Profit Shifting by German Multinational Enterprises – First Evidence Based on Individual Country-by-Country Reports

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Abstract

This paper is the first to use information from individual country-by-country reports to assess the extent of profit shifting by multinational enterprises (MNEs). …

Keywords: Corporate taxation, tax avoidance, profit shifting, country-by-country reporting

JEL: F23, H25, H26

1. Introduction

Tax avoidance and profit shifting activities by multinational enterprises (MNEs) are constantly sparking heated public debates. Consequently, those activities have attracted a lot of academic interest as well. The extent of tax avoidance by MNEs is typically assessed based on estimates of the tax sensitivity of pre-tax corporate profits. In a recent survey of the literature, Beer et al. (2019) review 37 studies that empirically evaluate the tax elasticity of MNEs' profits. These studies can be broadly divided into two groups. The first group utilizes micro data to assess the extent of tax avoidance and profit shifting at the firm level. The second group relies on macro data, that is, data aggregated at the country level. However, existing studies within both groups suffer from certain drawbacks. Firm-level studies often rely on data from the Orbis or Amadeus data base, both provided by Bureau van Dijk and collected from public business registries. The problem with these data is that information about MNEs' activities in many countries is missing, as these countries either do not keep business registries or do not make the information therein publicly available. This problem appears to apply especially to low-tax jurisdictions, which play a particularly important role in the profit shifting activities of MNEs (Tørsløv et al., 2018). To the best of our knowledge, micro evidence based on data with a complete coverage of MNEs' residence countries is restricted to U.S. based MNEs (Dowd et al., 2017). Macroeconometric analyses, on the other hand, have been criticized for failing to control for MNEs' scale of real economic activity, eventually resulting in biased estimates and an overstatement of the extent of profit shifting (Beer et al., 2019; Dharmapala, 2014; Heckemeyer and Overesch, 2017).

In the present paper, we estimate the tax-sensitivity of corporate profits based on a novel data set that does not suffer from the problems highlighted above. The data we use come from country-by-country (CbC) reports filed by German MNEs. These reports provide a complete coverage of the global distribution of German MNEs' profits, sales, and factors of production. CbC reporting has been introduced in the context of the OECD/G20 Base Erosion and Profit Shifting (BEPS) project and is obligatory for MNEs with a consolidated revenue of at least 750 million EUR (or an equivalent amount in a different currency) and whose headquarters are located in one of the 137 countries that take part in the Inclusive Framework on BEPS (see Section 2 for details). In Germany, a CbC reporting filing obligation was introduced in 2016. Thus far, though, the only country that has made information from CbC reports publicly available is the U.S.

(Garcia-Bernardo et al., 2019). However, the U.S. does not publish the original information from CbC reports. Instead, it aggregates the information across all U.S. MNEs obliged to file a CbC report at the level of the countries in which these MNEs have affiliates. Studies utilizing these data thus suffer from the same problems as other macro approaches. Our data, in contrast, covers information from individual CbC reports, allowing us to assess the extent of profit shifting at the MNE level. In the descriptive part of our paper, we demonstrate the advantages the CbC data have over Orbis data. In the Orbis data base, information about the activities of German MNEs' affiliates in many jurisdictions, especially low-tax countries, is either incomplete or completely missing.

The novel data at our disposal allow us to make several contributions to the existing empirical literature on profit shifting by MNEs. First, the complete coverage of the global activities of German MNEs allows us to provide a more credible estimate of the tax-sensitivity of corporate profits. Second, we are able to pay particular attention to the importance of tax havens for profit shifting activities. Studies relying on Orbis data are not able to do so, since the activities of MNEs in most tax haven countries are not reported in Orbis. This is very unfortunate, since a series of recent leaks as well as national accounts data suggests that MNEs book a significant share of their profits in tax havens. For instance, Zucman (2014) estimates that U.S. MNEs book almost 20 percent of their profits in tax havens, and Tørsløv et al. (2018) estimate that 40 percent of the profits by MNEs are shifted to tax havens globally. Third, the CbC reports contain information about the revenues generated through transactions with other affiliates of the same MNE group, allowing us to evaluate the importance of intra-firm transactions for profit shifting activities. More precisely, we assess whether the location of subsidiaries that mainly provide inputs and services for associated firms is sensitive to the level of taxation. Intra-company trade, financial services (i.e., debt shifting), and the strategic location of intellectual property (IP) are considered particularly important channels through which MNEs shift profits to low-tax jurisdictions (e.g., Buettner and Wamser, 2013; Dischinger and Riedel, 2011; Fuest et al., 2011; Griffith et al., 2014). The CbC data contain information about the revenues a MNE's affiliates generate through transactions with other affiliates of the MNE, including royalties, interest payments, and premiums, thus allowing us to assess the relevance of these channels. We obtain several interesting findings, some of which are novel to the literature. First, we find that the profits large German MNEs report in a country as well as intra-firm

revenues are sensitive to effective average tax rates. In our baseline specification, we obtain a semi-elasticity of profits with respect to changes in the effective average tax rate of −0.5 and a tax semi-elasticity of intra-firm revenues of −1.3. In contrast, differences in statutory tax rates do not seem to matter. We attribute this finding to the fact that nowadays, tax competition mainly takes place through instruments other than statutory tax rates, such as R&D tax subsidies, patent boxes, and tax exemptions for certain types of corporate income. Due to that, corporate tax rates are only an imperfect measure of the actual tax burden. Second, we find that profit shifting by large German MNEs takes mainly place through tax havens, whereby tax havens located in Europe are more important for German MNEs than tax havens outside of Europe. Holding other factors fixed, we find that the profits large German MNEs report in European tax havens are more than 60% higher than in non-tax havens. In non-European tax havens, profits are about 40% higher than in non-tax havens. Third, we find that German MNEs shift more profits to tax havens the larger (in terms of their sales) they are. Fourth, we demonstrate that using Orbis data in profit shifting regressions may lead to biased estimates, as they contain a systematic measurement error.

The rest of the paper is organized as follows. Section 2 describes the CbC data and our sample of German MNEs. Section 3 provides some descriptive statistics on the profitability of German MNEs in tax haven countries and non-haven countries and compares the CbC data to the data from the Bureau van Dijk's Orbis database. In Section 4, we introduce our empirical model and present the results of our profit shifting regressions based on CbC data. In Section 5, we re-estimate our empirical model based on Orbis data. Section 6 concludes.

2. CbC Data and Sample

The data that we use for our analysis are taken from the CbC reports filed by German MNEs. CbC reporting was initiated by the OECD and G20 in the context of the Base Erosion and Profit Shifting (BEPS) project. The CbC reports collect information on the global activities of MNEs. They are prepared by the MNE and submitted to the tax authority of the country where the MNE's headquarters are based. A MNE is legally obliged to submit a CbC report in case its consolidated global group revenues exceed a threshold of 750 million EUR (or an equivalent amount in a different currency) and if the country where its headquarters are based takes part in the OECD/G20 Inclusive Framework on BEPS, provided that the country has introduced a corresponding filing

obligation into national legislation.[1] In general, membership in the Inclusive Framework on BEPS is open to all interested countries. However, membership requires commitment to certain minimum standards, the introduction of CbC reporting being one of them. As of December 2019, 137 countries have joined in the Inclusive Framework on BEPS, of which 90 already introduced a CbC reporting filing obligation into national legislation.[2] In Germany, a CbC reporting filing obligation was introduced in 2016. The tax authority of the country where the MNE's headquarters are based shares the MNE's CbC report with the tax authorities of all other countries in which subsidiaries of that MNE are located, provided those countries also take part in the Inclusive Framework. However, the reports are not made public. The goal of the CbC reporting obligation is to "[…] provide tax administrations with a high level overview of the operations and tax risk profile of the largest multinational enterprise groups" (OECD, 2017: 11), allowing tax authorities to use their auditing capacities more efficiently.[3]

The CbC reports contain basic financial information about the global activities of a MNE. More precisely, the CbC reports include the following information:

- Profit/loss before taxation
- Taxes paid
- Taxes accrued (year of reporting)
- Stated capital
- Accumulated earnings
- Number of employees (on a full-time equivalent)
- Net book value of tangible assets
- Revenues generated from transactions with independent parties (revenues unrelated), including revenues from sales of inventory and properties, services, royalties, interest, and premiums
- Revenues generated from transactions with associated enterprises (revenues related), including revenues from sales of inventory and properties, services, royalties, interest, and premiums

[1] Note that a country can also require constituent entities of a MNE that are resident in that country for tax purposes to file a CbC report if the MNE is not obliged to do so in the country where its headquarters are based, provided that the MNE's consolidated group revenues exceed 750 million EUR.

[2] A regularly updated list of Inclusive Framework member countries acan be found here: https://www.oecd.org/tax/beps/beps-actions/action13/.

[3] Hugger (2019) provides more details on CbC reporting as well as a list of Inclusive Framework member states that already introduced CbC reporting filing obligations into national legislation.

- Total revenues (revenues unrelated plus revenues related)

Note that the information provided in the CbC reports is aggregated at the level of the tax jurisdiction. The CbC reports do not contain information on the subsidiary level. However, the information we use refers to the activities of individual MNEs. Hence, our analysis is based on a different level of aggregation than (most) existing micro and macro-analyses. Micro-analyses typically use information at the subsidiary level and, thus, more disaggregated data than we do. Exceptions are the studies by Dowd et al. (2017) and Huizinga and Leuven (2008), who use data at the same level of aggregation as we do. Macro-analyses (including those that use U.S. CbC data, like Garcia-Bernardo et al. (2019)), in contrast, typically use data that are aggregated by tax jurisdictions, which implies an even higher level of aggregation.

Unlike data from the Bureau van Dijk's Orbis and Amadeus data bases, CbC reports cover the activities of MNEs in all countries in which a MNE has affiliates. Orbis and Amadeus data, in contrast, are only available for countries that keep public business registries (Tørsløv et al., 2018).

Our data covers the information from the CbC reports filed by German MNEs for the years 2016 and 2017. The original data covers 386 German MNEs. However, we exclude some MNEs for different reasons. First, we exclude all non-corporate and public MNEs from our sample since they are subject to different tax regulations than corporate MNEs. I.e., the profits of corporate enterprises are subject to the corporate income tax plus the local business tax. Non-corporate enterprises have to pay the local business tax as well. However, they are not subject to the corporate income tax. Instead, the income of non-corporate enterprises is taxed at the level of the owner and, thus, subject to the personal income tax, which is characterized by a progressive tax schedule.[4] Second, we exclude corporate groups that have reported information for the financial years 2015 or 2018 instead of 2016 and/or 2017. Our final sample comprises 333 corporate MNEs.

[4] The corporate income tax rate is 15%. The personal income tax rate depends on the sum of a person's total taxable income. The initial tax rate is 14%, the maximum tax rate is 45%.

