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9757
2022

May 2022

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
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CESifo *Working Paper No. 9757*

Global Profit Shifting of Multinational Companies: Evidence from CbCR Micro Data

Abstract

This paper uses micro data from country-by-country reporting of more than 3600 large multinational companies operating in 238 jurisdictions to analyze global profit shifting to avoid taxes. These companies report 7% of their global profits in jurisdictions with effective average tax rates below 5%, but only 0.4% of their employees and 3% of their tangible assets are located there. We find that globally, these companies reduce their tax burden by EUR 53 billion (15% of their overall tax payments) by shifting profits to low-tax countries. Losses of the US and Canada are slightly lower, the losses of the EU 27 member states are similar to the global average. 60% of the profit shifting is carried out by the 10% largest multinational companies. We show that taking into account non-linearities in profit shifting and subsidiaries reporting zero profits is of key importance for accurate estimates of profit shifting. We also investigate profit shifting channels and provide evidence suggesting that the location of IP and equity in low tax countries as well as the provision of loans to entities in high tax countries play a key role for tax planning.

JEL-Codes: F230, H250, H260.

Keywords: corporate taxation, tax avoidance, profit shifting, multinational enterprises, country-by-country reporting.

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May 18, 2022
This research includes work undertaken on behalf of and financed by the German Federal Ministry of Finance. However, this work should not be construed to represent the Ministry's position or that of any of its staff members. The work was done independently by the authors and on their own responsibility. The views expressed in this paper are thus those of the authors We thank seminar participants at several universities and conferences, Martin Andresen, Colin Green and Astrid Sandsør for useful comments and suggestions. This research is funded by the Norweqian Directorate of Education and Training and the European Research Council (grant number 818425).

1 Introduction

Profit shifiting by multinational enterprises (MNEs) is one of the most important issues on the agenda of international tax policy. The OECD has launched various initiatives to address the problem. These include the *Base Erosion and Profit Shifting* (BEPS) project and the introduction of a global minimum tax on corporate profits of large MNEs.

In this debate, it is of central importance to clarify the extent to which MNEs shift profits to low-tax countries and which channels and instruments are used to do so. In recent years, a growing number of empirical studies have documented that MNEs do indeed use opportunities to avoid taxes through international profit shifting. However, the extent of tax avoidance is controversial, and the range of estimates is very broad. In a survey of the literature, Riedel (2018) shows that existing estimates of the share of profits MNEs shift to low-tax countries range from 5% to 30%. This is primarily due to a lack of appropriate data, especially data showing economic activities in low-tax countries and tax havens. Moreover, different methodological approaches are used to identify profit shifting empirically, and different concepts of when profits are considered to be 'shifted' are applied.

This paper is among the first to estimate the amount of profit shifting using newly available country-by-country (CbC) reporting micro data.[1] The data includes detailed information about the economic activities of MNEs and taxes paid in all jurisdictions, including small low-tax jurisdictions and offshore financial centers. We address four main questions: First, is there an imbalance between the global distribution of MNEs' profits and 'real' economic activity at the expense of high-tax jurisdictions and, if so, how large is it? Second, how sensitive are MNEs' profits to changes in a jurisdiction's corporate tax burden? Third, what share of MNEs' global profits are shifted to low-tax jurisdictions with the aim of avoiding taxes? Fourth, what instruments do MNEs use to shift profits? To answer these questions, we use information from individual CbC reports about the global activities of MNEs with a tax presence in Germany and global revenues of at least EUR 750 million. Our data includes more than 400 German MNEs and close to 3 200 foreign MNEs and covers the period from 2016 to 2019.

Our answers to the questions mentioned above can be summarized as follows. First, there is indeed an imbalance between the global distribution of MNEs' profits and real economic activity, and this imbalance is large. For instance, the MNEs included in our sample report close to 7% of their profits in jurisdictions with very low effective tax rates (effective tax rate is below 5%), but only 0.4% of their employees are located there. In contrast, almost two thirds of their employees are located in high-tax countries (effective tax rate is equal or larger

[1] To the best of our knowledge, the only studies that have used CbC micro data thus far are those by Fuest et al. (2022) and Bratta et al. (2021). However, as we explain below, there are several important differences between those studies and ours.

than 25%), but less than half of their profits are booked there. This imbalance results in large cross-country discrepancies in terms of profitability. E.g., profits per employee are about 23 times larger for subsidiaries located in jurisdictions with effective tax rates below 5% compared to subsidiaries located in high-tax jurisdictions.

