we discuss the pros and cons of the data sets used most often in similar research and those used in this paper. For the sake of space, we provide only a brief literature review in which we focus on the research most relevant for our paper. For more comprehensive reviews of academic literature on profit shifting, we refer to Dharmapala (2014), Clausing (2016) or Dowd *et al.* (2017).

Three main profit-shifting channels are recognized in the literature: debt shifting, the location of intangible assets and strategic transfer pricing. Naturally, all three are motivated by the MNEs' assumed desire to reduce their global tax liabilities by artificially shifting their profits and assets and thus tax bases to countries with lower (effective) tax rates, sometimes referred to as tax havens. First, in the case of the debt shifting channel, MNEs implement unnecessary loans at high interest rates from one MNE affiliate located in a low-tax jurisdiction to another profitable unit located elsewhere (Buettner and Wamser, 2013; Desai, 2005; Fuest *et al.,* 2011; Huizinga and Laeven, 2008). Second, intangible assets and intellectual property, such as brands or research and development, can be stationed artificially at a subsidiary in a tax haven, to which service fees are then paid by other parts of the MNE (Bryan *et al.,* 2017; Dischinger and Riedel, 2011; Seabrooke and Wigan, 2015; Taylor *et al.,* 2015). As discussed thoroughly by OECD (2017), pricing such intangible assets poses several major challenges, making it intrinsically difficult to disentangle profit-shifting effects from actual prices. The third main channel for profit shifting is to inflate or deflate the prices of goods or services being transferred between the various foreign parts of an MNE in such a way as to minimize the tax burden faced in all the countries put together (Bartelsman and Beetsma, 2003; Clausing, 2003; Davies *et al.*, 2014; Peralta *et al.*, 2006).

The quantitative evidence of MNEs shifting profits and debt and locating their headquarters or intellectual property in such a way as to avoid tax is substantial. As outlined above, a number of studies have provided evidence of profit shifting, especially on how tax rate differentials affect reported pre-tax profits, and on the strategies MNEs employ to reallocate profits within their groups. A range of studies analysed how reported income changes with respect to tax rate differences across countries, represented by Hines Jr and Rice (1994), Huizinga and Laeven (2008) and Dharmapala and Riedel (2013). Although the existing academic and policy studies provide useful guidance on what can be quantified, findings on the implications of tax avoidance for government revenue are rather limited. Three recent exceptions are Clausing (2009) and Zucman (2014), who both provide estimates for the United States, and Clausing (2016) who adds a speculative extension to other countries around the world. For developing countries, Johannesen and Pirttilä (2016) provide an overview and Johannesen *et al.* (2016) offer firm-level empirical results, whereas recent examples of revenue estimates come from Reynolds and Wier (2016) for South Africa and from Cobham and Janský (2018) for a range of countries. Furthermore, at least three international organizations have recently developed estimates of the budgetary impact of international corporate tax avoidance: OECD (2015a), IMF's Crivelli *et al.* (2015), UNCTAD (2015) and IMF (2014). Although these studies often make a number of strong assumptions and have to deal with a lack of any realistic counterfactual data (i.e. what the tax base would be in the absence of profit shifting), they do provide comparable estimates for many countries and have been influential in the policy debate.

We naturally build on a range of existing research in this paper, but here we build upon one specific source more than others. UNCTAD (2015) estimate tax revenue losses related to inward investment

stocks as directly linked to tax havens, focusing specifically on developing countries. They develop an FDI-driven approach to measure the scale and economic impact of tax avoidance schemes.[2] Their investment perspective on tax avoidance puts the spotlight on the role of tax havens as major global investment players. They estimate that some 30 per cent of cross-border corporate investment stocks are routed through tax havens before they reach their destination as productive assets (Bolwijn *et al.*, 2017b). Their preferred estimate of annual revenue losses for developing countries, the focus of their study, is 90 billion USD; extending that estimate globally results in USD 200 billion, or 8% of all corporate income tax, lost in government revenue in 2012. In this paper, we review their methodology and then extend it to help us better answer our research question. Moreover, using updated data sources, we report the results at country level and discuss the resulting distributional impacts of profit shifting.

The data source that many of the recent profit-shifting studies aiming for a wide coverage of countries use—including Fuest, Hebous and Riedel (2011) and Johannesen *et al.* (2017)—is the Orbis database, the largest commercially available database of company balance sheets. One of the advantages of Orbis is that it contains data that enable researchers to produce rigorous estimates about various profit-shifting channels such as, for example, the choice of patent location within MNEs, as documented by Karkinsky and Riedel (2012). Orbis, however, does have its quite well-known substantive shortcomings, in addition to being available only to subscribers. It suffers from a country selection bias, with some countries' companies being more likely to be represented than others. As argued by Clausing (2016) or Alstadsæter *et al.* (2017), Orbis includes extremely limited information on tax havens and an analysis based on the data thus excludes many of the observations that drive most of the income-shifting behaviour. Cobham and Loretz (2014) and Kalemli-Ozcan *et al.* (2015) document that the coverage is severely limited especially among developing countries. Therefore, as recently acknowledged by Garcia-Bernardo *et al.* (2017) while identifying tax havens, the Orbis data is biased against tax havens and developing countries, both of which are obviously crucial for research such as ours.

Instead of Orbis, we use country-level FDI statistics, described below and employed in various recent research ranging from Pérez *et al.* (2012), on illicit financial flows as motives for FDI, to Akkermans (2017), considering the long-term effects of FDI. On the one hand, the level of granularity of FDI data remains much lower than that of Orbis and some concerns about data quality remain, especially when the data is reported by tax havens. On the other hand, coverage of both tax havens and developing countries is what makes FDI data superior to Orbis for our purposes. All in all, we believe that both Orbis and country-level FDI data sets should be used for research into profit shifting and that their results

[2] For the methodological details of UNCTAD approach, we will refer to the complementing technical paper by Bolwijn *et al.* (2017a).

can complement each other. Given the better coverage, our FDI-data driven approach is apt for estimating the scale of global distribution of profit shifting and tax revenue losses.

3 Data

The methodology that we use in this paper relies on country-level FDI data. First and most important, we use data on FDI stocks on a bilateral level from the IMF's CDIS, which contains data for around 100 countries between 2009 and 2015.[3] For stocks of direct inward investment, we use the variable 'Inward Direct Investment Positions, US Dollars (IIW_BP6_USD)'. As a complement, in some limited cases where we do not need bilateral FDI data, we use UNCTAD's unilateral FDI database for its greater coverage of countries.[4] The volume of total global stock of international investment rose substantially over the observed time period. Figures A1 and A2 in the Appendix show this development for countries classified into income groups (Figure A1) and regions (Figure A2). While in 2009 the total global FDI stock amounted to 19.26 trillion USD, in 2015 it was 26.94 – a 40% increase. All groups increased their FDI stock except one – the Middle East and North Africa lost 69% of its FDI stock, likely due to the combined effect of declining oil prices, the Arab spring and military conflicts in the region. The significant increase (by 1,382%) in South Asia's FDI stock between 2009 and 2015 is caused by the lack of data for India in 2009 – if we use India's 2010 value to compute the difference over the observed time period, we arrive at a modest 43% increase. The bars in Figures A1 and A2 are divided into two parts based on the origin of the FDI—from tax havens and other countries—a classification that we explain in detail in the following section. We observe that the increase in total FDI stock was caused by investment from both OFCs and other countries. Summary statistics of the data on FDI stock are presented in Table A1 in the Appendix.

The other important data required for our methodology is FDI income, which we source from the IMF's Balance of Payments Statistics. Specifically, for FDI income we use the variable called 'Current Account, Primary Income, Investment Income, Direct Investment, Debit, USD (BMIPID_BP6_USD)'. We compute the rates of return on FDI as the shares of FDI income on total FDI stocks in each country. We recognize at least three potential drawbacks of this step. First, while investment from different countries may yield different returns across countries, the FDI income data are only available at country level (and not at a bilateral level), which hides some of the information that could potentially be used to obtain better estimates of the size of corporate profit shifting (for example by distinguishing between FDI income from OFCs and from other countries). Second, although both sources (for FDI income and

[3] Available at: http://data.imf.org/?sk=40313609-F037-48C1-84B1-E1F1CE54D6D5 [Accessed January 7, 2017]

[4] UNCTAD FDI statistics, available at: http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics.aspx [Accessed February 4, 2017]

FDI stocks) that are combined into a single number (the rate of return on FDI) come from the IMF, they may potentially use slightly inconsistent methodologies to identify what is classified as FDI. Third, while we use the equity and debt components of the rate of return (in addition to the overall rate of return), the equity and debt components are divided by the same overall FDI stock, rather than the equity component and the debt component of the FDI stock. Despite these data limitations, we assume that these sources are reflective of the true rate of return on FDI. In addition to FDI-related data, our methodological approach requires data sources that are auxiliary to the main analysis, including data on corporate tax rates from KPMG[5] and the WB (2016), lists of tax havens from various sources, and data on GDP from the World Bank, complemented by data from the UN[6] and the CIA's *World Factbook*[7]. To present the estimates in relative terms to tax revenues, we use the relatively recently introduced ICTD/WIDER *Government Revenue Dataset*[8] (Prichard *et al.*, 2014). We present summary statistics of all the used variables in Table A1 in the Appendix.

4 Methodology

In this section, we describe the empirical strategy that we use to estimate the scale of corporate profit shifting. Since the phenomenon is intrinsically difficult to observe directly, the existing methodological approaches aim to shed more light on certain aspects of profit shifting indirectly. In this paper, we build on one such approach developed by UNCTAD (2015) and detailed by Bolwijn *et al.* (2017a) and we extend it further to provide the answer to our research question of which countries' tax revenues are most affected by profit shifting. We begin by empirically testing whether a higher share of investment from tax havens is associated with a lower reported rate of return on inward FDI. After this relationship is tested and assumed to be due to profit shifting, we describe how we estimate its scale and the resulting tax revenue losses. The final part of this section explains in detail how we define the share of investment from tax havens in total inward FDI in each country, used as an input in the first part.

The hypothesis central to our analysis is that a higher share of FDI from tax havens is associated with a higher volume of profit-shifting practices, resulting in an artificially deflated reported rate of return on

[5] Corporate tax rates table, available at: https://home.kpmg.com/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html [Accessed February 4, 2017].

[6] Available at: http://data.un.org/Data.aspx?d=WDI&f=Indicator_Code%3ANY.GDP.MKTP.CD [Accessed June 6, 2017]

[7] The latest CIA data are available at: https://www.cia.gov/library/publications/the-world-factbook/ [Accessed February 12, 2017]

[8] Available at https://www.wider.unu.edu/project/government-revenue-dataset [Accessed July 17, 2017]

FDI. In our baseline model, the regression to be estimated using ordinary least squares (OLS) with regional- and time-fixed effects is:

$$FDI\_ROR_{it} = \beta * share\_offshore_{it} + \sum_{s=2009}^{2015} \delta_s z_{s,i} + \sum_{k=1}^{7} \phi_k d_{k,i} + \varepsilon_{it},$$

where FDI_ROR_{it} is the rate of return on FDI in country i in year t, $share\_offshore_{it}$ is the share of FDI from tax havens in country i in year t, $z_{s,i}$ are year-fixed effects, and $d_{k,i}$ are regional-fixed effects based on World Bank classifications. The rationale behind using regional-fixed effects is that some regions share common characteristics that have significant effects on both the explanatory and the dependent variable. To ensure the comparability of our results to those reached by UNCTAD (2015), the regression model is estimated using the same list of 72 countries, but includes additional data for 2013-2015 and thus increases the sample from 265 to 477 observations. We estimate the model for all countries as well as separately for two groups—for developing and developed countries—and for three alternatives of the dependent variable: rate of return on FDI and its equity and debt components. While we hypothesise a negative relationship for the rate of return and also its equity component, we expect a smaller effect for the debt component since it is composed primarily of interest paid by the foreign affiliates to the parent, which is, in fact, a cost for the affiliates that is not subject to corporate income taxation. Therefore, we include the estimation of the debt component for the sake of completeness, but we focus on models that use the equity component of the rate of return and the overall rate of return itself.