3. Descriptive analysis

3.1 The profitability of German MNEs across countries

Figures 1 to 3 graphically illustrate different measures for the profitability of German MNEs' subsidiaries calculated based on CbC data. The figures show the ratio of corporate profits to (i) total revenues (Figure 1), (ii) tangible assets (Figure 2), and (iii) the number of employees (in millions; Figure 3).[5] To check whether the profitability varies across different country groups, we compute the ratio for (i) the complete sample of German MNEs and their subsidiaries, (ii) subsidiaries located in European tax havens, and (iii) subsidiaries located in tax-havens outside of Europe (see Table A1 of Appendix A for a definition of European and non-European tax havens). The ratios are computed by dividing the sum of positive profits reported by all subsidiaries of German MNEs in each of these country groups by the sum of their revenues, the value of tangible assets, and the number of employees, respectively.

The figures highlight that the subsidiaries of German MNEs located in European tax havens are notably more profitable than subsidiaries located in non-havens. In European tax havens, the profit-to-sales ratio is close to 16%, which is almost double the size of the profit-to-sales ratio in non-tax havens. The differences with regard to the other two profitability measures are even more pronounced. The return to tangible assets for subsidiaries located in European tax haves is more than two times larger than for subsidiaries located in non-havens, and the profits per employee reported in European tax havens are even three time larger than in non-havens.

Interestingly, subsidiaries located in tax havens outside of Europe are characterized by a lower profit-to-sales ratio than subsidiaries located in non-havens, but a markedly higher return to tangible assets and profit per employee ratio. One possible explanation for this stylized fact is that a notable fraction of the subsidiaries in non-European tax havens represent financial holding companies that serve the purpose of extending loans to and/or holding equity of affiliated firms. Since (i) the return to such intra-firm financial transactions is typically low[6] and (ii) our asset measure does not include financial assets, it would explain both the low profit-to-revenue ratio as well as the high profit-to-tangible assets ratio.

[5] Note that the CbC data do not contain information about intangible assets or financial assets.

[6] For an intra-firm loan that is financed through a bank credit, the financial holding companies return is the difference in the interest paid by the affiliated firm and the interest of the bank loan. This difference should typically be rather small.

Figure 1: Profit to sales ratios of German MNEs' subsidiaries

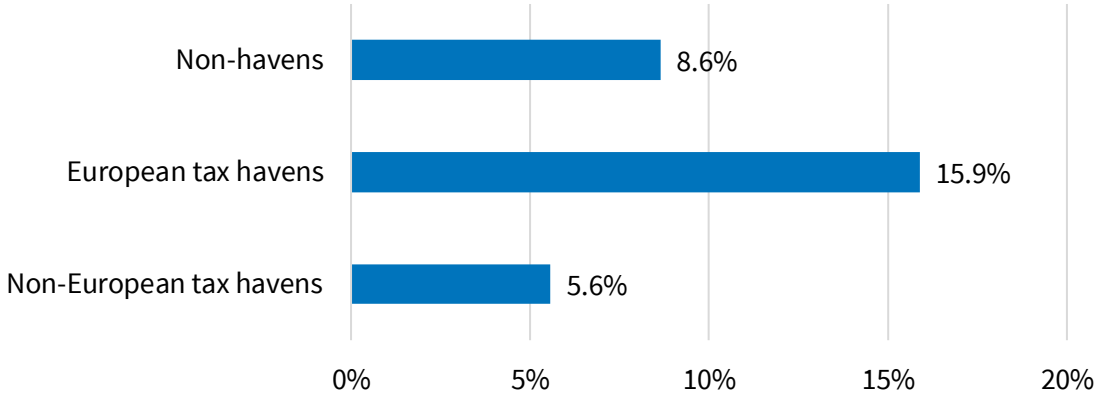


Figure 2: Return to tangible assets

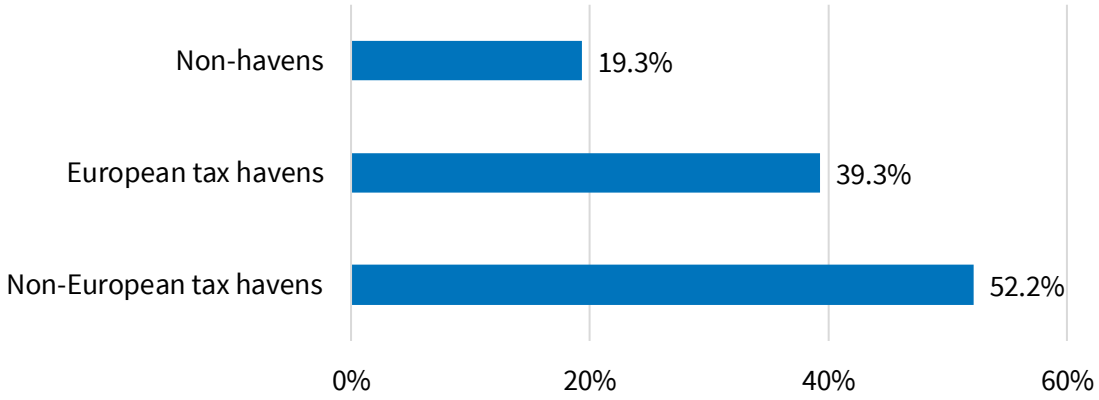


Figure 3: Profits per employee (in million EUR)

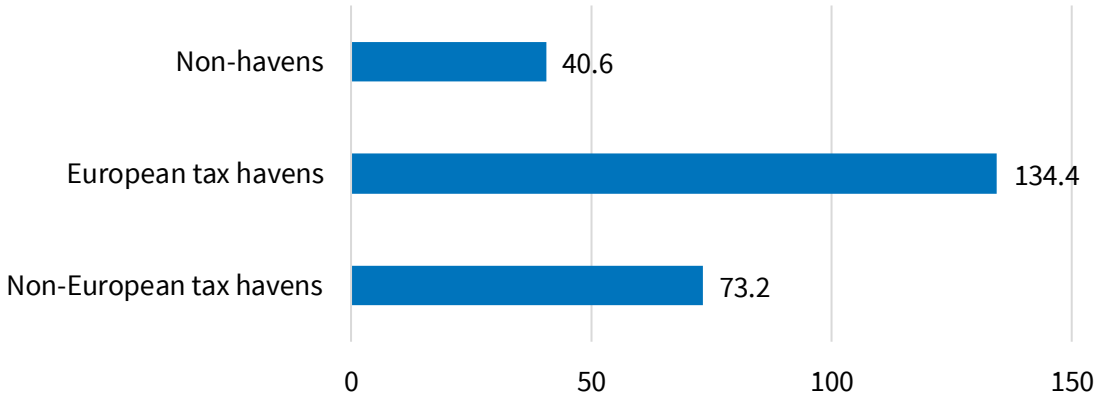
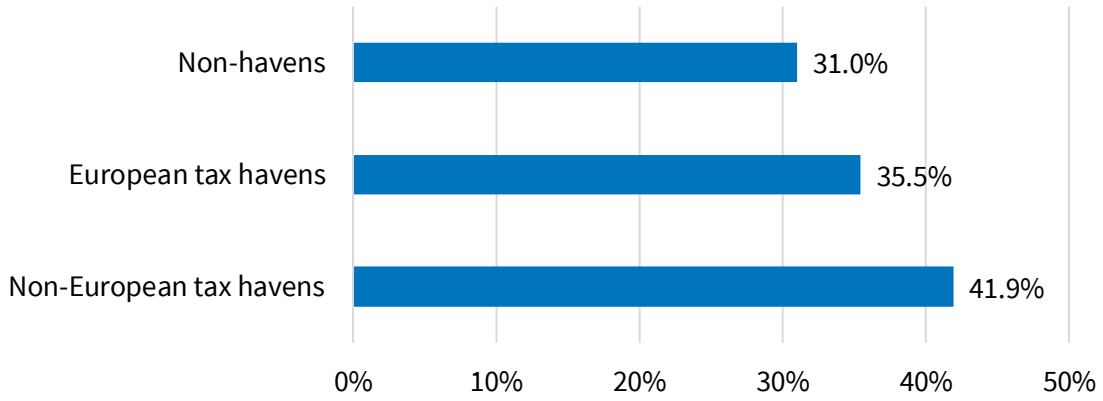


Figure 4 illustrates the share of intra-firm revenues to total revenues for the three country groups. The figures suggest that German MNEs' subsidiaries located in European and - even more so – non-European tax havens are particularly important for the provision of inputs and services for affiliated firms. Subsidiaries located in non-European tax havens (European tax havens) generate roughly 42% (36%) of their revenues through transaction with affiliated firms. For subsidiaries in non-havens, the share of intra-firm revenues is almost 11 (5) percentage points lower. Against the background of the higher profitability in tax havens, this finding may be interpreted as a first indication of a strategic location of inputs by German MNEs with the aim of shifting profits to low-tax jurisdictions. Moreover, the fact that the share of intra-firm revenues is particularly high in non-European tax havens is also in line with the conjecture that those countries are an important location for financial holding companies.

Figure 4: Revenues related over total revenues



3.2 Coverage of CbC and Orbis data

Figure 5 compares the number of subsidiaries of German MNEs included in the CbC and Orbis data as well as the information about the subsidiaries' global (unconsolidated) profits, tangible assets, and employment across the two data sets. We compare the information for three groups of countries: non-tax havens, European tax havens, and non-European tax havens. The figures represent the ratio of the variables' realizations in the Orbis data to their realizations in the CbC data. Assuming that the information about German MNEs' global activities provided in the CbC data is complete (and we have no reason to doubt that), the figures shed light on the coverage of the Orbis data base.

Figure 5: Coverage of CbC data by Orbis

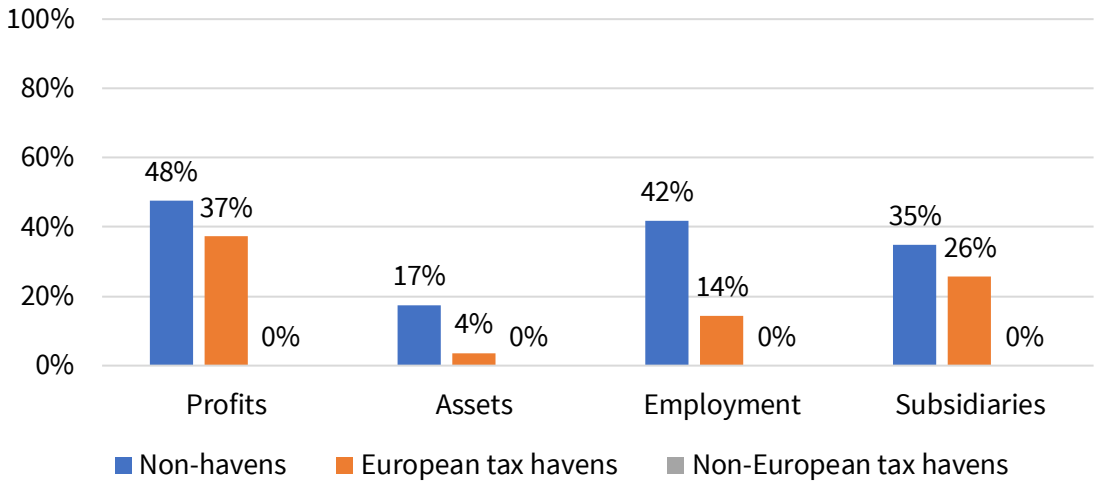


Figure 5 indicates that the coverage of the Orbis data must be considered poor, especially in tax havens. The Orbis data cover only 35% of German MNEs' subsidiaries located in non-tax havens. The subsidiaries covered by Orbis account for roughly half (i.e., 48%) of the profits all subsidiaries of German MNEs make in non-tax havens. The coverage of employment (42%) and assets (17%) in non-tax havens by the Orbis data is even lower. In European tax havens, only 26% of the subsidiaries of German MNEs and 37% of the profits they make are accounted for in the Orbis data. What is more, the Orbis data do not cover any activities of German MNEs in tax havens outside of Europe.