Second, based on restricted cubic spline estimation, we find that the association between pre-tax profits and corporate tax rates is highly non-linear. For low to moderate tax rate levels, there is a positive relationship between the tax semi-elasticity of corporate profits and the level of taxation. If the tax rate is very low, the tax semi-elasticity is as small as -13, implying that a one percentage point increase in the tax rate triggers a reduction in corporate profits of 13%. Once the tax rate grows beyond a level of 15% to 20%, our estimate of the tax semi-elasticity is close to zero and statistically insignificant. Arguably, this finding indicates that the corporate tax burden is an important factor for the global distribution of MNEs' profits only if it is sufficiently low. Above a certain tax rate level, other factors become more important for the allocation of profits.

Third, we estimate that the MNEs included in our data set shift EUR 242 billion of their profits to low-tax jurisdictions per year. This corresponds to 16% of their global profits. We obtain this figure by raising the tax rate of each jurisdiction whose tax rate is lower to a level of 20% and by using the estimated tax semi-elasticities obtained based on restricted cubic spline estimation. To determine where these shifted profits originate, we reallocate them across MNEs' residence countries based on the weighted sum of tangible assets, employment, and real GDP per capita. Our estimates suggest that almost 70% of the profits the MNEs covered by the CbC data report in jurisdictions with very low effective tax rates (below 5%) are a result of tax-motivated profit shifting. In contrast, high-tax jurisdictions (with effective tax rates equal or above 25%) lose about EUR 93 billion of their tax base per year due to profit shifting. This corresponds to roughly 14% of the profits the MNEs covered by our data report in these jurisdictions.

Fourth, we provide evidence that the main channels MNEs use to shift profits to low-tax jurisdictions are the strategic location of intellectual property (IP), subsidiaries holding equity or shares, and subsidiaries extending loans to affiliated firms in low-tax jurisdictions. Our findings indicate that subsidiaries holding IP/equity or shares/extending loans are 120%/100%/130% more profitable when they are located in jurisdictions with tax rates below 5% compared to subsidiaries performing these activities in high-tax jurisdictions.

Clearly, this is not the first paper to estimate the extent of corporate profit shifting. However, our analysis extends the literature in various ways. Our first contribution relates to our data. We use a novel data set, that is, individual CbC reports filed by both domestic and foreign MNEs with a tax presence in Germany. CbC reporting was introduced in 2016 in the context of the OECD's BEPS project. CbC reports must be prepared by MNEs with global revenues of at least EUR 750 million and are shared by tax authorities of jurisdictions in which

a MNE has a tax presence.[2] However, these reports are confidential and not made public. We were granted access to the CbC reports filed by more than 400 German MNEs and close to 3 200 foreign MNEs with a tax presence in Germany through the German Federal Ministry of Finance.[3]

CbC reports have at least two important advantages over other data sets that are used to estimate the tax sensitivity of corporate profits and the extent of profit shifting. The first advantage concerns their coverage. In their meta-analysis, Beer et al. (2020) review 37 empirical studies assessing the extent of corporate profit shifting and tax avoidance. Of these, 20 use balance sheet data compiled by Bureau van Dijk covering MNEs from around the world. 15 studies solely focus on US MNEs. A serious drawback of Bureau van Dijk data is that it suffers from a poor coverage of MNEs' activities in tax haven countries, which is why profit shifting estimates derived from these data are prone to bias (Fuest et al. 2022; Tørsløv et al. 2018).[4] CbC reports, in contrast, provide complete coverage of the global activities of MNEs, including their activities in tax havens. What is more, our data includes MNEs from 52 different headquarter countries, allowing us to provide evidence for corporate profit shifting beyond US MNEs.

The second advantage of CbC reports compared to other data sets refers to the treatment of the activities of permanent establishments (PEs). In other data sets, the activities of legally dependent PEs – including the profits they make and the taxes they pay – are typically reported at the level of the company owning the PE. Consequently, if the company owning the PE is located in country A, but the PE is located in country B, the profit of the PE is reported in country A rather than in country B, where the profit is actually taxable. In contrast, in the CbC reports, the profit of a PE is reported in the country where it is located, irrespective of the location of the company owning it. This constitutes an important advantage, because when estimating the extent of tax avoidance and profit shifting, researchers are interested in where profits are actually booked, as opposed to where reporting takes place due to accounting conventions.