In the second part of our empirical analysis, we propose an extended model:

$$\begin{aligned} FDI\_ROR_{it} = {} & \alpha * share\_offshore_{it} + \sum_{m=1}^{5} \beta_m * share\_offshore_{it} * inc_{m,i} \\ & + \sum_{k=1}^{7} \gamma_k * share\_offshore_{it} * d_{k,i} + \sum_{m=1}^{5} \delta_m inc_{m,i} + \sum_{k=1}^{7} \phi_k d_{k,i} + \sum_{s=2009}^{2015} \theta_s z_{s,i} \\ & + \varepsilon_{it}, \end{aligned}$$

where $inc_{m,i}$ are dummy variables for income groups (as per the classification by the World Bank), with the remaining notation the same as in the baseline model.

Our extended model makes four innovations over the baseline model. First, we use a more granular definition for lower-income countries, which is based on the World Bank's classification of countries by income. Specifically, we add controls for income groups in our model, using a dummy variable in the full-sample regression, rather than splitting the sample for developing and developed countries and performing the regressions separately. Second, the extended model allows for effects that are heterogeneous across regions and income groups, to influence the relationship between the offshore indicator and rate of return. This addition is enabled by including not only dummy variables for income

groups, regions and years, but also interaction terms for income groups and regions with the share of FDI from tax havens. The regional and income-group effects are thus implicitly divided into those that affect the examined relationship and those that do not. The rationale behind this process is that the countries within these groups share some common characteristics that have a specific effect on the behaviour of the MNEs that route their investment through tax havens. Our approach enables the capture of these common effects and this innovation is instrumental for the derivation of country-level results. A first-best model might be one that includes country-level fixed effects, yet the low levels of variation in inward investment stock and rate of return on these investments prevent a country-fixed effects model from having enough explanatory power. Third, we estimate the country-level results using specific corporate tax rates for each country rather than one estimate for all countries. This, together with the inherent fixed-effects heterogeneity, yields more accurate results at the country level. Fourth, our sample covers not only a longer time period, but also a larger number of countries, bringing the total number of observations included in our headline extended model to 509, compared to the 265 used by UNCTAD (2015).

While these innovations improve on the baseline model, some concerns and a need for assumptions remain and we discuss them here. For example, an MNE may decide to route the investment through an OFC because the destination country has an inefficient financial sector. As a result, the low level of financial development causes a lower rate of return (i.e. lower financial development implies fewer sources of local financing for the foreign affiliate and, therefore, a lower rate of return) and a higher offshore indicator (the MNE has to route the investment through the OFC in order to finance its foreign affiliate efficiently). More generally, due to potential endogeneity problems, we do not aim to establish causality in the relationship between the two variables, but instead focus on the correlation between them across countries, income and regional groups. Unfortunately, data on bilateral FDI are only available at country-, rather than industry- or firm-level, which prevents further improvement in the precision of estimating the relationship between the offshore indicator and the rate of return on FDI. There thus remain some concerns about, for example, potentially more profitable investment being routed more through tax havens, which would make our estimates biased upward. Conversely, investment into developing countries may be more likely to be routed through tax havens, but may also be likely to yield higher profits, which would make our estimates biased downward.

Furthermore, even if we observe a statistically significant negative relationship between the share of tax haven investment and rate of return, it is only evidence consistent with profit shifting and, of course, it does not necessarily imply that profit shifting is responsible for all, or much, or even any part of the observed relationship. As is the case with similar relationships, such correlation might be spurious or explained by some not included or unobserved variable, or some other endogeneity issue. There does not seem to be a credible way to establish the extent to which the correlation is driven by profit shifting. Instead, we assume that it is so. We make this important assumption mostly based on the underlying

logic, i.e. that the profits are lower as a consequence of being shifted to tax havens, that the origin of FDI should not significantly affect the actual profitability of the foreign affiliate, and existing evidence that profit shifting is indeed an important phenomenon presented by other studies, including those discussed in the literature review. Due to making this assumption, we can consider the estimates an upper bound for the effects of profit shifting, since we assume that only profit shifting is responsible for all of the observed relationship. On the other hand, another implication of this methodology is that, of all the various schemes used to shift profit, we capture only those that are reflected by the FDI data. For example, trade mispricing is thus not fully accounted for in our estimates, since it does not require a direct investment link. These estimates thus may not include the full effects of profit shifting and may, in this respect, be viewed as lower-bound estimates of the scale of all profit-shifting activity.

Once we make this assumption, we can estimate how much profit is shifted and the associated tax revenue loss for the affected countries. Specifically, to arrive at an estimate of the scale of shifted profits we multiply the actual amount of offshore investment by the responsiveness of the reported rate of return on offshore investment – a parameter estimated by the regression above. To further increase the coverage (from 79 to 92 countries), for countries that do not report bilateral FDI data but do report unilateral inward FDI data to the UNCTAD's FDI database, we calculate the share of offshore investment as a simple average of the shares of offshore investment in the region-income group. Finally, to arrive at an estimate of the associated tax loss, we transform the shifted profits to pre-tax values and multiply them by the relevant statutory tax rate. For the baseline model, we do so in the same straightforward way as UNCTAD (2015), considering average rather than country-specific values for FDI stock, a share of FDI from offshore financial centres and the corporate tax rate.[9] In contrast, for the extended model, we do use the country-specific values for these variables whenever available. These estimations are implicitly underpinned by a number of other assumptions, such as assuming that all the shifted profits would, were they not shifted, be liable to corporate income taxation at a the same particular statutory tax rate. Indeed, the important assumption discussed above, together with these additional assumptions, imply that we should be careful when interpreting and using these illustrative estimates of profit shifting.

We now return to explaining how we define the share of offshore investment that each country receives. In constructing the share of inward FDI from tax havens, we identify the OFCs in three categories, mostly following UNCTAD (2015). We acknowledge that this method partly relies on somewhat arbitrary decisions about the criteria for the dichotomous selection of OFCs, criticised for example by

[9] Their approach can be summed up in the following way (with their headline numbers for developing countries in the parentheses): corporate income tax revenues lost due to profit shifting for developing countries = average tax haven exposure of total inward FDI stock (46%) × reported FDI stock (USD 5,000 billion) × responsiveness of reported rate of return on tax haven investment (15.8%) × transforming the after-tax values to pre-tax values (1.25) × weighted average effective tax rate (20%) = USD 91 billion.

Cobham, Janský, & Meinzer (2015). Indeed, we would prefer to use a continuous measure that does not rely on binary criteria for all three groups. However, to our knowledge, there is currently no such one measure for offshore investments and the three groups used here at least combine binary with continuous measures.[10] The first group is a list of 38 *tax havens* compiled by UNCTAD (2015) based on OECD's (2000) initial list of 41 jurisdictions.[11] The whole stock of investment from these jurisdictions is considered as offshore investment. The second is a group of so-called self-declared special-purpose entity (SPE) countries. An SPE is an institutional unit that provides financial services to MNEs that allow it to transfer funds through a jurisdiction. These entities are sometimes called pass-through units or shell companies because the financial flows administered by these entities do not correspond to their actual economic activities in the SPEs' country of incorporation (OECD, 2015b). We consider four SPE countries from UNCTAD (2015) with data for 2012, available as of April 2014, from the countries' central banks. The share of inward investment operated through SPEs were 40% for Austria, 58% for Hungary, 96% for Luxembourg and 83% for the Netherlands.[12]

The final group of tax havens are 'other SPE countries', which do not declare themselves to be SPE-enabling countries, but seem to behave as such. We identify other SPE countries in the same way as UNCTAD (2015), proceeding in two steps. First, we identify countries that have been successful in becoming important offshore financial centres. We classify a country as an 'other SPE country' if, as of 2015 data, it ranks in the first quartile in terms of inward FDI stock and has a ratio of inward FDI stock to GDP of more than 1. For 2015 data, we identify 25 countries complying with the first criterion and 12 with the second, with seven countries at the intersection of these two groups (thus complying with both criteria). Excluding self-reported SPE countries results in four countries classified into the final 'other SPE countries' group (i.e. Hong Kong, Ireland, Singapore and Switzerland).[13] In the second step, we consider the four 'other SPE countries' and calculate the level of investment implied by the size of

[10] However, future research should investigate the sensitivity of the results to alternative lists and classifications that have been used in the literature to refer to selected jurisdictions as tax havens.

[11] Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Cyprus, Dominica, Gibraltar, Grenada, Guernsey, Isle of Man, Jersey, Liberia, Liechtenstein, Malta, Marshall Islands, Mauritius, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Seychelles, Turks and Caicos Islands, US Virgin Islands, Vanuatu.

[12] In future research, the selection process for classifying countries into this group may thus potentially be improved by using newly available data from other countries' central banks.

[13] Based on 2012 data, 26 countries compled with the first criterion and 12 with the second, the intersection of which results in six countries falling into the 'other SPE countries' category. Out of these, Hungary, Luxembourg and the Netherlands were already included in the self-declared SPE countries category, so that only the remaining three countries fall into the 'other SPEs' group: Hong Kong, Ireland and Singapore.

their economy (based on a simple OLS cross-country regression of reported inward investment on GDP in 2015). The difference between the actual FDI stock and the predicted FDI stock is then accounted towards the offshore indicator. Combined, the three categories contribute to how much each country receives in inward FDI from offshore financial centres relative to all of its inward FDI. This figure feeds into the regression at the methodology's start and with it we also begin the discussion of results.

5 Results

We present our empirical results in this section. First, we present estimates of the baseline model using updated data sources. Second, we break down these numbers into country-level results. Third, we estimate the newly developed extended model and present its country-level estimates. Fourth, we compare our results with three other similar studies and highlight their relevance for the cross-country distributional impact of international corporate profit shifting.

We begin with the results of the estimation of the baseline model in Table A2 in the Appendix. For both the rate of return and its equity component, we find a statistically significant negative relationship between the offshore indicator and the rate of return on FDI stock using the full sample of countries, with larger and statistically significant coefficients for the sample of only developing countries and with no statistically significant effect for the sample of only developed countries. Our longer data series improves the explanatory power of the model and suggests slightly smaller coefficients in absolute value than the original results reached by UNCTAD (2015). Positive and statistically significant coefficients obtained for the model that uses the debt component of the FDI rate of return are in line with the notion that the debt component is composed primarily of interest paid by the foreign affiliates to the parent, which is, in fact, a cost for the affiliates and thus an element that actually erodes the taxable base. In the remaining part of our analysis, including the extended model, we focus only on models that use the equity component of the rate of return or the rate of return itself.