There are several reasons for the incomplete coverage of the Orbis data. First, some countries are not covered by Orbis since they do not keep business registries or publish the information therein. This is true for a large number of low-tax jurisdictions commonly labelled as tax havens. Second, in some countries, the obligation to report financial information is limited to certain types of firms. For example, it is quite common that reporting obligations only apply to large firms or firms of certain legal forms (cf. Kalemli-Oczan et al., 2015). Third, some countries, although covered by Orbis as they keep public business registries, do either not require firms to report their profits, the value of assets, or the number of employees, or do not publish this particular information, which is why the corresponding information is missing in Orbis. Third, the information about ownership structures and, hence, the list of subsidiaries in Orbis is incomplete.

Table C1 of the Appendix documents the coverage at the country level. According to the CbC reports, the 333 German MNEs included in our sample have subsidiaries in 193

countries. The Orbis data set only covers subsidiaries in 46 of these countries. I.e., Orbis misses information for more than three quarters of countries in which German MNEs have subsidiaries. What is more, in 21 of these 46 countries, less than half of the profits made by German MNEs' subsidiaries are accounted for in Orbis. In contrast. the coverage of profits by Orbis exceeds 80 percent in only nine countries. Interestingly, there are four countries in our data set for which the ratio of profits reported in Orbis to the profits reported in the CbC data exceeds 100 percent. One potential explanation could be the different treatment of profits made by legally dependent permanent establishments (PE) in the Orbis and CbC data. In the Orbis data, the profits made by a legally dependent PE will be reported at the level of its direct parent company. Hence, if the direct parent is situated in country A, but the PE in country B, the profit of the PE will be reported in country A. In contrast, in the CbC data, the profit of a PE is reported in the country it is situated, irrespective of where its direct parent company is located. Note that the treatment of profits made by foreign PEs constitutes another important advantage of the CbC data over Orbis data. When estimating the extent of tax avoidance and profit shifting, researchers are interested in where the profits are actually booked, and not where they are reported due to accounting conventions.

The incomplete coverage of the Orbis data is also documented by Tørsløv et al. (2018). The authors compare the consolidated global profits of all MNEs covered by Orbis to the sum of the profits reported by those MNEs' subsidiaries. They find that only 17% of MNEs' global profits could be traced in Orbis.

4. Regressions based on CbC data

4.1 Empirical approach

We follow the extant empirical literature and estimate a modified version of the empirical model proposed by Hines and Rice (1994). Our baseline specification looks as follows:

$$(1)\ y_{ict} = \alpha_i + \beta\tau_{ct} + \gamma' Firm_{ict} + \delta' Country_{ct} + \varepsilon_t + \theta_{ict}$$

Index *i* refers to the corporate group, *c* to the residence country of the group's affiliates, and *t* to the year.[7] We employ two different dependent variables in our analysis:

[7] In some cases, the financial year does not correspond to the calendar year. In those cases, we assign the financial information to year t if the financial year ended before or on 30 June of the following year and to year t+1 if the financial year ended after 30 June.

(i) the log of the sum of profits of group *i*'s affiliates located in country *c* and (ii) the log of intra-firm revenues generated by group *i*'s affiliates through transactions with other affiliates of group *i* (intra-firm revenues). Note that the latter variable includes royalty and interest payments. An inverse relationship between this variable and the level of taxation in a country would thus provide (suggestive) evidence that the strategic location of inputs and services (including IP and financial services/intra-company loans) is an important instrument of tax avoidance.[8] The vector $Firm$ includes three variables that depict the group's activities in country c and year t. These variables are the number of employees, the value of tangible assets, as well as the revenues the group's affiliates in country c generate from sales to third parties (revenues unrelated). Arguably, the latter variable captures the importance of country c as a country of sale for the group. The vector $Country$ includes the log of PPP adjusted GDP per capita, log population (both taken from the Penn World Table 9.1; cf. Feenstra et al., 2015), as well as the realization of Amnesty International's Corruption Perception Index. α_i is a corporate group fixed effect, ε_t is a year fixed effect. Standard errors are clustered at the corporate group level.[9]

The variable of main interest is the tax variable τ. In our empirical analysis, we use two different tax variables: (i) the statutory tax rate of country c and (ii) the effective average tax rate. Existing studies either use the statutory tax rate (e.g., Huizinga and Laeven, 2008; Dischinger and Riedel, 2011) or effective average tax rates (e.g., Clausing, 2016), but rarely both (an exception is Dowd et al., 2017). Statutory tax rates are taken from KPMG and EY. Effective average tax rates are computed by dividing the sum of taxes the corporate groups in our sample pay in country c by the sum of profits the corporate groups make in these countries. To circumvent endogeneity problems, we follow Dowd et al. (2017) and compute the effective average tax rate for group i in country c only based on the information about the taxes paid and the profits made by other corporate groups in that country. Also, we compute average tax rates only for countries in which at least ten of the corporate groups in our sample have affiliates. Due to that, our sample size is slightly smaller when using effective average tax rates

[8] Admittedly, this variable is only an imperfect indicator for the strategic location of IP and debt. Unfortunately, though, CbC reports do not contain information about royalty and interest payments.

[9] Note that we cannot include country fixed effects to our specification since there is virtually no variation in our tax variables and controls across the two sample years. Note, though, that even studies that cover longer time spans rarely control for country fixed effects.

instead of statutory tax rates. Note that since all MNEs in our sample have their headquarters in Germany, using the level of the tax rate in country *c* as an explanatory variable is equivalent to using the difference between the tax rate in country *c* and the tax rate in a MNE's base country.

To glean further insights, we modify our baseline specification in several ways. In a first modification, we follow Dowd et al. (2017) and add the squared realization of the tax variable to our baseline specification. This allows us to test whether the tax-sensitivity of profits and revenues varies across low and high-tax jurisdictions. The resulting regression equation is:

$$(2)\ y_{ict} = \dot{\alpha}_i + \dot{\beta}_1 \tau_{ct} + \dot{\beta}_2 \tau_{ct}^2 + \dot{\gamma}' Firm_{ict} + \dot{\delta}' Country_{ct} + \dot{\varepsilon}_t + \dot{\theta}_{ict}$$

In a second modification, we add two dummy variables to our baseline specification. The first dummy variable takes on the value 1 if country *c* is considered a tax haven within Europe, the second dummy takes on the value 1 if country *c* is considered a tax haven outside of Europe. Unfortunately, there is disagreement in the extant literature concerning the countries which qualify as tax havens. Menkhoff and Miethe (2019) provide a summary of the classifications used in six different publications. For our analysis, we decided to include only those countries to our list of tax havens which are labelled accordingly in all of the six publications reviewed by Menkhoff and Miethe (2019). We believe that this procedure yields the least arbitrary classification of tax havens. The regression equation is:

$$(3)\ y_{ict} = \tilde{\alpha}_i + \tilde{\beta}_1 \tau_{ct} + \tilde{\beta}_2 Haven_c^{Europe} + \tilde{\beta}_3 Haven_c^{\overline{Europe}} + \tilde{\gamma}' Firm_{ict} + \tilde{\delta}' Country_{ct} + \tilde{\varepsilon}_t + \tilde{\theta}_{ict}$$

In a final set of modifications, we test whether the tax-sensitivity of profits and revenues varies across corporate groups by re-estimating Equation (3) for different subsamples. First, we create subsamples based on information about the importance of intangible assets. To this end, we compute the ratio of the value of intangible assets to total assets and split our sample in four subsamples based on the quartiles of that ratio. We collect the information about the value of intangible assets from the Orbis data base since it is not included in the CbC reports. Second, we test whether the tax-sensitivity varies with the size of the corporate group by creating four subsamples based on the quartiles of total consolidated revenues.

As a robustness test, we replace the tax variable τ by the absolute difference between the tax rate in country *c* and the weighted average of the tax rates of all other countries

in which the corporate group has affiliates as an explanatory variable. Following Huizinga and Laeven (2008), we use the revenues generated by the corporate group's affiliates in a country as weights.

4.2 Results

4.2.1 Baseline specification

The results of our baseline specification are presented in Table 1. Columns (1) and (2) show the results when using profits as dependent variable, columns (3) and (4) for the revenues generated through transactions with associated firms.

Our results indicate a statistically significant association between the effective average tax rate on the one hand and profits as well as intra-firm revenues on the other hand. Holding other factors such as the value of tangible assets, employment, and revenues fixed, a one percentage point (pp) increase in the average tax rate is associated with a decrease in profits by roughly 0.5% and a decrease in intra-firm revenues by 1.3%. Thus, tax rate differentials between countries apparently matter for the profit allocation of large German MNEs. However, although of a relevant magnitude, our estimates are notably smaller than the average semi-elasticities reported in the meta-analyses by Beer et al. (2019) as well as Heckemeyer and Overesch (2017). Beer et al. (2019) find an average tax semi-elasticity of corporate profits of −1, Heckemeyer and Overesch (2017) of −0.8.

In contrast, the relationship between statutory tax rates and profits as well as revenues generated through transactions with associated firms is insignificant. One explanation for this finding is that the statutory tax rate is an inaccurate measure for the actual tax burden in a country. In fact, the coefficient of correlation between the average tax rate and the statutory tax rate is only 0.239, indicating a weak correlation between these two variables. Moreover, many countries consistently labelled as tax havens are actually characterized by high statutory tax rates despite their tax haven status. For example, Switzerland has a statutory corporate income tax rate of 18%, Luxembourg of 26%, and Malta even of 35%. Discrepancies between effective tax rates and statutory tax rates can be due to tax exemptions of certain income, tax credits for certain activities (such as R&D), as well as patent boxes.