To the best of our knowledge, so far, there are only two studies using CbC micro data to assess the extent of profit shifting. Fuest et al. (2022) use information from CbC reports filed by 333 German MNEs in 2016 and 2017 to estimate the extent of profit shifting to tax haven countries. Their results indicate that roughly 40% of the profits German MNEs report in tax havens are shifted. Bratta et al. (2021) use information from CbC reports of 2 262

[2] Appendix A provides details about the exchange of CbC reports.

[3] We were granted access as part of a research project with the goal of estimating the tax revenue loss due to corporate profit shifting and the fiscal effects of a global effective minimum tax. The research project thus served as a regulatory impact assessment. The data we used was anonymized.

[4] Information about the activities of U.S. MNEs from the U.S. Bureau of Economic Analysis (BEA) and the Internal Revenue Service (IRS) face similar constraints. BEA data reports the activities of U.S. MNEs for only 57 countries, IRS data (form 5471) for only 44 countries.

MNEs with a tax presence in Italy from the year 2017. They estimate that about 4% of the profits MNEs included in their data set book in tax havens are shifted, which is surprisingly small. Besides covering more MNEs in our analysis and three additional years of data, we make three additional contributions to the existing profit shifting literature that also distinguish our analysis from the ones by Fuest et al. (2022) and Bratta et al. (2021).

The second contribution that we make is estimating the relationship between pre-tax profits and the level of corporate taxation using restricted cubic spline functions, which allows us to account for non-linearities in the relationship between corporate profits and tax rates. Previous studies captured non-linearities mainly by estimating quadratic (Dowd et al., 2017) or cubic models (Bratta et al., 2021). However, restricted cubic spline estimation allows to model more complex functional relationships between corporate profits and tax rates. We find that for our data, using a quadratic specification yields considerably smaller estimates of the tax sensitivity of corporate profits in low-tax countries.

Our third contribution is that we account for the role of subsidiaries that make zero profits when estimating the tax sensitivity of corporate profits. Most existing studies estimate the relationship between pre-tax profits and tax rates based on a log-linear empirical model and use OLS to obtain an estimate of the tax semi-elasticity of corporate profits. However, by taking the logarithm of pre-tax profits, subsidiaries with zero profits are excluded from the analysis. This is unfortunate, as zero profits can be a result of tax-motivated profit shifting. Bilicka (2019) and Bilicka and Scur (2022), for instance, find a large bunching of MNEs' profits around zero in high-tax jurisdictions. We find a similar pattern in our data. Due to that, omitting cases where MNEs report zero profits may lead to an underestimation of the tax semi-elasticity and the extent of profit shifting. To address this problem, we estimate a multiplicative model using pseudo-poisson maximum likelihood (PPML) estimation, which allows us to keep observations with zero profits. Our findings suggest that compared to a log-linear specification, the estimated amount of profit shifting is around 42% larger when accounting for zero profits in our analysis by means of PPML estimation.

Our fourth contribution is to shed light on the channels through which MNEs shift profits to low-tax jurisdictions. CbC reports include information about the revenues a MNE's subsidiaries generate through transactions with affiliated firms – including royalties and interest payments – as well as about subsidiaries' main business activities. We use these information to test (i) whether internal revenues are sensitive to tax rate differences and (ii) whether business activities that are particularly conducive for profit shifting are more profitable when performed in low-tax jurisdictions.

The rest of the paper is structured as follows. In the next section, we provide some background information about CbC reporting and the data we use for our analysis. In section 3, we investigate the imbalance between the global distribution of corporate profits and real economic activity based on descriptive analyses. In section 4, we estimate the tax-sensitivity of corporate

profits and in section 5, we use these estimates to compute the amount of shifted profits on a global scale as well as for different country groups. Section 6 sheds some light on the channels through which MNEs shift profits to low-tax countries. Section 7 concludes.

2 Country-by-country reporting and sample

Our data set comprises information from CbC reports filed by MNEs with a tax presence in Germany.[5] CbC reporting was introduced as part of the OECD/G20 initiative against *Base Erosion and Profit Shifting* (BEPS). The BEPS initiative requires all MNEs with consolidated global revenues of at least EUR 750 million (USD 850 million/an equivalent amount in another currency) to file a CbC report. Our data set includes 434 German MNEs as well as 3 179 foreign MNEs with at least one subsidiary or permanent establishment (PE) in Germany.[6] Detailed information about CbC reporting is provided in appendix A.