We now derive the estimate of the scale of profit shifting, assuming that the observed negative relationship between the share of offshore investment and the rate of return on FDI can be attributed to profit shifting. Table A3 in the Appendix summarizes the results for 2015. We use information on the total global exposure to tax haven investment reached (41.5% for all, 52% for developing and 37% for developed countries) and the total reported FDI stock (19.57 trillion USD for all, 6.37 trillion USD for developing and 13.19 trillion USD for developed countries). One option is to use the regression estimates for all countries from Table A2. That way, we arrive at a global estimate of 126 and 178 billion USD lost in tax revenues in 2015, using the rate of return and its equity component only, respectively. While the obvious advantage of this option is to have the estimates of tax losses for all countries (except for tax havens, of course), a drawback of this model is that it averages out significant heterogeneity across countries. Therefore, we consider more granular options, starting with the one that divides the

sample into two groups – developing and developed countries. Our results for 2015, presented in detail in Table A3 in the Appendix, show similar results to those reached by UNCTAD (2015) for 2012. While our estimated profitability gap is lower, total FDI stock in developing countries increased from 5 in 2012 to 6.37 trillion USD in 2015, leading to estimates of similar magnitude – 91 and 114 billion USD lost in tax revenue in developing countries in 2015.[14] Using actual corporate tax rates (instead of the averaged ones as indicated in Table A3) results in country-level estimates as presented in the first two columns of Table A4 in the Appendix. These estimates, however, use the same estimated profitability gaps for all countries and for the groups of developed and developing countries (in the first and second column, respectively). In our extended model, we use an even more granular level of fixed effects at the region-income level to derive more precise estimates of the profitability gap.

For the extended model, we begin with the regression results in Table 1. As in the baseline model, we use three specifications that differ in their dependent variable. In line with the hypotheses outlined above, we observe a statistically significant, negative relationship between the offshore indicator and the first two dependent variables, as well as a lower coefficient for the debt component of the rate of return. [15] Importantly, the regressions in the extended model include controls for income-, region- and year-fixed effects. The coefficient combinations for the two classifications result in the estimates presented in Table 2. We exclude from further analysis countries in those region-income groups for which the estimated profitability gap is positive, since we focus on estimated losses only and, similarly, we do not investigate the potential tax gains by tax havens.[16] Our extended approach takes advantage of

[14] One speculative, and perhaps too optimistic, explanation for the lower estimated profitability gap is that recent government efforts to curb profit shifting have already started to have an impact and we can observe that change in the estimates. Also speculatively, because of the statistically insignificant coefficients for developed countries, we derive the estimate of 102–116 billion USD of tax revenue losses for developed countries – only to be interpreted with caution. If we combine it with the estimate for developing countries, a global estimate of 193–230 billion USD is slightly higher than in our first model, which used the same regression estimate for all countries.

[15] We do not observe statistically significant estimates for the interaction terms 'OI*North America' and 'OI*Middle East and North Africa' only; the remaining estimates are statistically significant, at least at the 10% level. We, nevertheless, account for the insignificant estimates in the construction of the coefficient combinations.

[16] We recognize several potential reasons why we obtained positive regression estimates for some country groups. First, our list of tax havens and SPE countries is the same for all countries, but in reality, each country's MNEs may use different tax havens with different intensity, resulting in an artificially deflated or inflated offshore indicator for such countries. A potential solution for future research might be to weigh the tax-haven FDI against a form of bilateral definition for tax havens, preferably defined as a continuous variable rather than a binary one. Second, the data on bilateral FDI may be collected using different methodologies in different countries, as not all countries comply with the IMF's international standards for FDI reporting. Third, in some countries there might

the inclusion of region- and income-fixed effects and exploits the heterogeneity in the relationship between the rate of return and the offshore indicator across combinations of these classifications, thereby providing a more country-specific, and thus precise, estimate of the relationship for individual countries. We use these estimates in the following section to compute estimated tax revenue losses at the country level.

We follow the steps as applied above for the baseline model, but with information specific to each country on actual tax haven exposure and nominal corporate tax rates. Where those are missing, we input the average values in the respective region-income group at the cost of losing some degree of precision, but with the objective of obtaining estimates for as many countries as possible despite data limitations. In total, we obtain country-level results of positive tax revenue losses for 89 countries. If we sum up these country-specific estimates, the total global tax revenue losses amount to 66.7 and 81.5 billion USD, using the rate of return and its equity component only, respectively. We present these country-level estimates for all countries in our sample in Table A4 in the Appendix (along with these estimates as shares of GDP, corporate tax revenue and total tax revenue) and in Figure 1, which shows the share of total tax revenue losses from the total GDP, by income and regional groups. As explained above, unfortunately, the relatively short panel of observations and low heterogeneity of the explanatory variable over time prevents the use of country-fixed effects, which is why we use the income-region groups instead. Therefore, the differences between countries within the income-region groups are driven by the heterogeneity in FDI stock, tax haven exposure and corporate tax rates, whereas the differentiated regression estimates also contribute to the differences across countries from different income-region groups.

not be any substantial profit shifting requiring a direct FDI link with the countries that we define as tax havens, and the higher profits are achieved there for reasons other than corporate profit shifting.

Table 1: Estimation results of the extended model

	(1) Rate of return	(2) Rate of return – equity component	(3) Rate of return – debt component
Offshore indicator (OI)	-0.132***	-0.106**	-0.0256***
	(0.0439)	(0.0420)	(0.00813)
OI*Low income	Omitted (=base)	Omitted (=base)	Omitted (=base)
OI*Lower-middle income	0.197**	0.175**	0.0232***
	(0.0842)	(0.0820)	(0.00852)
OI*Upper-middle income	0.261***	0.214**	0.0575***
	(0.0934)	(0.0921)	(0.00999)
OI*High income: non-OECD	0.228**	0.223**	0.0376***
	(0.0967)	(0.0964)	(0.00973)
OI*High income: OECD	0.289***	0.282***	0.0137
	0.197**	0.175**	0.0232***
OI*Sub-Saharan Africa	Omitted (=base)	Omitted (=base)	Omitted (=base)
OI*Europe and Central Asia	-0.171**	-0.186**	0.00346
	(0.0831)	(0.0827)	(0.00464)
OI*East Asia and Pacific	-0.142*	-0.161*	0.0153
	(0.0826)	(0.0830)	(0.0101)
OI*Latin America and Caribbean	-0.266***	-0.256***	-0.0122**
	(0.0843)	(0.0846)	(0.00557)
OI*Middle East and North Africa	-0.110	-0.0979	-0.00772*
	(0.0791)	(0.0772)	(0.00413)
OI*North America	-0.144	-0.181*	0.0297***
	(0.0943)	(0.0941)	(0.00973)
OI*South Asia	-0.348**	-0.361***	-0.000383
	(0.142)	(0.139)	(0.0130)
Constant	0.0740***	0.0627***	0.0118***
	(0.0124)	(0.0119)	(0.00313)
Observations	513	502	422
R-squared	0.327	0.353	0.318
Income effects	Yes	Yes	Yes
Regional effects	Yes	Yes	Yes
Year effects	Yes	Yes	Yes

Source: Authors.

*Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Table 2: Results of the estimation of the extended model – summary of region-income group combinations

Region	Income group	ROR method	ROR – equity component method	No. of countries
South Asia	Low income	-0.467	-0.472	2
South Asia	Lower-middle income	-0.291	-0.274	5
Latin America and Caribbean	Lower-middle income	-0.187	-0.198	6
Latin America and Caribbean	Upper-middle income	-0.148	-0.138	11
Latin America and Caribbean	High income: non-OECD	-0.139	-0.184	9
Europe and Central Asia	Lower-middle income	-0.116	-0.125	8
Sub-Saharan Africa	Low income	-0.106	-0.132	25
East Asia and Pacific	Lower-middle income	-0.091	-0.077	10
Latin America and Caribbean	High income: OECD	-0.080	-0.084	1
Europe and Central Asia	Upper-middle income	-0.077	-0.065	12
Europe and Central Asia	High income: non-OECD	-0.069	-0.110	8
East Asia and Pacific	Upper-middle income	-0.052	-0.016	9
East Asia and Pacific	High income: non-OECD	-0.044	-0.062	7
Middle East and North Africa	Lower-middle income	-0.028	-0.043	6
Europe and Central Asia	High income: OECD	-0.009	-0.010	17
Middle East and North Africa	High income: non-OECD	0.019	-0.029	5

Source: Authors.

Figure 1 presents weighted averages of the shares of estimated tax revenue losses on GDP for income and regional groups. We find evidence in favour of the hypothesis that lower-income countries lose more tax revenue in relative terms than higher-income countries. For low-income, lower-middle-income and upper-middle-income countries, we estimate the total tax revenue losses due to profit shifting at 0.4%, 0.54% and 0.22% of GDP, respectively, which can be considered substantial amounts. On average, our estimates suggest that Sub-Saharan Africa, South Asian, and Latin American and Caribbean countries lose the most significant amounts relative to their GDP. Figure 2 shows the estimates of tax revenue losses as shares of GDP for low-income, lower-middle-income and upper-middle-income countries, providing a clearer picture of which lower-income countries' losses contribute most to the high numbers for the three least developed groups of countries in Figure 1. The estimated tax revenue losses for the countries that lose the most reach up to around 1% of GDP.[17]

[17] We present the estimates of tax revenue losses as shares of GDP for two reasons. First, we consider it a suitable indicator for the relative size of the tax revenue losses. Second, and in contrast to some other potentially suitable

Figure 1: Estimated tax revenue loss as a share of GDP, by income and region group, 2015.

Source: Authors.

Note: The number of countries in each income group is included in parentheses.