Table 1: Baseline specification

Dependent Variable	**log(profits)**		**log(revenues related)**	
	(1)	**(2)**	**(3)**	**(4)**
Statutory tax rate	0.104		0.380	
	(0.266)		(0.421)	
Effective tax rate		−0.517**		−1.262***
		(0.183)		(0.318)
log(assets)	0.153***	0.156***	0.262***	0.269***
	(0.040)	(0.041)	(0.069)	(0.070)
log(employment)	0.369***	0.373***	0.930***	0.925***
	(0.056)	(0.058)	(0.095)	(0.097)
log(revenues unrelated)	0.324***	0.315***	−0.128***	−0.133***
	(0.030)	(0.030)	(0.038)	(0.038)
Corruption perception index	0.461**	0.384*	1.047***	0.935***
	(0.148)	(0.155)	(0.242)	(0.245)
log(GDP pc)	0.258***	0.279***	0.663***	0.644***
	(0.050)	(0.054)	(0.094)	(0.104)
log(population)	0.051**	0.062***	0.058	0.081**
	(0.019)	(0.018)	(0.033)	(0.031)
Dummy year 2017	−0.058	−0.064	−0.036	−0.036
	(0.052)	(0.052)	(0.086)	(0.087)
Constant	1.910***	1.912***	0.698	0.990
	(0.514)	(0.457)	(0.890)	(0.899)
No. of observations	9410	9275	8338	8246
Adjusted R^2	0.797	0.798	0.718	0.721

Notes: Results are based on OLS regression. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

4.2.2 Quadratic specification

Dowd et al. (2017) argue that the affiliates of a MNE located in low-tax jurisdictions may react more sensitively to tax rate changes than those in high-tax jurisdictions, implying that the semi-elasticity of profits with respect to the tax rate may be larger (in absolute terms) when the level of taxation in a country is low. To test this conjecture, they include the squared realization of the tax variable to their empirical model. We follow their approach and report the results for this modification in Table 2. To facilitate the interpretation of the coefficients, we also illustrate the resulting average marginal effects of a tax rate change for different realizations of the tax rate level graphically. Figure 6 illustrates the marginal effects of a tax rate change on profits, Figure 7 on intra-firm revenues.

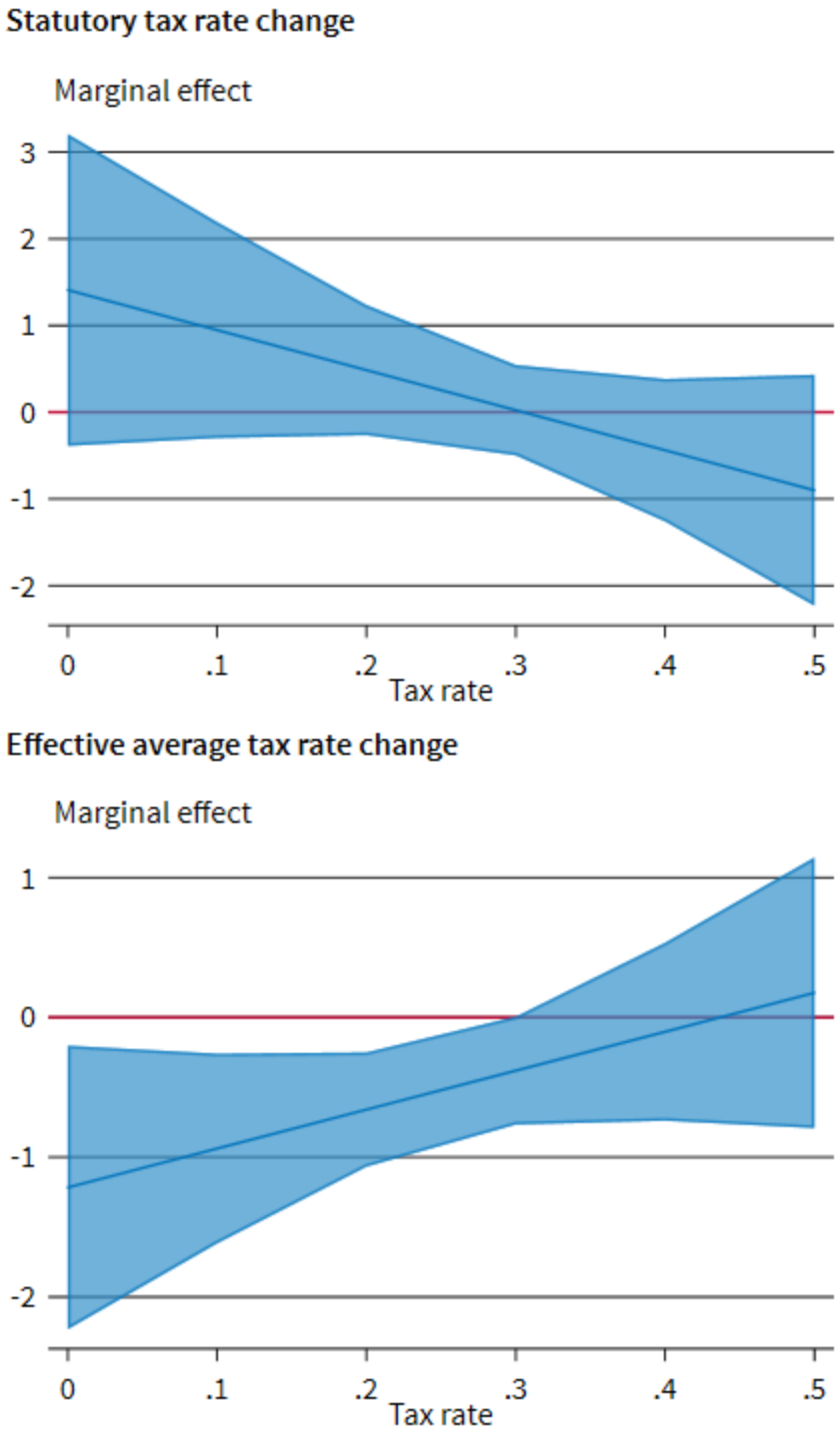
The results we obtain when using the effective average tax rate as an explanatory variable are well in line with those reported by Dowd et al. (2017). The lower the level of taxation, the more sensitive profits are to tax rate changes. For instance, if the average tax rate is 10%, then a 1 pp increase in the tax rate is associated with a decrease in profits by about 1% (cf. Figure 6). For an average tax rate of 25%, the resulting marginal effect of a tax rate change is only half that size. Moreover, once the average tax rate exceeds a level of about 30%, the marginal effect becomes insignificant. Note that the result of an F-test indicates that the coefficients of the linear and quadratic tax variable are jointly highly significant (second row from the bottom of Table 2). Thus, the weak individual significance of the coefficient estimates is apparently due to a collinear relationship. The results we obtain when using intra-firm revenues are qualitatively similar. Yet again, though, we find no statistically significant association (neither individually nor jointly) between the level of taxation and profits or intra-firm revenues when using the statutory tax rate as an explanatory variable.

Table 2: Results for the quadratic specification

Dependent Variable	**log(profits)**		**log(revenues related)**	
	(1)	**(2)**	**(3)**	**(4)**
Statutory tax rate	1.410		1.597	
	(0.914)		(1.613)	
Statutory tax rate squared	−2.311		−2.140	
	(1.499)		(2.614)	
Effective tax rate		−1.216*		−2.872***
		(0.515)		(0.806)
Effective tax rate squared		1.393		3.306*
		(0.942)		(1.465)
log(assets)	0.153***	0.156***	0.261***	0.269***
	(0.040)	(0.041)	(0.069)	(0.070)
log(employment)	0.369***	0.373***	0.930***	0.924***
	(0.056)	(0.058)	(0.095)	(0.097)
log(revenues unrelated)	0.324***	0.315***	−0.128***	−0.132***
	(0.030)	(0.030)	(0.038)	(0.038)
Corruption perception index	0.410**	0.359*	1.001***	0.884***
	(0.148)	(0.154)	(0.251)	(0.245)
log(GDP pc)	0.272***	0.283***	0.676***	0.653***
	(0.053)	(0.054)	(0.098)	(0.104)
log(population)	0.047*	0.064***	0.054	0.085**
	(0.019)	(0.018)	(0.033)	(0.031)
Dummy year 2017	−0.056	−0.065	−0.034	−0.036
	(0.052)	(0.052)	(0.087)	(0.087)
Constant	1.650**	1.945***	0.456	1.176
	(0.542)	(0.456)	(0.943)	(0.899)
No. of observations	9410	9275	8338	8246
F statistic (joint sign. tax variables)	1.22	5.04**	0.63	9.67***
Adjusted R^2	0.797	0.798	0.718	0.721

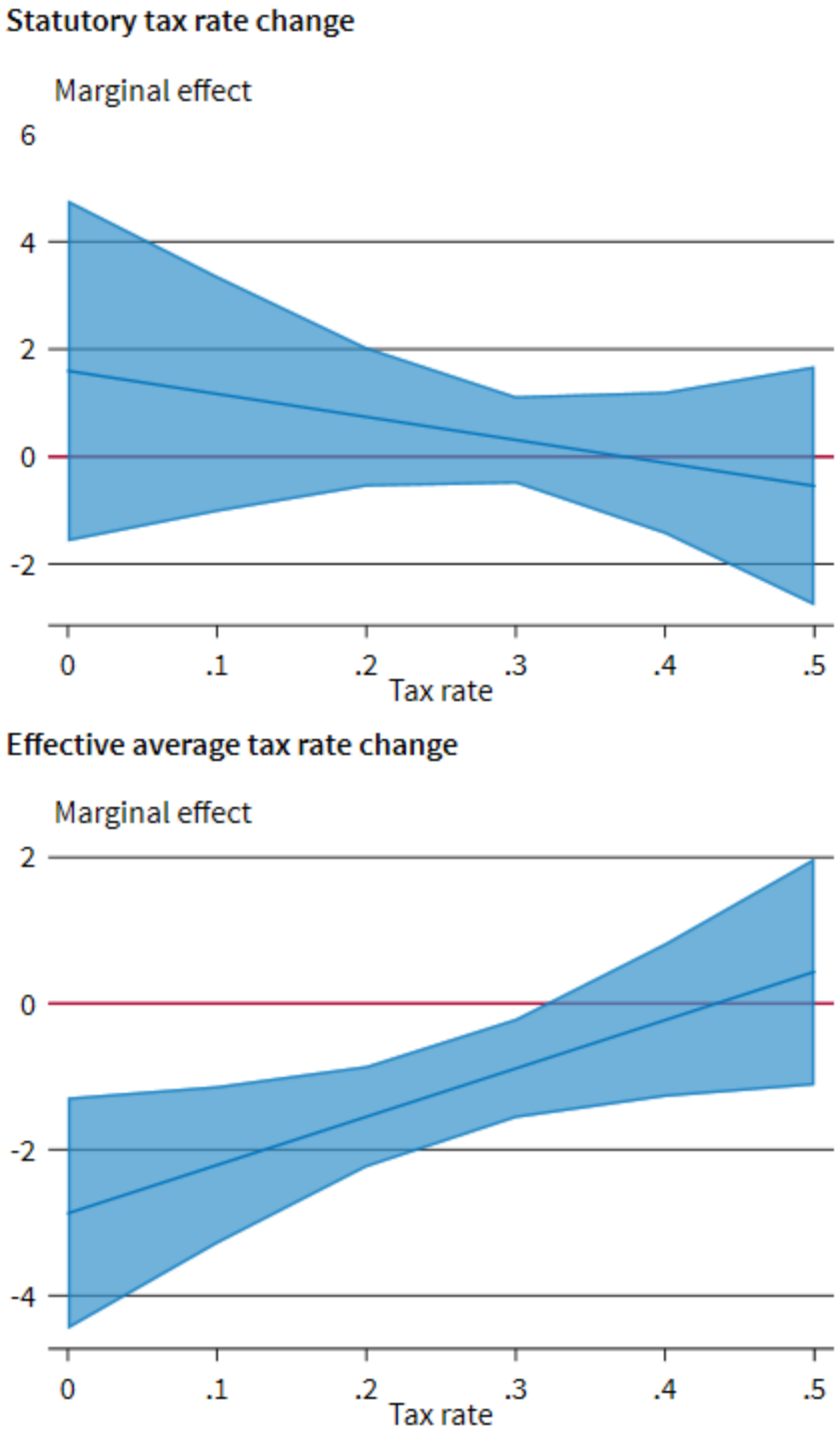
Notes: Results are based on OLS regression. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

Figure 6: Marginal effect of tax rate change on profits



Notes: The figures illustrate the average marginal effects of a change in the statutory tax rate (upper figure) and the effective average tax rate (lower figure) on the log of profits for different realizations of the tax rate. Average marginal effects are computed based on the coefficient estimates in Table 2. The shaded areas show 95% confidence intervals.

Figure 7: Marginal effect of tax rate change on intra-firm revenues



Notes: The figures illustrate the average marginal effects of a change in the statutory tax rate (upper figure) and the effective average tax rate (lower figure) on the log of intra-firm revenues for different realizations of the tax rate. Average marginal effects are computed based on the coefficient estimates in Table 2. The shaded areas show 95% confidence intervals.

4.2.3 Including tax haven dummies

In this section, we take a closer look at the importance of tax havens for German MNEs profit shifting and tax avoidance activities. The exposure of tax avoidance strategies by some well-known corporations in the past years as well as the so-called Luxembourg Leaks have also put certain countries under spotlight for the role they play in MNEs' profit shifting activities. Menkhoff and Miethe (2019) summarize the tax haven definitions applied in different publications. We take this summary as a benchmark for our own definition of tax havens. Thereby, we differentiate between tax havens located in Europe and those located outside of Europe.

Table 3 shows the regression results when including dummy variables for European and non-European tax havens to our baseline specification. The results we obtain are quite remarkable. When the two dummy variables are included, the estimate of the tax semi-elasticity of profits reduces by half and is no longer significant. The coefficient estimates of the tax haven dummies, on the other hand, are not only statistically significant at every reasonable level of significance, but also sizeable. Other factors fixed, the profits large German MNE report in European tax havens exceed the profits reported in non-havens by roughly 67%. In non-European tax havens, the profits by German MNEs are about 41% higher. These findings suggest that profit shifting by large German MNEs mainly takes place through tax havens, whereby European tax havens seem to be more important for profit shifting activities than non-European tax havens. In a similar vein, we find that for affiliates located in European (non-European) tax havens, the revenues generated through sales to associated firms are 69% (100%) higher than for affiliates located in non-havens. This finding suggests that German MNEs strategically locate inputs in tax havens in order to shift profits there. The fact that intra-firm revenues are, *ceteris paribus*, higher in non-European tax havens than in European tax havens although German MNEs report higher profits in European tax havens fits well to the stylized facts presented in section 3.1. Note that the estimated tax semi-elasticity of revenues generated through intra-firm transactions remains statistically significant when the two dummy variables are included. However, its magnitude decreases (in absolute terms) as well.

Table 3: Including dummy variables for tax havens

Dependent Variable	**log(profits)**		**log(revenues related)**	
	(1)	**(2)**	**(3)**	**(4)**
Statutory tax rate	0.532		1.254**	
	(0.274)		(0.453)	
Effective tax rate		−0.249		−0.867**
		(0.184)		(0.325)
European tax havens	0.665***	0.630***	0.774***	0.690***
	(0.080)	(0.078)	(0.126)	(0.124)
Non-European tax havens	0.414***	0.371***	1.104***	1.004***
	(0.091)	(0.091)	(0.158)	(0.151)
log(assets)	0.151***	0.154***	0.257***	0.265***
	(0.039)	(0.041)	(0.069)	(0.070)
log(employment)	0.380***	0.383***	0.953***	0.943***
	(0.056)	(0.058)	(0.096)	(0.097)
log(revenues unrelated)	0.320***	0.312***	−0.134***	−0.136***
	(0.030)	(0.030)	(0.038)	(0.038)
Corruption perception index	0.236	0.251	0.722**	0.779**
	(0.146)	(0.151)	(0.244)	(0.245)
log(GDP pc)	0.221***	0.250***	0.593***	0.590***
	(0.049)	(0.053)	(0.097)	(0.105)
log(population)	0.066***	0.083***	0.077*	0.114***
	(0.018)	(0.018)	(0.033)	(0.031)
Dummy year 2017	−0.055	−0.064	−0.030	−0.036
	(0.052)	(0.052)	(0.087)	(0.087)
Constant	2.243***	2.147***	1.273	1.428
	0.665***	(0.451)	(0.889)	(0.888)
No. of observations	9410	9275	8338	8246
Adjusted R^2	0.800	0.801	0.723	0.725

Notes: Results are based on OLS regression. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

4.2.4 Effect heterogeneity

It is often argued that MNE that rely on intangible assets to large extent find it easier to shift profits to low-tax jurisdictions. In the BEPS project, for instance, the OECD highlights the importance of intangible assets for MNEs' tax avoidance activities (OECD, 2018). Also, Griffith et al. (2014) as well as Dischinger and Riedel (2011) provide evidence that the location of MNEs' intellectual property is sensitive to the level of taxation. For that reason, we check whether the estimated tax semi-elasticities of profits and revenues vary with the ratio of the value of intangible assets to total assets. To this end, we split our sample into four subsamples based on the quartiles of this ratio and re-estimate our baseline empirical model including the tax haven dummies for each subsample. Since the CbC reports do not contain information about intangible assets, we compute the ratio based on Orbis data and merge this information with the CbC data. The results are shown in Table 4. Overall, the findings do not indicate that the extent of profit shifting by German MNEs is related to the share of intangible assets. The coefficient estimates of the dummy variables for both European and non-European tax havens varies only little across the four subsamples. The only exception is the 3rd quartile, where the coefficient estimate of the dummy for non-European tax havens is statistically insignificant.

Another claim that is often made is that larger firms are more prone to engage in profit shifting and tax avoidance than smaller firms. The reason is that tax planning and profit shifting activities involve non-negligible fixed costs, which large firms can bear more easily. These costs may include, for example, staffing costs, costs for legal advice, or the expected costs arising from a loss of reputation in case the profit shifting activities become public. Davies et al. (2018), Desai et al. (2006), Langenmayr and Liu (2020), as well as Wier and Reynolds (2018) provide evidence for a positive relationship between firm size and profit shifting activities. Taking up on this, we check whether the estimates of the tax semi-elasticity of profits vary with firm size. As a proxy for firm size, we use the consolidated revenues of the MNE group. Like before, we split our sample into four subsamples based on the quartiles of the firm size indicator and re-estimate our empirical model for each subsample. Table 5 reports the results. The findings we obtain are in line with the notion that the extent of profit shifting is positively related to firm size. The larger the MNE, the higher are the profits reported in European tax havens. E.g., the profits reported by the 'smallest' 25% of German MNEs in European tax havens exceed the profits reported in non-tax havens by about 45%.

For the largest 25% of German MNEs, this effect grows to over 80%. Moreover, we find that only the largest 50% of German MNEs in our sample appear to use non-European tax havens to shift profits. For the smallest 50%, the coefficient estimate of the dummy for non-European tax havens is statistically insignificant. Our results thus provide additional evidence along the lines of Desai et al. (2006). For intra-firm revenues, though, there is no clear pattern.

Table 4: Semi-elasticities by intangible asset shares

Dependent Variable	**log(profits)**							
	1st quartile		**2nd quartile**		**3rd quartile**		**4th quartile**	
Statutory tax rate	0.477		0.993		1.174		−0.000	
	(0.765)		(0.584)		(0.731)		(0.646)	
Effective tax rate		0.527		−0.420		−0.920*		−0.039
		(0.487)		(0.415)		(0.397)		(0.464)
European tax havens	0.722**	0.730***	0.722***	0.661**	0.725***	0.628**	0.758***	0.722***
	(0.217)	(0.206)	(0.204)	(0.191)	(0.186	(0.183)	(0.185)	(0.192)
Non-European tax havens	0.469*	0.451*	0.696**	0.579*	0.276	0.132	0.605***	0.657***
	(0.210)	(0.210)	(0.213)	(0.218)	(0.217)	(0.214)	(0.161)	(0.147)
Dependent Variable	**log(revenues related)**							
	1st quartile		**2nd quartile**		**3rd quartile**		**4th quartile**	
Statutory tax rate	−0.269		2.222		1.742		1.780	
	(0.972)		(1.316)		(1.235)		(0.941)	
Effective tax rate		−1.062		−0.453		−1.605		−0.731
		(0.949)		(0.960)		(0.868)		(0.437)
European tax havens	0.264	0.226	1.087**	0.993*	1.108***	0.979***	1.210***	1.050***
	(0.281)	(0.276)	(0.402)	(0.392)	(0.217)	(0.222)	(0.286)	(0.273)
Non-European tax havens	1.254**	1.211**	1.856***	1.683***	1.198*	1.010*	1.053***	0.923***
	(0.418)	(0.405)	(0.465)	(0.459)	(0.448)	(0.397)	(0.232)	(0.210)

Notes: Results are based on OLS regression. Coefficients of control variables are omitted to conserve space. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

Table 5: Semi-elasticities by firm size

Dependent Variable	**log(profits)**							
	1st quartile		**2nd quartile**		**3rd quartile**		**4th quartile**	
Statutory tax rate	−0.535		0.849		0.926		0.950	
	(0.525)		(0.480)		(0.571)		(0.494)	
Effective tax rate		0.015		−0.359		−0.306		−0.271
		(0.359)		(0.303)		(0.324)		(0.365)
European tax havens	0.433**	0.452**	0.584***	0.540***	0.780***	0.738***	0.872***	0.815***
	(0.139)	(0.137)	(0.153)	(0.147)	(0.149)	(0.148)	(0.152)	(0.162)
Non-European tax havens	0.345	0.373	0.228	0.141	0.662***	0.605***	0.476**	0.418**
	(0.215)	(0.214)	(0.210)	(0.212)	(0.170)	(0.175)	(0.139)	(0.133)
Dependent Variable	**log(revenues related)**							
	1st quartile		**2nd quartile**		**3rd quartile**		**4th quartile**	
Statutory tax rate	1.765*		1.699		0.658		1.198	
	(0.890)		(1.024)		(0.836)		(0.651)	
Effective tax rate		−0.666		−1.413		−0.101		−1.072**
		(0.795)		(0.797)		(0.453)		(0.371)
European tax havens	0.192	0.074	0.807**	0.725*	1.060***	1.025***	1.155***	1.050***
	(0.242)	(0.240)	(0.295)	(0.283)	(0.206)	(0.204)	(0.189	(0.180)
Non-European tax havens	0.898**	0.704**	1.277***	1.139***	1.287***	1.232***	0.962***	0.907**
	(0.280)	(0.256)	(0.349)	(0.325)	(0.300)	(0.296)	(0.254)	(0.259)

Notes: Results are based on OLS regression. Coefficients of control variables are omitted to conserve space. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

4.2.5 Using tax rate differentials

Some studies use the difference between the tax rate in the country of the subsidiary and the average of the tax rates in all other countries in which a MNE has affiliates as an explanatory variable (e.g., Dischinger and Riedel, 2011; Huizinga and Leven; 2008). To test whether our results are robust to this modification, we re-estimate Equation (1) to (3) using such tax rate differentials. Thereby, we follow Huizinga and Leven (2008) and compute a weighted average of subsidiaries' tax rates, whereby the weights correspond to the revenues generated by the MNE's subsidiaries located in the respective countries. Table 6 shows the results. As can be seen, the coefficient estimates of the tax variables remain virtually unchanged across all three specifications. Consequently, our conclusions are not affected by this modification. Note that this is also true when re-estimating the tax semi-elasticities for different subsamples as in section 4.2.4.[10]

[10] Results available on request.