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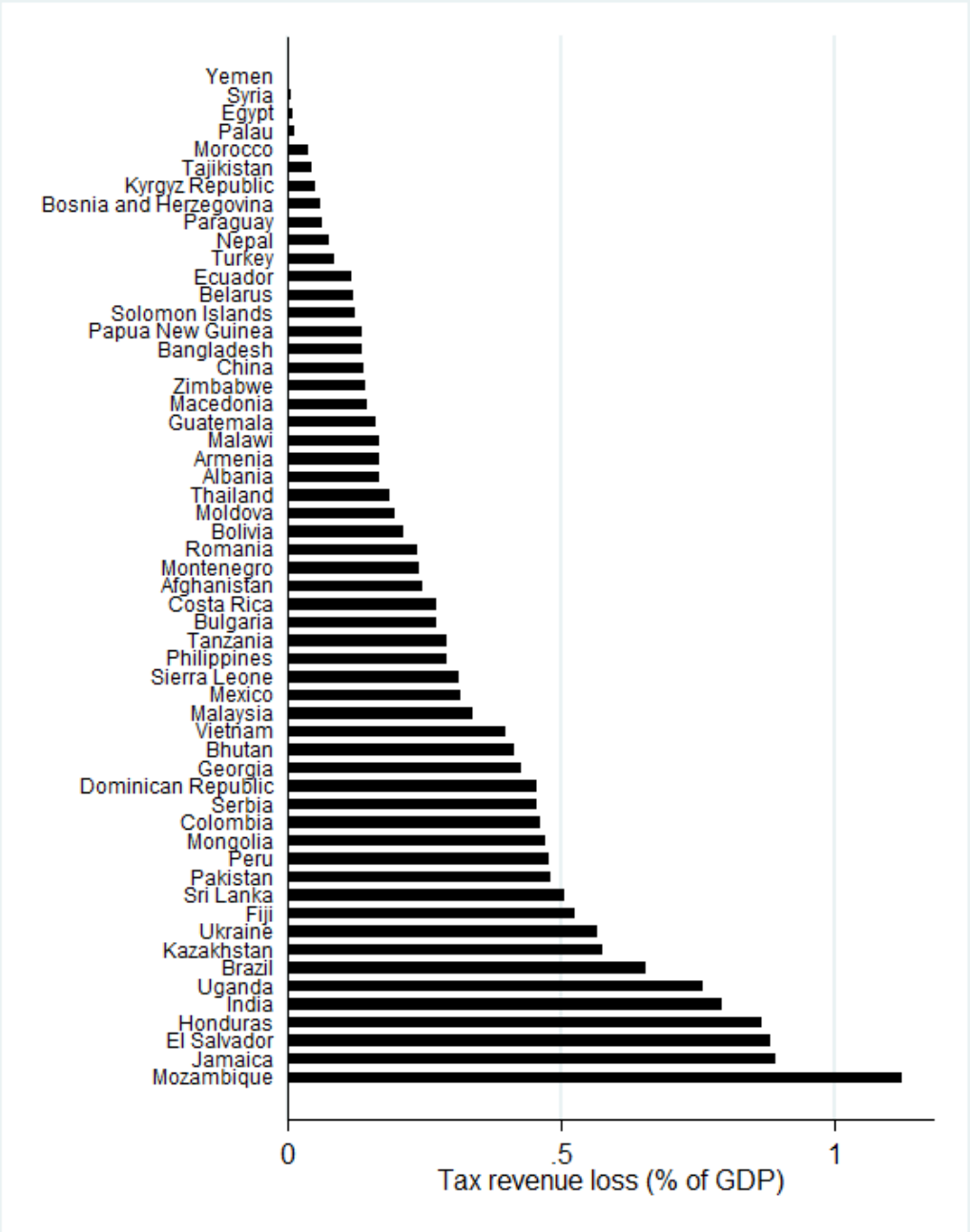
data such as tax revenues, data on GDP is available for most countries worldwide. Still, we believe it is relevant to present the estimated losses in terms of the total tax revenues or corporate tax revenues. Therefore, in Figures A6 and A7 we present our estimates as shares of corporate tax revenue and total tax revenues, respectively, for all countries in our sample that have data on these tax revenues available in the *Government Revenue Dataset*. They suggest that significant shares of the countries' current tax revenues are relinquished due to profit shifting, with lower-income countries again losing higher shares of corporate tax revenue in relative terms. Furthermore, as reported in Table A5, the correlation between GDP per capita and tax revenue losses as shares of corporate tax revenue is negative at -0.3464 and is statistically significant at the 5% level, underlining our previous results.

Figure 2: Estimated tax revenue loss as a share of GDP for low-income, lower-middle-income and upper-middle-income countries, 2015



Source: Authors.

In the final part of this section, we compare our estimates with those obtained by three other recent studies that use different methodologies to derive country-level estimates of tax revenue losses that could be related to profit shifting. Figure A3 in the Appendix shows a direct comparison of our results with those provided by Cobham and Janský (2018), whose approach builds on the spillover methodology developed by IMF's Crivelli et al. (2016), and those provided by Cobham and Janský (2017) and Clausing (2016), who both only focus on US-headquartered MNEs, in contrast to the other studies' intended global coverage. While Cobham and Janský (2017) estimate the misalignment between the

location of the profits and the economic activity, Clausing (2016) derives her revenue effect estimates from profits' sensitivity to lower tax rates. All four sets of estimates employ different methodologies (detailed discussion of which is beyond the scope of this paper), samples and scope, making direct comparisons difficult. While recognising the differences and related difficulties, we make these comparisons.[18] Figure 3 compares the various studies' results by showing the estimated tax revenue losses as weighted shares of GDP for the income groups used above. In addition to the average tax revenue loss as a percentage of GDP, we include the number of countries per income group for each of the studies in parentheses.

In the first such comparison made, we find that every study identifies substantial differences across income groups, but the nature of these differences varies across the four studies. There are substantial differences in the weighted averages, for example, around 0.4% of GDP for our estimates and 2% of GDP for Cobham and Janský (2018). Importantly, the number of countries included in the income groups varies greatly. For example, neither Cobham and Janský (2017) nor Clausing (2016) have any low-income country in their sample, while our paper, as well as that by Cobham and Janský (2018), has a relatively good coverage of lower-income countries. While Cobham and Janský (2017) and Clausing (2016) identify high-income, OECD countries and then only lower-middle-income countries as the countries most affected by profit shifting, the results are different for the two studies with better country coverage. Although on different scales, our results and those of Cobham and Janský (2018), with the exception of the smallest group in their sample (high-income, non-OECD countries) point to the similar pattern that, in relative terms, the tax revenues of lower-income countries are generally affected more than those of higher-income countries. This pattern is mostly confirmed by Figure A4, which shows the amount of profit shifted rather than tax revenue losses.[19]

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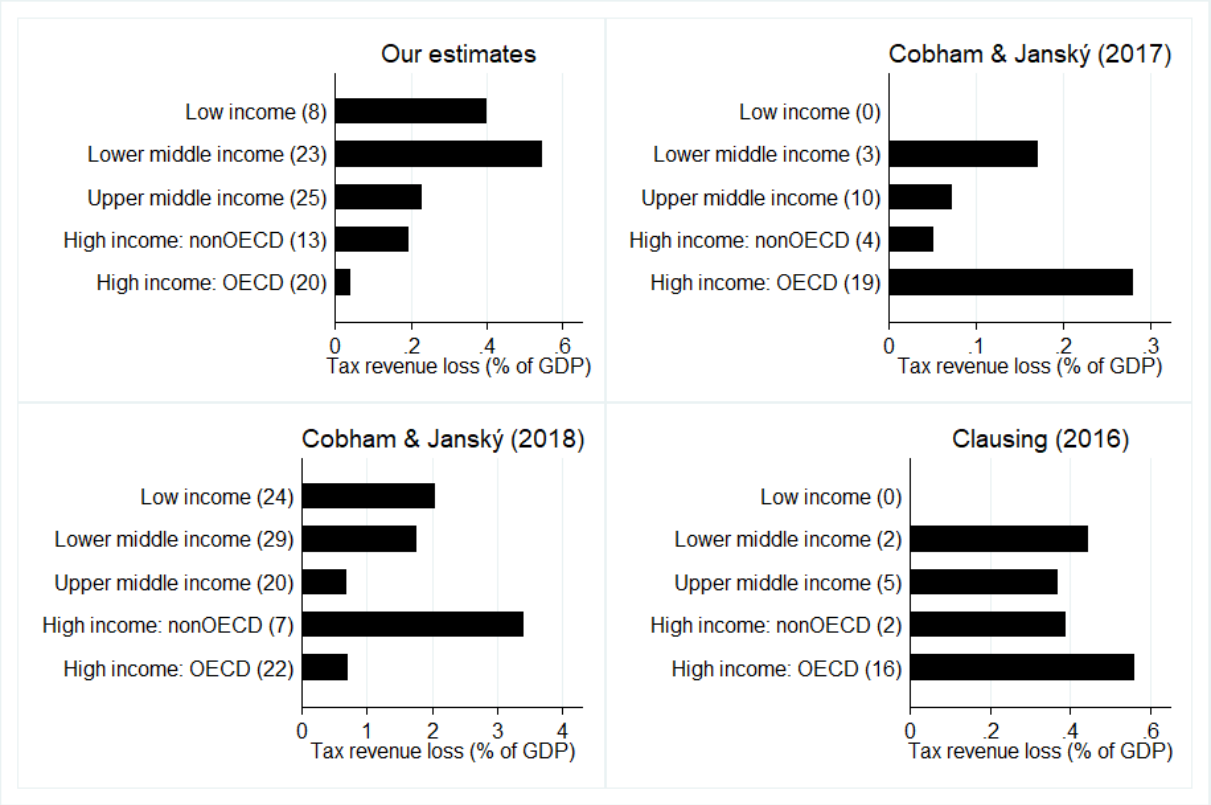
[18] Although we do provide results in both dollars and relative terms, due to the differences in methodologies and scope of the compared studies, our preference is for the latter, as with our main results discussed above. In order to analyse the disparities between the relative losses of different income groups, we compute the share of each income group on the total global estimated tax revenue losses resulting from profit shifting. Figure A3 thus shows the share for each income group of the total tax revenue losses, as estimated by the four studies. Since these are absolute numbers, it is not surprising that the loss of higher-income economies accounts for the bulk of global tax revenue losses. Moreover, as indicated by the numbers in parentheses in the bar labels of Figures 3, A4 and A5, lower-income countries are strongly underrepresented in the samples of the three above mentioned studies, especially those by Cobham and Janský (2017) and Clausing (2016), a characteristic on which our results improve significantly.

[19] The reason we also consider the amount of profit shifted is to ensure that differences in tax rates across countries alone do not cause the heterogeneity in estimates of the tax revenue losses across income groups, as these are calculated as the product of the estimated amount of shifted profit and the nominal corporate tax rate in each country. Nevertheless, as documented by the fact that Figure A5 (which shows the tax revenue losses for each

Figure 3: Estimated tax revenue loss as a share of GDP – weighted averages by income group, 2015



Source: Authors, data from Cobham and Janský (2018), Cobham and Janský (2017) and Clausing (2016).

Note: The number of countries in each income group is included in parentheses.

We further analyse correlations between the results from our and the three other papers and GDP per capita to shed more light on the relationship between countries' incomes and their estimated tax revenue losses resulting from profit shifting, and to compare our estimates more rigorously with those reported by similar studies. Tables A5-8 report the correlation coefficients for tax revenue losses as shares of corporate tax revenue, GDP, total tax revenue and in absolute numbers, respectively.[20] Overall, the estimated correlation coefficients vary across the four studies and the four versions, and most of the correlation coefficients are not different from zero at the standard levels of statistical significance. Still,

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income group in absolute terms) shows similar patterns to Figure A4, the heterogeneity in corporate tax rates at the country level does not play a significant role in the distribution of estimated tax revenue losses among income groups.

[20] A caveat of presenting and comparing these results in terms of shares of corporate and total tax revenue is that, out of the 89 countries for which we provide estimates of tax revenue losses, only 47 and 71 have data available for corporate and total tax revenue, respectively.

they suggest that there is some negative correlation between our estimates and GDP per capita, a result that is in support of the findings reported above. Moreover, as best documented by Table A8, our estimates are positively correlated with the results reached by all three other studies, even those that have much lower coverage than our estimates (i.e. Cobham and Janský (2017) with 36 observations and Clausing (2016) with 25 observations), suggesting that the pattern we find using the FDI approach is roughly in line with the results of other efforts to quantify international corporate tax avoidance. While our estimates are, in general, lower in magnitude than those reached by the other studies (for reasons described above), their wide coverage—especially for lower-income countries—makes them particularly suitable for the study of the global distributional impact of international corporate profit shifting.

6 Conclusion

In this paper, we have focused on quantifying the scale of one particular aspect of international corporate tax avoidance – profit shifting related to FDI. We began by closely following the methodology of one of the leading works in the area by UNCTAD (2015), what we call a baseline model, using new data to obtain updated estimates. We reach similar results, with a global estimate of lost tax revenue of around 150–200 billion USD, roughly evenly divided between developing and developed countries, with the former incurring much more significant losses in relative terms, whereas our preferred extended model results in a more conservative estimate of around 80 billion USD.

We extend the baseline model in three major ways. First, we use a more sensitive classification of countries by regional and income groups. Second, our model implicitly divides the regional- and income-group effects into those that affect the examined relationship and those that do not. The rationale behind this is that countries within these groups share some common characteristics that have a specific effect on the behaviour of the MNEs that route their investment through tax havens. Our approach has enabled us to capture these effects. Third, we derived country-level estimates using specific corporate tax rates and shares of tax-haven FDI for each country, rather than using averages for the whole sample. This approach, together with the inherent fixed-effects heterogeneity, yields more accurate results at the country level.

We find that lower-income countries lose significantly more revenue in relative terms than higher-income countries, a force that contributes toward widening the gap between rich and poor countries, rather than diminishing it. At the same time, lower-income countries are more likely to be among those that are relatively less able to implement effective tools to reduce the amount of profit shifted out of their countries. Our work thus further corroborates the importance of the wider inclusiveness of initiatives such as the OECD's Base Erosion and Profit Shifting framework for the tax revenues that developing countries need.

We provide a direct comparison of our estimates with the ones reached by Cobham and Janský (2018), Cobham and Janský (2017) and (Clausing, 2016). We find that every study identifies differences across income groups, but the nature of these differences varies across the four studies, as does their country coverage. We observe that the other existing study with relatively good developing country coverage, Cobham and Janský (2018), is mostly in line with our results, supporting the hypothesis that lower-income countries lose significantly more tax revenue in relative terms than higher-income countries, although in different magnitudes. Furthermore, our estimates are lower in magnitude compared to the other studies, which might be due to several reasons. For example, our methodology captures only those profit-shifting outcomes observable in the FDI data. Also, we exploit the differences in profitability between countries that are exposed to offshore investment to different extents, but we are not able to observe the counterfactual of what the rate of return on FDI would be in case of no profit shifting at all. On the other hand, our approach has a significantly increased coverage compared to most previous studies, and, as we argue, it provides a more suitable tool for analysing the distributional impact of international corporate profit shifting.

Several limitations of our approach persist. First, we have observed a statistically significant negative relationship between the share of inward investment stock originating from tax havens and the rate of return for developing countries, and for groups of other countries too in our extended model. We believe that this relationship can be attributed in part to missing profits due to profit shifting. However, we are not able to estimate how much of this is due to profit shifting and and how much is due to other potential reasons for lower profitability. Furthermore, our approach does not provide insight into the likely channels of profit shifting associated with lower returns; it is, however, clear that there exist corporate tax avoidance schemes that do not require a direct investment relationship through equity or debt, and are thus not captured by our estimates.

In addition to addressing these limitations, it would be desirable for further research to focus on the role of various assumptions, including those concerning tax rates—perhaps using average effective tax rates—and on the definition of tax havens, for example by applying various sets of definitions as a robustness check and as a means of learning about which havens are responsible for the estimated revenue losses. An alternative approach to the definition of tax havens could be to focus on continuous measures of tax havens, such as the Financial Secrecy Index, rather than on dichotomous classifications. Furthermore, despite significant data limitations, combining FDI with micro-level data could lead to interesting findings about which industry sectors are exploited the most by the current international tax avoidance schemes.

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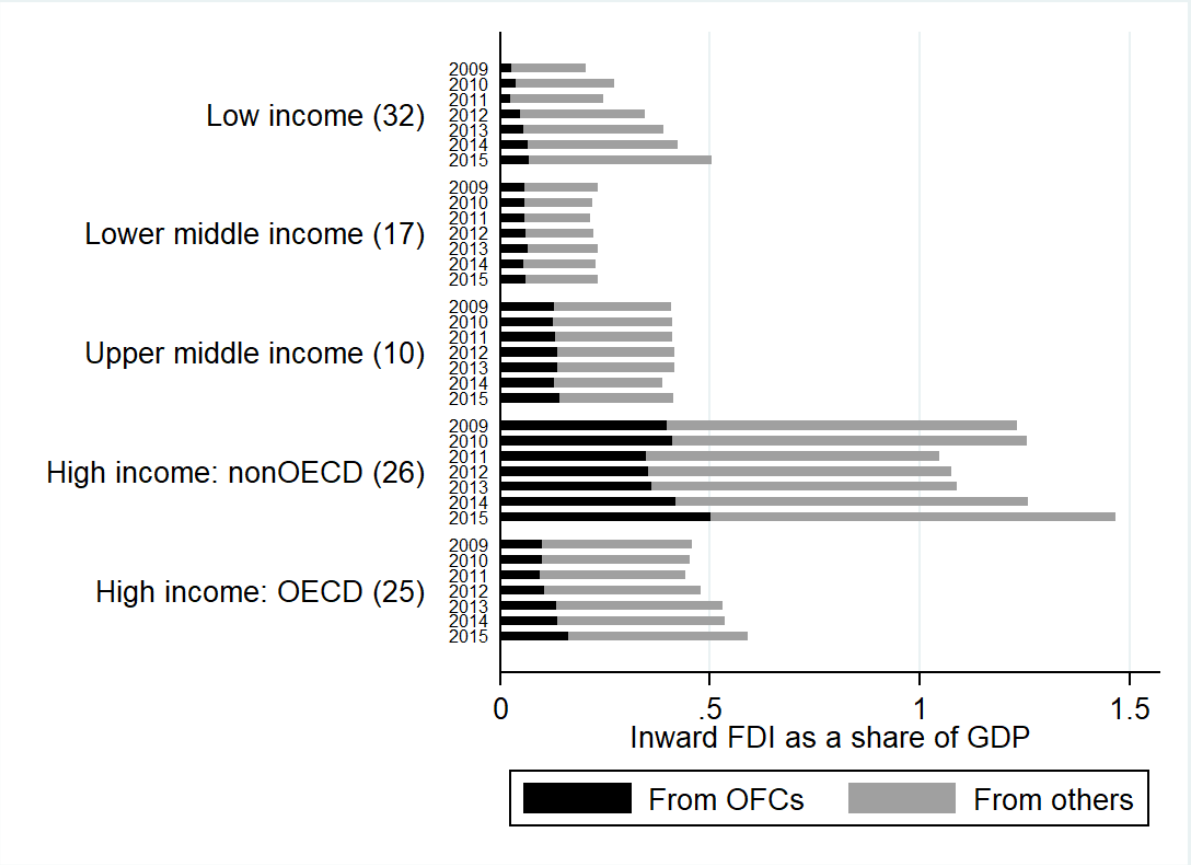
8 Appendix

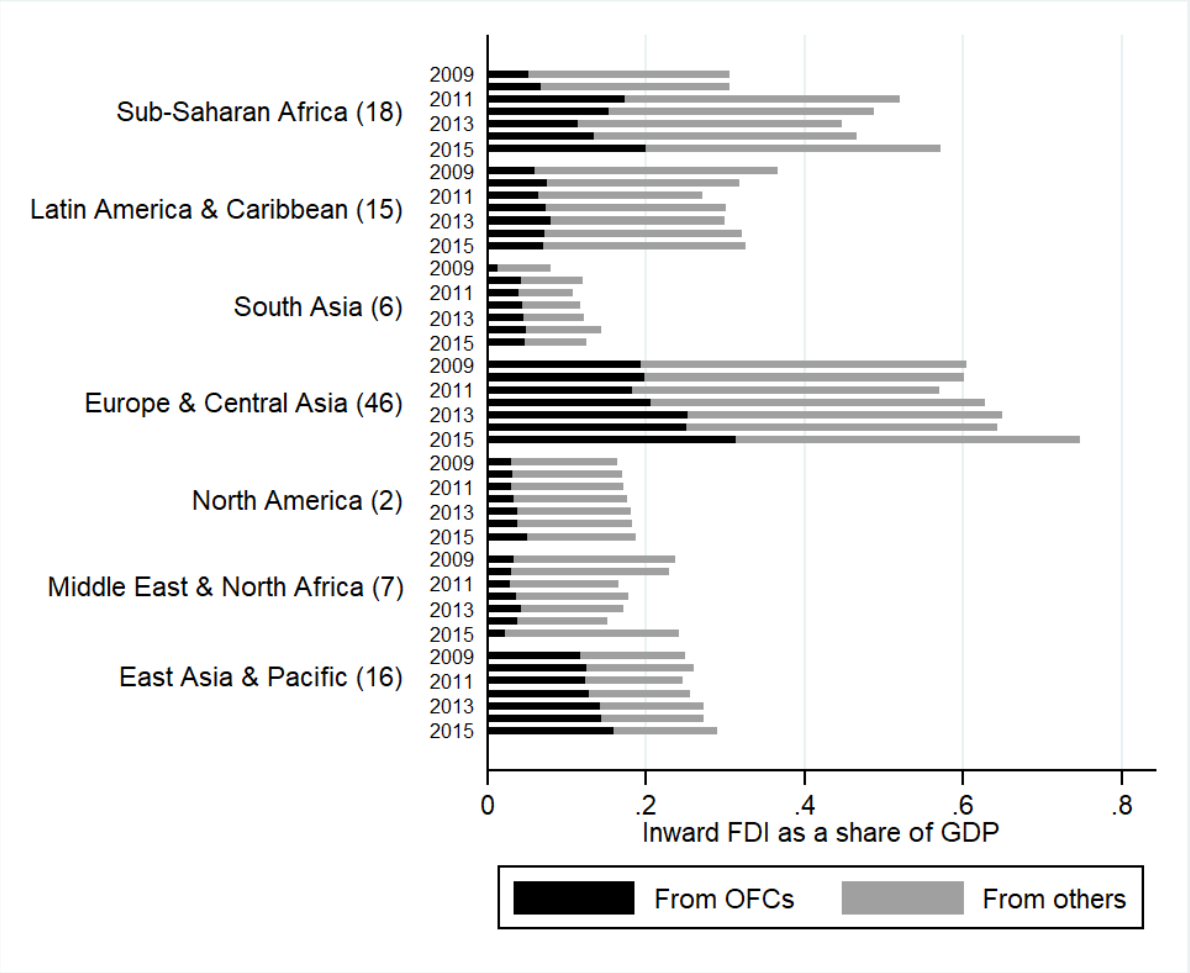
Figure A1: Development of the volume of total inward FDI stock between 2009 and 2015 (as a share of GDP; by income group and origin).



Source: Data from IMF's CDIS; classification by the World Bank; authors' construction.

Note: The classification of 'offshore financial centres' is defined in Section 4. The number of countries in each income group is included in parentheses.