Table 6: Tax rate differentials

Dependent Variable	**log(profits)**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Statutory tax rate differential	0.080	0.057	0.515			
	(0.256)	(0.254)	(0.265)			
Statutory tax rate diff. squared		−2.123				
		(1.496)				
Effective tax rate differential				−0.515**	−0.743**	−0.266
				(0.179)	(0.240)	(0.180)
Effective tax rate diff. squared					1.326	
					(0.901)	
European tax havens			0.667***			0.630***
			(0.080)			(0.078)
Non-European tax havens			0.414***			0.370***
			(0.091)			(0.091)
No. of observations	9397	9397	9397	9262	9262	9262
F stat. (joint sign. tax variables)	---	1.03	---	---	5.17**	---
Adjusted R^2	0.797	0.797	0.800	0.798	0.798	0.801
Dependent Variable	**log(revenues related)**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Statutory tax rate differential	0.359	0.356	1.217**			
	(0.407)	(0.405)	(0.435)			
Statutory tax rate diff. squared		−0.365				
		(2.290)				
Effective tax rate differential				−1.297***	−1.847***	−0.932**
				(0.311)	(0.403)	(0.318)
Effective tax rate diff. squared					3.483*	
					(1.408)	
European tax havens			0.779***			0.689***
			(0.126)			(0.124)
Non-European tax havens			1.105***			1.002***
			(0.157)			(0.151)
No. of observations	8329	8329	8329	8237	8237	8237
F stat. (joint sign. tax variables)	---	0.39	---	---	10.68***	---
Adjusted R^2	0.718	0.718	0.721	0.721	0.721	0.725

Notes: Results are based on OLS regression. Coefficients of control variables are omitted to conserve space. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

4.3 Calculating the extent of shifted profits

In the context of the BEPS project, the OECD/G20 currently discusses the introduction of a global effective minimum tax rate. The idea is to allow the base country of a MNE to tax the foreign profit of that MNE in case the effective rate at which the foreign profit is taxed is below a certain threshold. The introduction of such a rule would thus lead to an increase in the effective tax rate on profits located in low-tax jurisdictions. To get an idea about the consequences such a rule would have on the allocation of profits, we calculate the absolute change in profits reported in tax havens in response to a 1 pp increase in tax havens' effective tax rates. The results are presented in Table 7.
Not surprisingly, the implied absolute change in profits is notably larger when we base our estimation on the quadratic specification. The reason is the marked non-linear relationship between the effective average tax rate and the estimated tax (semi-)elasticity of profits (cf. Section 4.4.2.). Based on the results of the quadratic specification, we find that a 1 pp increase in the effective tax rate would be associated with an annual reduction in profits reported in tax havens by about 4.5 billion EUR. This corresponds to roughly 1.6% of the average annual profits German MNEs report in non-havens (cf. Table A1 of the Appendix).

Table 7: Estimated absolute change in profits reported in tax havens

Specification	Annual change in profits in response to a 1pp tax rate hike (in million p.a.)
Linear specification	2,005
Quadratic specification	4,445

Notes: The change in profits is calculated based on the coefficient estimates of the effective average tax rate presented in Tables 1 and 2.

Based on the results of the specification including tax haven dummies (cf. Table 4), we can also derive a rough estimate of the total amount of profits shifted to tax havens. Our estimates suggest that in 2016 and 2017 combined, German MNEs shifted about 28 to 30 billion EUR to tax havens, depending on the specification. This corresponds to roughly 5.2 to 5.5 percent of the profits German MNEs have reported in non-havens in these two years and to roughly 10 to 11 percent of the profits these MNEs booked in Germany.

5. Regressions based on Orbis data

To check whether using (incomplete) Orbis data yields different results than the CbC data, we re-estimate the linear specification, the quadratic specification, and the specification including tax haven dummies based on Orbis data. To this end, we collect information on profits, taxes paid, the value of tangible assets, employment, and revenues of the subsidiaries of those German MNEs that are covered in the CbC data from the Orbis database.[11] Then, for each MNE, we aggregate this information at the level of the subsidiaries' residence countries so that the data we use refers to the same level of aggregation than the CbC data.[12] Our empirical approach thus perfectly resembles the one outlined in Section 4.1. Table 8 shows the results.

What is striking is that we lose almost two-thirds of our observations when using Orbis data. The reason is a drastic reduction in the number of countries included in the sample. The CbC data document activities of German MNEs in 193 countries, the Orbis data only in 46 countries.[13] For instance, information about the activities of German MNEs in non-European tax havens is completely missing. For European tax havens, the Orbis data lacks information about the activities in Cyprus, Liechtenstein, Malta, and Switzerland.

The estimates we obtain based on Orbis data draw a very different picture than the results based on CbC data. The linear specification yields an estimate for the coefficient of the statutory tax rate of notable size and with a p-value that is just above the 5% level of significance ($p = 0.053$). According to the estimate, a one pp increase in the statutory tax rate is associated with a 1.2% decrease in profits. However, the quadratic specification yields coefficient estimates for the statutory tax rate that are statistically insignificant both individually and jointly. In contrast, for the effective average tax rate, we obtain an insignificant coefficient estimate in the linear specification, but individually and jointly significant estimates in the quadratic specification. The resulting

[11] Note that the Orbis data do not contain information about the revenues a firm generates through sales to third parties, which is why we use the log of total revenues as a control variable instead. However, the estimates we obtain based on CbC data remain unaffected when replacing the revenues generated through sales to third parties by total revenues.

[12] Note that Huizinga and Leven (2008) use the same approach to estimate the extent of profit shifting by MNEs.

[13] Note that a large fraction of the 157 countries for which information is lacking are actually covered in Orbis, but the realizations of the variables included in our empirical model are missing.

marginal effects show an odd pattern, though (cf. Figure 8). I.e., we observe an unreasonably large reaction to a tax rate hike in low-tax jurisdiction. In countries with an average effective tax rate of 10% (which roughly corresponds to the 10th percentile), a 1 pp hike in the tax rate is associated with a reduction in profits by about 5%. Once the average effective tax rate exceeds a level of roughly 20% (which is close to the sample median), the tax semi-elasticity becomes significantly positive. Only the coefficient estimate of the dummy variable for European tax havens remains relatively stable. The estimates in Table 8 suggest that the profits reported by German MNEs in European tax havens exceed the profits reported in non-havens by about 72% to 100%, holding other factors fixed. We do not obtain a coefficient estimate for the dummy for non-European tax havens since the countries labelled as such are not covered by the Orbis data base.

But how come that in the baseline specification, the coefficient estimate of the statutory tax rate turns out to be (almost) statistically significant and of notable size when using Orbis data, while it is insignificant and close to zero when using CbC data? It seems likely that this has to do with the poor coverage of the Orbis data. In section 2, we discussed different reasons for the poor coverage, including (i) an incomplete coverage of countries, (ii) an incomplete list of subsidiaries, and (iii) missing values in the variables of interest. The first reason implies that the results based on Orbis data may be subject to a sample selection bias. The other two reasons imply that the dependent (and some of the independent) variables included in our empirical model are measured with an error when using Orbis data, which may lead to biased estimates as well. To check the relevance of these two explanations, we perform two tests. First, we re-estimate our baseline specification utilizing the CbC data, but only include those 48 countries to our sample that are covered in the Orbis data. If the differences in the results are due to a sample selection bias, then restricting our CbC sample to countries also covered by Orbis should produce similar coefficient estimates as in Table 8. However, when doing so, we obtain a coefficient estimate for the statutory tax rate that is statistically insignificant at every reasonable level of significance. In contrast, the coefficient estimate of the effective average tax rate grows to −1.3 (in absolute terms) and is significant even at the 0.1% level. These findings indicate that the omittance of countries not covered by the Orbis data does not explain the different results based on the two data sets.

In the second test, we try to assess whether the measurement error in the dependent variable, that is, the sum of profits made by a MNE in a country, may explain the different results. The existence of a measurement error implies that the error term of Equation (1) comprises two components when using Orbis data:

$$(4)\ \theta_{ict} = \vartheta_{ict} + e_{ict}$$

Where e is the measurement error and ϑ is the idiosyncratic component of the composite error term. Under the standard assumption that $E(e|X) = E(e) = 0$, OLS will yield unbiased coefficient estimates. In our application, though, this assumption is violated for two reasons. First, the measurement error is strictly negative as Orbis consistently underreports the profits MNEs make in every country. This violation, though, may not necessarily lead to biased coefficient estimates for the explanatory variables.[14] Second, we find that coverage of the Orbis data is inversely related to the statutory tax rate, implying that $E(e|X) \neq E(e)$. The coefficient of correlation between the statutory tax rate on the one hand and the ratio of profits reported in Orbis to the profits reported in the CbC data on the other hand is −0.54, which is sizeable. The inverse relationship implies that the extent of underreporting tends to be larger in countries with high statutory tax rates which, in turn, leads to a downward bias in the OLS estimate of the statutory tax rate's coefficient. Given the large size of the correlation coefficient, it is no wonder that the bias turns out to be so severe. Our findings thus clearly indicate that the results of profit shifting regressions based on Orbis data should be interpreted with great caution.

But why does the extent of underreporting of profits in Orbis tend to be higher in high-tax countries? One reason could be the different treatment of profits by PEs in the two data sets (cf. section 3.2.). I.e., in the CbC data, the profits of PEs are reported in the country where the PE is situated, while in Orbis, they are reported in the residence country of its direct parent company. Consequently, if German MNEs rely to a large extent on legally dependent PEs to run their operations in high-tax jurisdictions, while their legally independent subsidiaries are situated in low-tax jurisdictions, than the ratio of profits reported in Orbis to the profits reported in CbC would indeed be inversely related to the statutory tax rate.