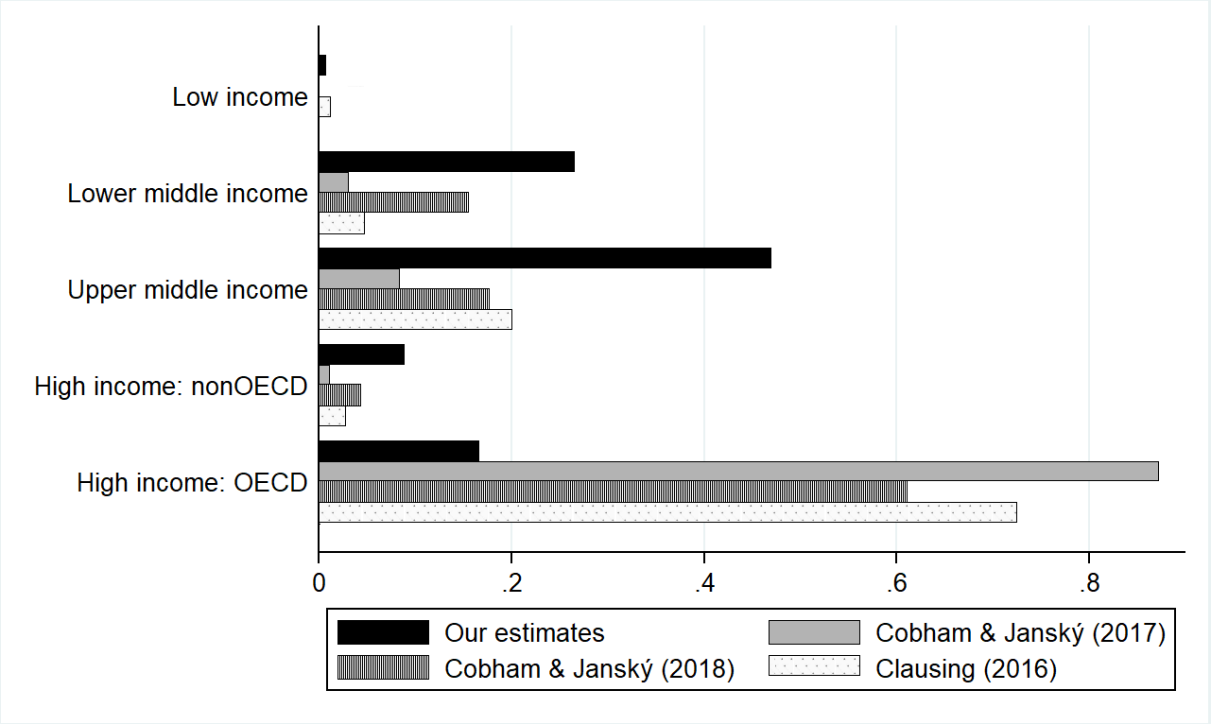
Figure A2: Development of the volume of total FDI stock between 2009 and 2015 (by region and origin).



Source: Data from IMF's CDIS; classification by the World Bank; authors' construction.

Note: The classification of 'offshore financial centres' is defined in Section 4. The number of countries in each income group is included in parentheses.

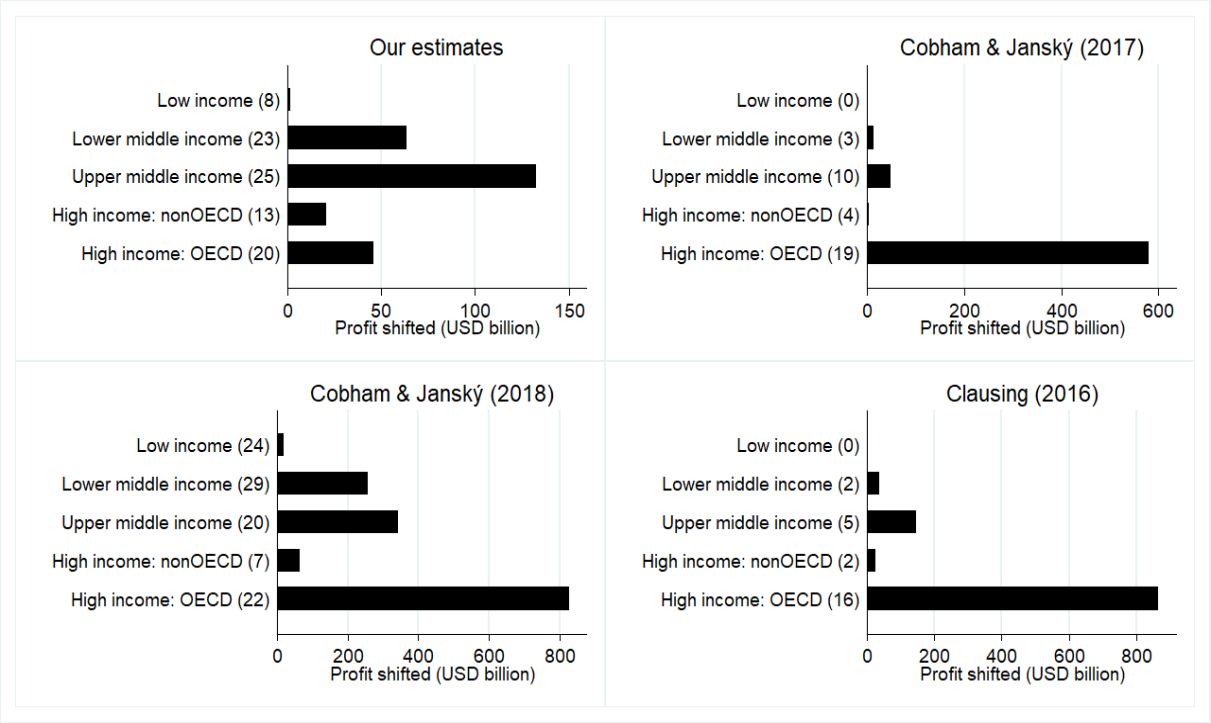
Figure A3: Share of estimated tax revenue losses on total global estimated revenue losses, by income group, 2015.



Source: Authors; data from Cobham and Janský (2017), Cobham and Janský (2018) and Clausing (2016).

Note: The number of countries in each income group is included in parentheses.

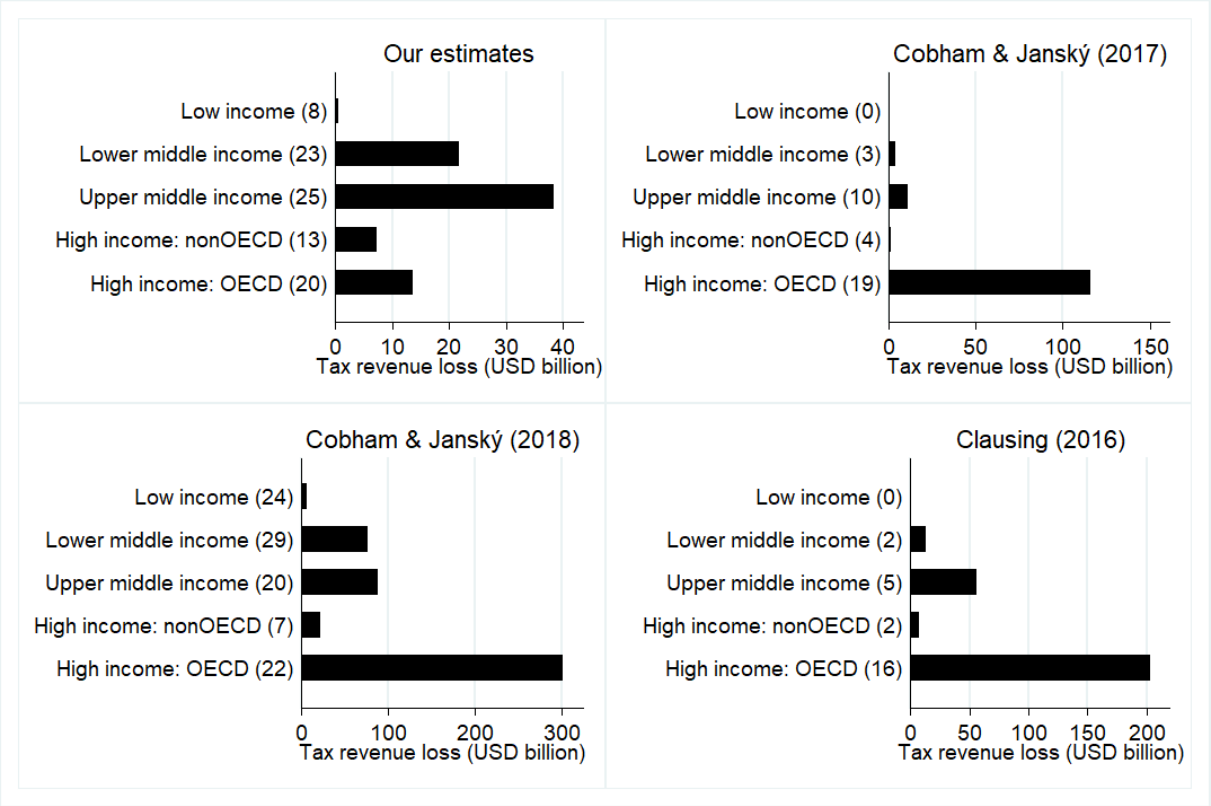
Figure A4: Estimated profit shifted out of countries – sums by income group, 2015.



Source: Authors; data from Cobham and Janský (2017), Cobham and Janský (2018) and Clausing (2016).

Note: The number of countries in each income group is included in parentheses.

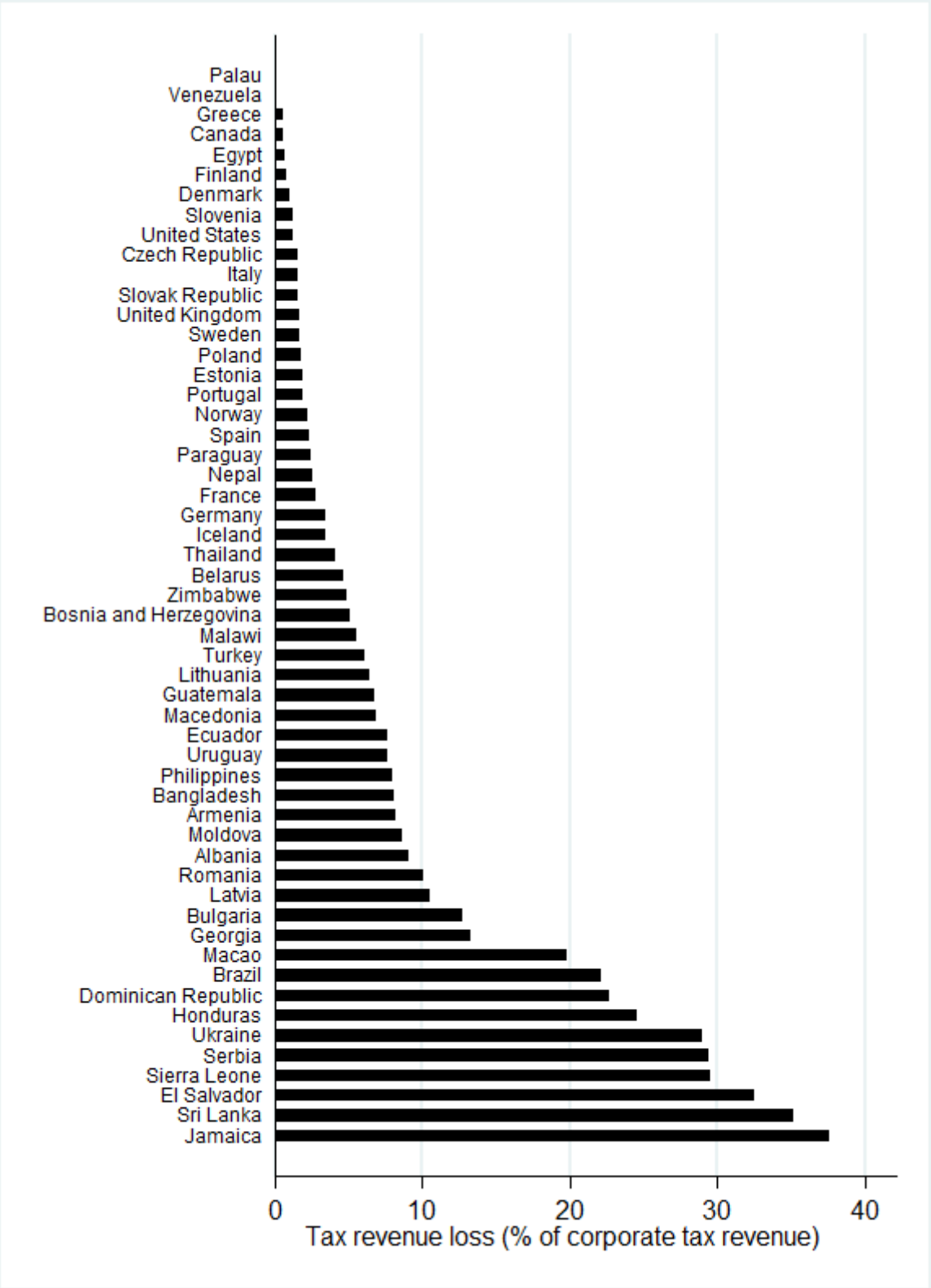
Figure A5: Estimated tax revenue losses – sums by income group, 2015.



Source: Authors; data from Cobham and Janský (2017), Cobham and Janský (2018) and Clausing (2016).

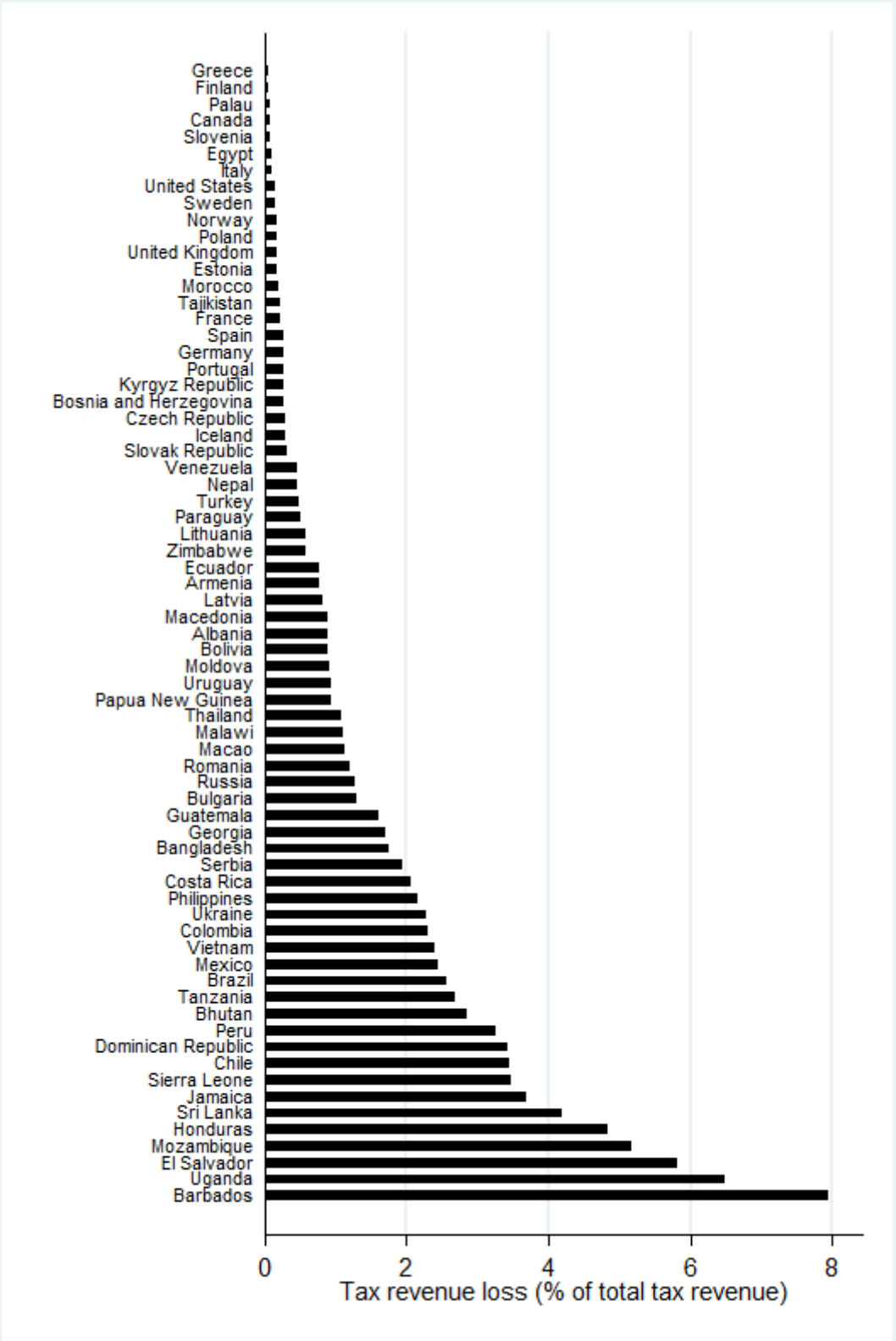
Note: The number of countries in each income group is included in parentheses.

Figure A6: Share of estimated tax revenue losses on corporate tax revenue, 2015



Source: Authors.

Figure A7: Share of estimated tax revenue losses on total tax revenue, 2015



Source: Authors.

Table A1: Summary statistics of the used variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Rate of return on FDI (%)	513	6.9301	4.9019	0	25.3039	IMF BoP
Rate of return on FDI - equity component (%)	502	6.4044	5.0152	0	25.2433	IMF BoP
Rate of return on FDI - debt component (%)	422	0.7048	0.7164	0	4.7702	IMF BoP
Share of FDI from OFCs	538	0.2504	0.1464	0	0.7210	IMF CDIS
Inward FDI stock (USD billion)	538	182	417	0.147	3120	IMF CDIS
Inward FDI stock (USD billion)	1066	112	404	0.0046	5590	UNCTAD
GDP (USD billion)	1296	395	1590	0.0271	18600	WB, UN, CIA
Nominal corporate tax rate (%)	756	24.5541	8.2794	0	55	KPMG, WB
Total corporate tax revenue (% of GDP)	542	2.5268	1.3326	0	14.0881	GRD
Total tax revenue (% of GDP)	898	17.0100	7.2575	0.6074	54.3056	GRD

Source: Authors; data from IMF's CDIS and UNCTAD's FDI database.

*Note: Only the basic statistics displayed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Table A2: Regression of the offshore indicator on the rate of return

	Dependent variable: FDI rate of return			Dependent variable: equity component of FDI rate of return			Dependent variable: debt component of FDI rate of return		
	All	Developing	Developed	All	Developing	Developed	All	Developing	Developed
Offshore indicator	-.0395** (.0177)	-.0824*** (.0299)	-.049 (.0429)	-.0558*** (.0182)	-.1036*** (.03)	-.0557 (.0437)	.0104*** (.0033)	.0162*** (.0055)	.008 (.0066)
No. of obs.	477	215	188	464	209	181	402	160	175
R^2	0.278	0.289	0.102	0.309	0.303	0.108	0.236	0.177	0.152

Source: Authors; data from IMF's CDIS and UNCTAD's FDI database.

*Note: Only the basic statistics displayed. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Table A3: Estimating the size of profit shifting, 2015.

		A	B	C = A*B	D	E = D*C	F	G = E/(1-F)	
	Model	Estimate from the regression	Exposure to tax haven investment	Estimated profitability gap	Reported FDI stock (billion USD)	Simulated profit shifting (after-tax, billion USD)	Average corporate tax rate weighted by FDI income	Simulated profit shifting (pre-tax, billion USD)	Tax revenue losses (billion USD)
All countries	Our results – ROR	.0395**	41.54%	.0164	19,570	320.95	28.20%	447	126.05
	Our results – ROReq	.0558**	41.54%	.0232	19,570	454.02	28.20%	632.34	178.32
Developing countries	UNCTAD (2015) – ROR	.115***	46%	.053	5,000	265	20%	331	66
	UNCTAD (2015) – ROReq	.158***	46%	.072	5,000	360	20%	450	90
	Our results – ROR	.0824***	51.99%	.0428	6,370	272.64	24.97%	363.37	90.73
	Our results – ROReq	.1036***	51.99%	.0539	6,370	343.34	24.97%	457.6	114.26
Developed countries	Our results – ROR	.049	37%	.0181	13,190	238.74	29.9%	340.57	101.83
	Our results – ROReq	.0557	37%	.0206	13,190	271.71	29.9%	387.6	115.89

*Source: Authors' construction; UNCTAD (2015). *** p<0.01, ** p<0.05, * p<0.1.*

Table A4: Estimated tax revenue losses and their share on GDP. Global model, developed and developing countries model, and extended model's rate of return and rate of return on equity method, 2015

	Global model	Developed and developing countries model	Extended model							
Country	ROR – equity component	ROR – equity component	ROR – equity component, 2015 (USD million)	ROR – equity component, 2015 (% of GDP)	ROR – equity component, 2015 (% of corporate tax revenue)	ROR – equity component, 2015 (% of total tax revenue)	ROR (USD million)	ROR (% of GDP)	ROR (% of corporate tax revenue)	ROR (% of total tax revenue)
Sint Maarten	6.81	5.44	13.64	3.73			17.96	4.91		
Barbados	46.14	36.91	92.44	2.09		7.95	121.74	2.75		10.47
Trinidad and Tobago	192.44	153.96	385.60	1.64			507.81	2.16		
Mozambique	109.50	87.60	166.38	1.12		5.18	207.06	1.40		6.44
Jamaica	59.88	47.91	127.48	0.89	37.57	3.69	118.95	0.83	35.05	3.44
El Salvador	85.74	68.59	230.19	0.88	32.43	5.82	244.42	0.94	34.44	6.18
Honduras	67.50	54.00	181.23	0.87	24.55	4.83	192.43	0.92	26.07	5.13
India	4010.97	3208.82	16785.27	0.79			15783.01	0.75		
Uganda	139.63	111.71	212.15	0.76		6.50	264.03	0.95		8.08
Brazil	5565.61	4452.56	11847.49	0.66	22.11	2.57	11055.19	0.61	20.63	2.40
Kazakhstan	958.08	766.48	1065.90	0.58			892.01	0.48		
Chile	1211.25	969.01	1391.52	0.57		3.44	1454.26	0.60		3.60
Ukraine	309.90	247.92	517.08	0.57	28.92	2.28	556.41	0.61	31.12	2.46
Fiji	30.63	24.51	23.08	0.53			7.24	0.16		