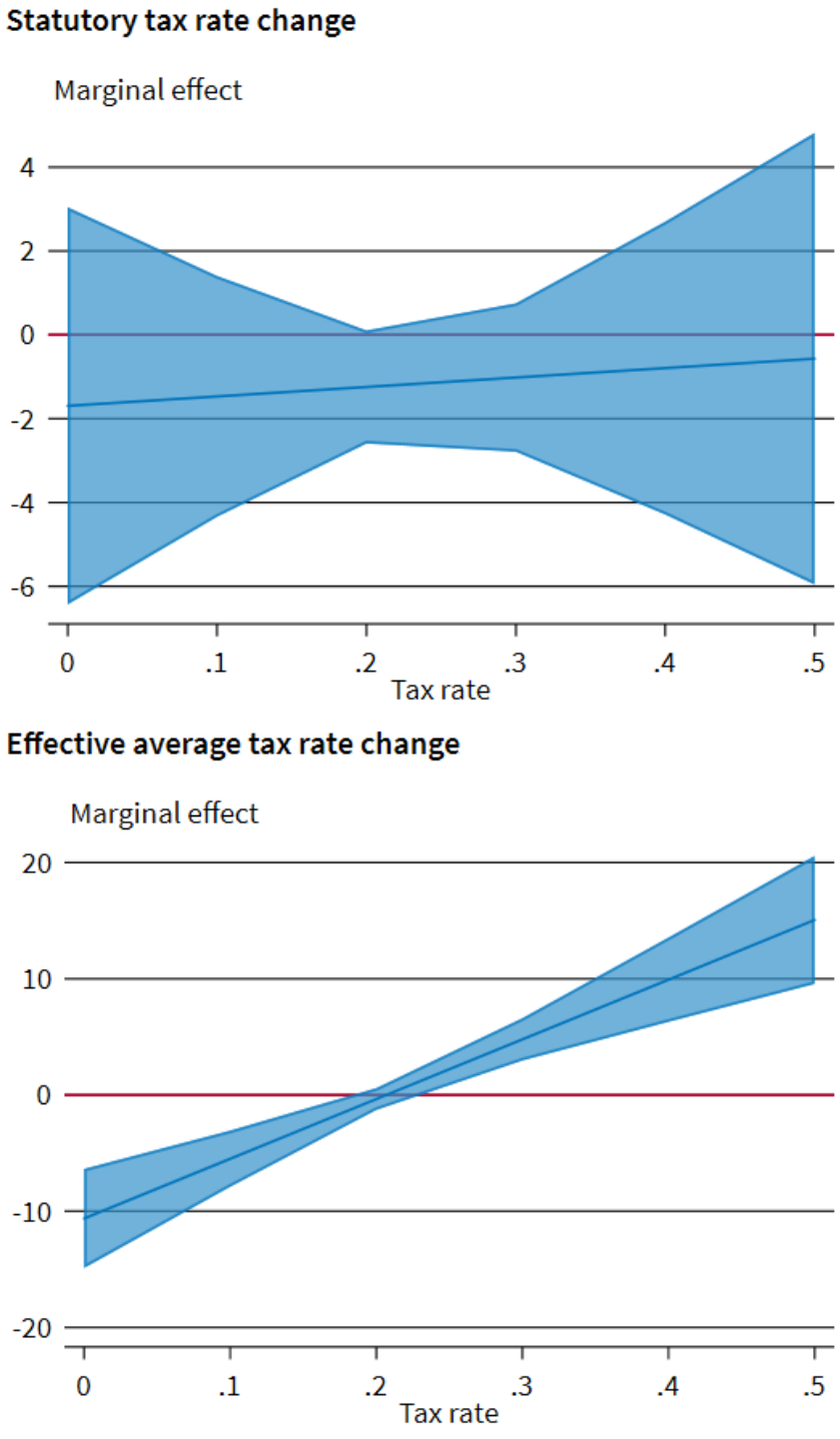
[14] Using Monte Carlo simulations, Millimet and Parmeter (2019) show that strictly negative or positive measurement errors (which he refers to as 'one-sided measurement errors') mainly affect the estimate of the intercept, but not the estimates of the control variables' coefficients, at least as long the measurement error is not correlated with the explanatory variables.

Table 8: Results based on Orbis data

Dependent Variable	**log(profits)**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Statutory tax rate	−1.165	−1.692			−0.667	
	(0.600)	(2.402)			(0.610)	
Statutory tax rate squared		1.124				
		(4.993)				
Effective tax rate			0.034	−10.623***		1.419**
			(0.467)	(2.164)		(0.459)
Effective tax rate squared				25.690***		
				(4.876)		
European tax havens					0.772***	1.069***
					(0.163)	(0.162)
Non-European tax havens					---	---
					(---)	(---)
No. of observations	3349	3349	3316	3316	3349	3316
F statistic (joint sign. tax variables)	---	1.93	---	14.59***	---	---
Adjusted R^2	0.791	0.791	0.791	0.795	0.794	0.796

Notes: Results are based on OLS regression. Coefficients of control variables are omitted to conserve space. All specifications include corporate group fixed effects. Standard errors shown in parantheses are clustered at the corporate group level. */**/*** indicate significance at the 5%/1%/0.1% level.

Figure 8: Marginal effect of tax rate change on profits – Orbis data



Notes: The figures illustrate the average marginal effects of a change in the statutory tax rate (upper figure) and the effective average tax rate (lower figure) on the log of profits for different realizations of the tax rate. Average marginal effects are computed based on the coefficient estimates in Table 8. The shaded areas show 95% confidence intervals.

6. Conclusions

The tax sensitivity of corporate profits has been studied extensively in the empirical literature. However, most of the existing studies use information from the Bureau van Dijk's Orbis or Amadeus data base to study the tax-sensitivity of corporate profits, which do not cover the activities of multinational enterprises (MNEs) in all countries. In particular, information about MNEs' activities in tax havens is often missing. In the present paper, we utilize information from country-by-country (CbC) reports filed by German MNEs to evaluate the tax sensitivity of corporate profits. CbC reporting has been introduced in the context of the OECD/G20 Base Erosion and profit Shifting project and is obligatory for all MNEs with a global consolidated revenue of at least 750 million EUR. Unlike Orbis or Amadeus data, CbC reports contain information about MNEs' activities in all countries of the world, including tax havens.

Our findings suggest that the profits of German MNEs are sensitive to the level of corporate taxation in a country. In our baseline specification, we obtain a tax semi-elasticity of corporate profits of −0.5, which means that a ten percentage point increase in the tax burden is associated with a 5% decrease in profits. Further analyses reveal that German MNEs mainly use countries commonly considered as tax havens for their profit shifting activities. Holding other factors such as capital and labor endowment as well as sales fixed, the profits reported by German MNEs in European (non-European) tax havens exceed those reported in non-havens by 63% to 67% (37% to 41%), depending on the specification. These estimates imply that in 2016 and 2017, German MNEs shifted about 28 to 30 billion EUR to tax havens. This finding is novel since the tax-haven activities of MNEs are not accounted for in the Orbis or Amadeus data. Also, we find that larger MNEs react more strongly to tax rate differentials than smaller MNEs.

References

Beer, S., De Mooij, R., and Liu, L. (2019). International corporate tax avoidance: A review of the channels, magnitudes, and blind spots. *Journal of Economic Surveys*, forthcoming.

Buettner, T., and Wamser, G. (2013). Internal debt and multinational profit shifting: Empirical evidence from firm-level panel data. *National Tax Journal*, *66*(1), 63–96.

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.

Davies, R. B., Martin, J., Parenti, M., and Toubal, F. (2018). Knocking on tax haven's door: Multinational firms and transfer pricing. *Review of Economics and Statistics*, *100*(1), 120–134.

Desai, M. A., Foley, C. F., and Hines Jr, J. R. (2006). The demand for tax haven operations. *Journal of Public Economics*, *90*(3), 513–531.

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.

Dischinger, M., and Riedel, N. (2011). Corporate taxes and the location of intangible assets within multinational firms. *Journal of Public Economics*, *95*(7-8), 691–707.

Dowd, T., Landefeld, P., and Moore, A. (2017). Profit shifting of US multinationals. *Journal of Public Economics*, *148*, 1–13.

Feenstra, R. C., Inklaar, R., and Timmer, M. P. (2015). The next generation of the Penn World Table. *American Economic Review*, *105*(10), 3150–3182.

Fuest, C., Hebous, S., and Riedel, N. (2011). International debt shifting and multinational firms in developing economies. *Economics Letters*, *113*(2), 135–138.

Garcia-Bernardo, J., Jansky, P., and Tørsløv, T. (2019). Multinational Corporations and Tax Havens: Evidence from Country-by-Country Reporting. *Institute of Economic Studies Working Papers* 31/2019.

Griffith, R., Miller, H., and O'Connell, M. (2014). Ownership of intellectual property and corporate taxation. *Journal of Public Economics*, 112, 12–23.

Heckemeyer, J. H., and Overesch, M. (2017). Multinationals' profit response to tax differentials: Effect size and shifting channels. *Canadian Journal of Economics*, *50*(4), 965–994.

Hines Jr, J. R., and Rice, E. M. (1994). Fiscal paradise: Foreign tax havens and American business. *The Quarterly Journal of Economics*, *109*(1), 149–182.

Hugger, F. (2019). The impact of country-by-country reporting on corporate tax avoidance. *ifo Working Paper* No. 304.

Huizinga, H., and Laeven, L. (2008). International profit shifting within multinationals: A multi-country perspective. *Journal of Public Economics*, *92*(5-6), 1164–1182.

Langenmayr, D., and Liu, L. (2020). Where does multinational profit go with territorial taxation? Evidence from the UK. *CESifo Working Paper* No. 8047.

Menkhoff, L., and Miethe, J. (2019). Tax evasion in new disguise? Examining tax havens' international bank deposits. *Journal of Public Economics,* 176, 53–78.

Millimet, D., and Parmeter, C. F. (2019). Accounting for skewed or one-sided measurement error in the dependent variable. *IZA Discussion Paper* No. 12576.

OECD (2017). *BEPS action 13 on country-by-country reporting*. OECD Publishing, Paris. www.oecd.org/tax/beps/beps-action-13-on-country-by-country-reporting-peer-review-documents.pdf (accessed on 23 July 2020).

Tørsløv, T. R., Wier, L. S., and Zucman, G. (2018). The missing profits of nations. *National Bureau of Economic Research Working Paper* No. 24701.

Wier, L., and Reynolds, H. (2018). Big and 'unprofitable': How 10% of multinational firms do 98% of profit shifting. *WIDER Working Paper* No 2018/111.

Zucman, G. (2014). Taxing across borders: Tracking personal wealth and corporate profits. *Journal of Economic Perspectives*, 28(4), 121–148.