Sri Lanka	98.05	78.44	410.34	0.51	35.14	4.20	385.84	0.48	33.04	3.95
Curaçao	7.78	6.23	15.59	0.50			20.53	0.66		
Pakistan	312.99	250.39	1309.79	0.48			1231.58	0.45		
Peru	426.65	341.33	908.21	0.48		3.26	847.47	0.45		3.04
Mongolia	73.46	58.77	55.35	0.47			17.37	0.15		
Colombia	635.69	508.56	1353.20	0.46		2.31	1262.71	0.43		2.15
Serbia	152.77	122.22	169.96	0.46	29.35	1.93	142.23	0.38	24.57	1.62
Dominican Republic	145.97	116.78	310.73	0.46	22.69	3.41	289.95	0.43	21.17	3.19
Croatia	215.89	172.72	213.20	0.44			341.86	0.70		
Georgia	36.05	28.84	60.15	0.43	13.31	1.70	64.72	0.46	14.33	1.83
Bhutan	2.05	1.64	8.58	0.42		2.85	8.07	0.39		2.68
Vietnam	588.29	470.64	770.32	0.40		2.40	647.65	0.34		2.02
Argentina	1049.33	839.48	2102.54	0.36			2768.94	0.47		
Malaysia	1331.33	1065.08	1003.04	0.34			314.86	0.11		
Macao	232.83	186.27	146.31	0.32	19.81	1.14	206.97	0.46	28.02	1.61
Mexico	1719.46	1375.59	3660.21	0.32		2.44	3415.43	0.30		2.28
Sierra Leone	8.77	7.02	13.33	0.31	29.51	3.48	16.59	0.39	36.72	4.33
Philippines	655.92	524.74	858.87	0.29	7.97	2.15	722.10	0.25	6.70	1.81
Tanzania	87.61	70.09	133.11	0.29		2.68	165.66	0.36		3.33
Bulgaria	122.80	98.25	136.62	0.27	12.77	1.30	114.34	0.23	10.68	1.08
Costa Rica	70.06	56.04	149.13	0.27		2.06	139.15	0.25		1.93
Afghanistan	7.31	5.85	48.97	0.25			49.56	0.25		
Montenegro	8.76	7.01	9.75	0.24			8.16	0.20		
Russia	3292.13	2633.74	3251.07	0.24		1.28	5212.94	0.38		2.05
Romania	379.10	303.28	421.76	0.24	10.10	1.19	352.95	0.20	8.45	1.00

Bolivia	26.20	20.96	70.34	0.21		0.90	74.69	0.23		0.96
Moldova	7.71	6.17	12.87	0.20	8.63	0.91	13.85	0.21	9.28	0.98
Thailand	1002.94	802.36	755.63	0.19	4.13	1.08	237.19	0.06	1.30	0.34
Uruguay	45.57	36.45	91.30	0.17	7.66	0.93	120.24	0.23	10.09	1.22
Albania	17.43	13.94	19.39	0.17	9.04	0.89	16.22	0.14	7.56	0.74
Latvia	46.08	36.86	45.50	0.17	10.56	0.82	72.96	0.27	16.93	1.31
Armenia	10.62	8.50	17.72	0.17	8.17	0.78	19.07	0.18	8.79	0.84
Malawi	7.06	5.65	10.72	0.17	5.55	1.11	13.34	0.21	6.91	1.38
Guatemala	38.85	31.08	104.30	0.16	6.77	1.61	110.75	0.17	7.19	1.71
Macedonia	13.31	10.65	14.81	0.15	6.85	0.89	12.39	0.12	5.74	0.74
Zimbabwe	15.24	12.19	23.16	0.14	4.84	0.58	28.82	0.18	6.02	0.72
China	20387.26	16310.05	15360.05	0.14			4821.60	0.04		
Bangladesh	64.65	51.72	270.56	0.14	8.12	1.75	254.41	0.13	7.64	1.64
Papua New Guinea	28.86	23.08	37.78	0.14		0.93	31.77	0.12		0.79
Solomon Islands	1.07	0.86	1.41	0.12			1.18	0.10		
Belarus	61.88	49.50	68.84	0.12	4.60		57.61	0.10	3.85	
Ecuador	56.15	44.92	119.53	0.12	7.57	0.77	111.54	0.11	7.07	0.72
Lithuania	41.22	32.97	40.70	0.10	6.40	0.57	65.26	0.16	10.25	0.91
Iceland	124.31	99.45	16.49	0.10	3.42	0.30	18.07	0.11	3.74	0.32
Venezuela	192.78	154.23	386.28	0.09		0.45	508.71	0.12		0.60
Turkey	665.31	532.25	740.18	0.09	6.03	0.48	619.42	0.07	5.05	0.40
Nepal	2.42	1.94	16.21	0.08	2.54	0.45	16.41	0.08	2.57	0.46
Paraguay	8.44	6.76	17.97	0.07	2.47	0.51	16.77	0.06	2.30	0.48
Bosnia and Herzegovina	8.93	7.15	9.94	0.06	5.08	0.27	8.32	0.05	4.25	0.23

Portugal	917.90	734.33	121.78	0.06	1.94	0.27	133.40	0.07	2.12	0.29
Germany	15027.95	12022.53	1993.87	0.06	3.40	0.26	2183.99	0.06	3.72	0.29
France	10515.67	8412.66	1395.19	0.06	2.71	0.21	1528.23	0.06	2.97	0.24
Slovak Republic	370.07	296.06	49.10	0.06	1.60	0.31	53.78	0.06	1.76	0.34
Czech Republic	781.29	625.04	103.66	0.06	1.57	0.30	113.54	0.06	1.72	0.32
Spain	5002.58	4002.12	663.73	0.06	2.29	0.25	727.02	0.06	2.51	0.28
Kyrgyz Republic	2.10	1.68	3.51	0.05		0.27	3.78	0.06		0.29
Sweden	1907.41	1525.95	253.07	0.05	1.72	0.16	277.20	0.06	1.88	0.17
Tajikistan	2.19	1.75	3.65	0.05		0.21	3.93	0.05		0.22
Taiwan	808.27	646.63	507.92	0.05			718.49	0.06		
United Kingdom	8978.75	7183.11	1191.28	0.04	1.68	0.17	1304.87	0.05	1.84	0.18
Norway	1197.96	958.38	158.94	0.04	2.22	0.16	174.10	0.05	2.43	0.18
Morocco	99.55	79.64	40.69	0.04		0.19	62.07	0.06		0.29
Estonia	67.19	53.76	8.92	0.04	1.89	0.18	9.77	0.04	2.08	0.19
Italy	4486.35	3589.13	595.24	0.03	1.59	0.11	652.00	0.04	1.74	0.12
Poland	1169.49	935.60	155.16	0.03	1.77	0.16	169.96	0.04	1.93	0.18
United States	72590.23	58073.04	5050.94	0.03	1.28	0.14	-28428.81	-0.16	-7.18	-0.80
Denmark	603.73	482.99	80.10	0.03	1.03		87.74	0.03	1.13	
Canada	4155.76	3324.65	289.16	0.02	0.59	0.07	-1627.54	-0.10	-3.34	-0.39
Slovenia	57.09	45.67	7.57	0.02	1.20	0.08	8.30	0.02	1.32	0.09
Finland	281.16	224.93	37.30	0.02	0.74	0.05	40.86	0.02	0.81	0.06
Palau	0.05	0.04	0.04	0.01		0.07	0.01	0.00		0.02
Greece	177.65	142.12	23.57	0.01	0.56	0.05	25.82	0.01	0.61	0.05
Egypt	88.69	70.95	36.25	0.01	0.63	0.10	55.30	0.02	0.96	0.16
Syria	9.82	7.86	4.01	0.01			6.12	0.01		

Yemen	0.56	0.45	0.23	0.00			0.35	0.00		
Qatar	41.62	33.30								
Kuwait	29.10	23.28								
Japan	1906.10	1524.91								
Oman	30.84	24.67								
South Korea	950.07	760.07								
Saudi Arabia	632.53	506.03								
New Zealand	338.88	271.11								
Kenya	35.12	28.10								
Australia	3464.27	2771.45								
Cape Verde	1.61	1.29								
United Arab Emirates	1533.95	1227.18								
Angola	95.19	76.15								
Cameroon	52.33	41.87								
Sudan	183.26	146.61								
Nigeria	927.21	741.78								
Ghana	122.67	98.14								
Botswana	33.54	26.83								
South Africa	1028.99	823.20								
Namibia	42.14	33.71								
Zambia	128.85	103.08								
Total	188207.15	150567.94	81586.15				66694.80			

Source: Authors' construction.

Table A5: Correlations between GDP per capita and estimated tax revenue losses as shares of corporate tax revenues.

	GDP per capita	Our estimates	Cobham and Janský (2018)	Cobham and Janský (2017)	Clausing (2016)
GDP per capita	1				
Our estimates	-0.3464** (0.0119)	1			
Cobham and Janský (2018)	-0.4895*** (0.0021)	0.5912*** (0.0009)	1		
Cobham and Janský (2017)	-0.0257 (0.9096)	0.0892 (0.7336)	0.2537 (0.3096)	1	
Clausing (2016)	0.43* (0.0749)	0.2207 (0.4484)	0.5048 (0.0785)	0.532* (0.0613)	1

Source: Authors; data from the World Bank; Cobham and Janský (2018), Cobham and Janský (2017) and Clausing (2016).

*Note: p-values in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

Table A6: Correlations between GDP per capita and estimated tax revenue losses as shares of GDP.

	GDP per capita	Our estimates	Cobham and Janský (2018)	Cobham and Janský (2017)	Clausing (2016)
GDP per capita	1				
Our estimates	-0.1676 (0.1186)	1			
Cobham and Janský (2018)	-0.3864*** (0.0001)	0.3210** (0.0296)	1		
Cobham and Janský (2017)	-0.202 (0.2444)	0.3308* (0.0988)	0.0719 (0.7269)	1	
Clausing (2016)	0.3001 (0.1449)	0.1817 (0.4566)	0.3863 (0.1394)	0.0142 (0.9556)	1

Source: Authors; data from the World Bank, Cobham and Janský (2018), Cobham and Janský (2017) and Clausing (2016).

*Note: p-values in parentheses, * p<0.1, ** p<0.05, *** p<0.01*

Table A7: Correlations between GDP per capita and estimated tax revenue losses as shares of total tax revenues.

	GDP per capita	Our estimates	Cobham and Janský (2018)	Cobham and Janský (2017)	Clausing (2016)
GDP per capita	1				
Our estimates	-0.3531*** (0.0029)	1			
Cobham and Janský (2018)	-0.3142** (0.0115)	0.4792*** (0.0027)	1		
Cobham and Janský (2017)	-0.1803 (0.3681)	0.498** (0.0184)	0.1597 (0.5012)	1	
Clausing (2016)	-0.078 (0.7299)	0.4803* (0.0597)	0.7535*** (0.0029)	0.1256 (0.6429)	1

Source: Authors; data from the World Bank, Cobham and Janský (2018), Cobham and Janský (2017) and Clausing (2016).

*Note: p-values in parentheses, * p<0.1, ** p<0.05, *** p<0.01*

Table A8: Correlations between GDP per capita and estimated tax revenue losses (in USD)

	GDP per capita	Our estimates	Cobham and Janský (2018)	Cobham and Janský (2017)	Clausing (2016)
GDP per capita	1				
Our estimates	-0.0102 (0.9252)	1			
Cobham and Janský (2018)	0.2678*** (0.0068)	0.525*** (0.0002)	1		
Cobham and Janský (2017)	0.2817 (0.1011)	0.1443 (0.4818)	0.9159*** (0)	1	
Clausing (2016)	0.2932 (0.1549)	0.3273 (0.1713)	0.9705*** (0)	0.8895*** (0)	1

Source: Authors; data from the World Bank, Cobham and Janský (2018), Cobham and Janský (2017) and Clausing (2016).

*Note: p-values in parentheses, * p<0.1, ** p<0.05, *** p<0.01*