Appendix A: Tax haven definitions

Table A1: List of tax havens

Kategorie	Länder
Europäische Investment Hubs	Irland, Lichtenstein, Luxembourg, Malta, Niederlande, Schweiz, Zypern
Außereuropäische Investment Hubs	Antigua und Barbuda, Bahamas, Bahrain, Barbados, Belize, Bermuda, Britische Jungferninseln, Cookinseln, Curacao, Gibraltar, Grenada, Guernsey, Hongkong, Isle of Man, Jersey, Kaimaninseln, Liberia, Montserrat, Panama, Sankt Kitts und Nevis, Sankt Pierre und Miquelon, Singapur, Sint Maarten, Turks- und Caicosinseln, Vanuatu

Quellen: IMF (2019), Menkhoff und Miethe (2019).

Appendix B: Descriptive statistics

Table B1: Descriptive statistics for the CbC sample

	Complete sample			European tax havens			European tax havens		
Variable	**Obs.**	**Mean**	**Std.-dev.**	**Obs.**	**Mean**	**Std.-dev.**	**Obs.**	**Mean**	**Std.-dev.**
log(profits)	9,465	14.689	2.668	717	15.239	2.653	362	14.527	2.465
profits (in mio. EUR)	9,465	57.614	474.721	717	57.713	225.572	362	16.374	40.049
log(revenues related)	8,375	15.058	3.463	647	15.502	3.505	338	15.300	3.232
Revenues related (in mio. EUR)	9,465	203.314	2386.049	717	128.828	483.385	362	123.187	759.483
Statutory tax rate	9,410	0.245	0.075	717	0.214	0.057	358	0.163	0.050
Effective average tax rate	9,275	0.194	0.095	717	0.104	0.020	345	0.110	0.053
Statutory tax rate (differential)	9,397	−0.044	0.081	717	−0.075	0.061	358	−0.133	0.063
Effective avg. tax rate (differential)	9,262	0.033	0.098	717	−0.054	0.029	345	−0.050	0.059
log(assets)	9,465	15.369	3.187	717	15.222	3.347	362	14.505	2.794
Assets (in mio. EUR)	9,465	284.269	3405.950	717	146.795	1,152.1	362	31.379	133.283
log(employment)	9,465	4.933	2.076	717	4.518	1.870	362	4.028	1.706
Employment	9,465	1338.222	7617.984	717	429.255	1042.490	362	223.563	515.143
log(revenues unrelated)	9,465	17.048	2.894	717	17.235	2.790	362	16.584	2.728
Revenues unrelated (in mio. Euro)	9,465	444.482	3004.052	717	234.484	538.327	362	170.745	727.942
Corruption perception index	9,465	0.598	0.192	717	0.807	0.072	362	0.764	0.136
log(GDP per capita)	9,465	10.267	0.706	717	10.993	0.252	362	10.941	0.586
log(population)	9,465	3.314	1.597	717	1.859	1.180	362	1.519	1.012

Table B2: Descriptive statistics for the Orbis sample

Variable	Complete sample			European tax havens			European tax havens		
	Obs.	Mean	Std.-dev.	Obs.	Mean	Std.-dev.	Obs.	Mean	Std.-dev.
log(profits)	3,751	15.022	2.430	165	15.734	2.155	0	---	---
profits (in mio. EUR)	3,751	67.420	387.582	165	93.477	357.133	0	---	---
Statutory tax rate	3,751	0.227	0.062	165	0.216	0.065	0	---	---
Effective average tax rate	3,713	0.198	0.073	164	0.067	0.048	0	---	---
Statutory tax rate (differential)	3,702	−0.032	0.069	162	−0.049	0.069	0	---	---
Effective avg. tax rate (differential)	3,664	−0.034	0.094	161	−0.168	0.068	0	---	---
log(assets)	3,751	14.728	3.159	165	14.021	3.220	0	---	---
Assets (in mio. EUR)	3,751	120.999	839.083	165	22.910	162.800	0	---	---
log(employment)	3,751	5.146	2.018	165	4.612	1.522	0	---	---
Employment	3,751	1377.312	7032.780	165	265.885	407.344	0	---	---
log(revenues)	3,751	17.896	2.158	165	17.996	1.928	0	---	---
Revenues (in mio. Euro)	3,751	3902.572	198749.20	165	283.711	708.017	0	---	---
Corruption perception index	3,751	0.620	0.169	165	0.793	0.046	0	---	---
log(GDP per capita)	3,751	10.416	0.421	165	11.058	0.281	0	---	---
log(population)	3,751	3.103	1.432	165	1.766	1.273	0	---	---

Appendix C: List of countries

Table C1: Complete list of countries covered by CbC reports vs. Orbis

Country (ISO Code)	Coverage of profits	Coverage of assets	Coverage of employment	Coverage of number of entities	Country (ISO Code)	Coverage of profits	Coverage of assets	Coverage of employment	Coverage of number of entities
AD	0	---	---	0	KZ	0	0	0	0
AE	0	0	0	0	LA	0	0	0	0
AF	0	---	0	0	LB	0	0	0	0
AG	---	---	---	0	LI	0	0	0	0
AL	0	0	0	0	LK	0	0	0	0
AM	0	0	0	0	LR	0	0	0	0
AO	0	0	0	0	LS	0	0	0	0
AR	0	0	0	0	LT	77.7	29.4	48.6	27.3
AT	45.4	27.8	63.0	67.3	LU	37.6	2.7	33.4	17.3
AU	28.6	19.4	77.3	18.6	LV	108.5	23.9	61.9	47.5
AW	0	0	0	0	LY	---	0	0	0
AZ	0	0	0	0	MA	0	0	0	0
BA	53.9	37.9	59.0	69.7	MC	0	0	0	0
BB	0	0	0	0	MD	0	0	0	0
BD	0	0	0	0	ME	101.6	94.5	57.2	66.7
BE	64.0	43.0	71.9	56.6	MG	0	0	0	0
BF	0	0	0	0	MH	0	0	---	0
BG	65.9	55.3	96.4	59.6	MK	83.9	87.2	107.2	37.5
BH	0	0	0	0	ML	0	0	0	0
BI	0	0	0	0	MM	0	0	0	0
BJ	0	0	0	0	MN	0	0	0	0
BM	0	0	0	0	MO	0	0	0	0
BN	0	0	0	0	MQ	0	0	0	0

BO	0	0	0	0	MR	0	0	0	0
BR	26.5	4.3	2.6	5.7	MT	0.0	0.0	0.8	2.7
BS	0	0	0	0	MU	0	0	0	0
BW	0	0	0	0	MW	---	0	0	0
BY	0	0	0	0	MX	0.5	0.2	0.3	0.3
BZ	0	0	0	0	MY	0	0	0	0
CA	0	0	0	0	MZ	---	0	0	0
CD	0	0	0	0	NA	0	0	0	0
CF	0	0	0	0	NC	0	0	0	0
CG	0	0	0	0	NE	0	0	0	0
CH	0	0	0	0	NG	0	0	0	0
CI	0	0	0	0	NI	0	0	0	0
CL	0	0	0	0	NL	47.9	7.9	16.4	29.3
CM	0	0	0	0	NO	96.8	134.7	106.2	75.9
CN	51.5	18.9	44.1	21.6	NP	0	0	0	0
CO	0	0.002	0.01	1.1	NZ	0	0	0	0
CR	0	0	0	0	OM	0	0	0	0
CU	---	0	0	0	PA	0	0	0	0
CV	0	0	0	0	PE	10.2	0.6	4.7	1.6
CW	0	0	0	0	PF	0	0	0	0
CY	0	0	0	0	PG	0	0	0	0
CZ	51.5	46.6	64.2	76.0	PH	0	0	0	0
DE	62.0	19.6	43.7	39.5	PK	0	0	0	0
DK	59.5	31.0	56.0	44.1	PL	42.8	24.1	45.8	50.0
DO	0	0	0	0	PR	0	0	0	0
DZ	0	0	0	0	PS	---	0	0	0
EC	0	0	0	0	PT	68.4	26.4	57.4	70.7
EE	43.6	34.6	42.9	46.7	PY	0	0	0	0
EG	0	0	0	0	QA	0	0	0	0
ES	44.4	45.1	67.5	62.9	RE	0	0	0	0

ET	0	0	0	0	RO	77.9	64.0	66.5	61.4
FI	99.1	18.7	57.3	44.4	RS	105.3	55.6	80.1	73.4
FJ	0	0	0	0	RU	101.0	36.5	67.0	64.1
FM	0	0	0	0	RW	0	0	0	0
FR	91.2	20.3	72.2	54.9	SA	0	0	0	0
GA	---	0	0	0	SB	0	0	0	0
GB	73.0	49.7	103.3	74.2	SE	10.1	56.3	54.5	52.5
GE	0	0	0	0	SG	0	0	0	0
GF	---	---	0	0	SI	79.1	39.5	70.4	65.9
GG	0	0	0	0	SK	47.1	34.9	36.8	47.5
GH	0	0	0	0	SL	0	0	0	0
GI	0	---	---	0	SM	0	0	0	0
GM	0	0	0	0	SN	0	0	0	0
GN	0	0	0	0	SV	0	0	0	0
GP	0	0	0	0	SX	---	0	0	0
GQ	0	0	0	0	SY	0	0	0	0
GR	14.3	4.3	17.8	34.2	SZ	0	0	0	0
GT	0	0	0	0	TD	0	0	0	0
GW	0	0	0	0	TG	0	0	0	0
HK	0	0	0	0	TH	0	0	0	0
HN	0	0	0	0	TJ	---	0	0	0
HR	84.5	64.8	85.6	64.9	TL	0	0	---	0
HT	---	0	0	0	TM	---	0	0	0
HU	36.0	45.8	53.1	39.8	TN	0	0	0	0
ID	0	0	0	0	TO	---	---	---	0
IE	65.8	2.1	67.6	111.4	TR	0.6	0.2	0.9	0.8
IL	0	0	0	0	TT	0	0	0	0
IM	0	---	---	0	TW	38.0	6.7	48.7	1.4
IN	0.1	0.9	1.0	4.7	TZ	0	0	0	0
IQ	0	0	0	0	UA	77.1	37.9	77.0	35.3

IR	0	0	0	0	UG	0	0	0	0
IS	56.5	51.5	86.9	75.0	US	0	0	0	0
IT	41.0	23.3	51.9	72.3	UY	0	0	0	0
JE	0	0	0	0	UZ	0	0	0	0
JM	---	0	0	0	VE	0	0	0	0
JO	0	0	0	0	VG	0	0	0	0
JP	1.5	0.6	1.8	3.5	VI	0	0	0	0
KE	0	0	0	0	VN	0	0	0	0
KG	---	---	---	0	WS	0	---	---	0
KH	0	0	0	0	XK	0	0	0	0
KP	0	0	0	0	ZA	0	0	0	0
KR	48.8	7.8	52.9	30.3	ZM	0	0	0	0
KW	0	0	0	0	ZW	0	0	0	0
KY	0	0	0	0					

Notes: The table shows the coverage of CbC data by Orbis (in %). The figures represent the ratio of the respective variable's realization in Orbis to its realization in the CbC data. "---" indicates that the variable is zero in the CbC data.