CbC reports consist of three sections.[7] The first section contains financial information about the global activities of MNEs. This includes the following variables:

- Profit/loss before taxation
- Taxes paid
- Taxes accrued (year of reporting)
- Stated capital
- Accumulated earnings
- Number of employees (full-time equivalents)
- 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
- Total revenues (revenues unrelated plus revenues related)

The second section comprises information about the business activities of MNEs' subsidiaries and PEs. More precisely, MNEs have to indicate which of the following 13 activities each subsidiary or PE pursues (multiple answers are allowed):

[5] We were provided with the original CbC reports by the German Federal Tax Agency. However, to ensure anonymity, company names and addresses were removed, which made it impossible to identify individual MNEs.

[6] The OECD (2020) estimates that the global number of multinational companies with revenues exceeding EUR 750 million is about 8 000 (p. 59).

[7] The CbC reporting template is shown in Figure B1 of Appendix B.

1. Research and development
2. Holding or managing intellectual property
3. Purchasing or procurement
4. Manufacturing or production
5. Sales, marketing or distribution
6. Administrative, managing or support services
7. Provision of services to unrelated parties
8. Internal group finance
9. Regulated financial services
10. Insurance
11. Holding shares or other equity instruments
12. Dormant
13. Other

In the third section, MNEs can provide additional information they deem relevant for tax authorities.

In their CbC reports, MNEs report business activities separately for each single one of their subsidiaries. In contrast, financial information are reported at the level of the jurisdictions in which MNEs have a tax presence. I.e., financial variables are aggregated across all subsidiaries and PEs located in the same tax jurisdiction. Thus, CbC reports reveal how much profit a MNE books in a jurisdiction, how much taxes it pays there, how much revenue its subsidiaries/PEs located in that jurisdiction generate and how much workers these subsidiaries/PEs employ. CbC reports do not reveal how much profit a single subsidiary makes or how much taxes it pays or how much revenue it generates. Consequently, our level of analysis is the MNE-country-year level.[8] Our data set covers information from CbC reports filed for the years from 2016 to 2019. All financial information refer to the fiscal year. In total, the MNEs covered by our data set reported activities in 238 different jurisdictions.[9]

Table 1 shows descriptive statistics for the MNEs included in our sample by the location of MNEs' headquarters. We differentiate between six different headquarters countries and

[8] This implies that our analysis is based on a different level of aggregation than (most) existing micro- and macro-analyses. Micro estimates of profit shifting typically use subsidiary-level information and, thus, more disaggregated data than we do. Exceptions are the studies by Dowd et al. (2017) and Huizinga and Laeven (2008), whose data also refer to the MNE-country-year level. Macro profit shifting estimates (including those that use US CbC data, like Garcia-Bernardo et al. (2019)) typically use data aggregated by tax jurisdictions, which implies a higher level of aggregation.

[9] The number of tax jurisdictions is larger than the number of countries of the world because there are regions that are self-governing and have autonomy in the area of tax policy although they are under the sovereignty of other states. Examples are the British and French Overseas Territories. Throughout the paper, we use the terms 'country' and 'jurisdiction' synonymously.

regions:[10] (i) Germany, (ii) the EU27 member states excluding Germany, (iii) East Asia and Pacific, (iv) Europe (excluding EU27 member states) and Central Asia, (v) North America, and (vi) other countries including cases in which the headquarters country is unknown.[11] Column (1) shows the number of MNEs covered by our data that have their headquarters in the respective country/region. Column (2) shows the total number of CbC reports these MNEs filed for the period from 2016 to 2019. Column (3) indicates the average number of subsidiaries per MNE and year. Column (4) indicates in how many jurisdictions, on average, a MNE has a tax presence. The remaining columns show average realizations of financial variables per MNE and year.

In total, the 3 613 MNEs included in our sample filed 8 376 CbC reports for the period from 2016 to 2019, which makes on average 2.3 reports per MNE. The average MNE has a tax presence in 30 jurisdictions and generates EUR 4.4 billion of external revenues per year. Multiplied by the number of MNEs, this makes a total of almost EUR 16 trillion in revenue annually. This is close to the nominal GDP of the U.S. in 2019 (EUR 18.9/USD 21.4 trillion) and about 4.5 times the 2019 nominal GDP of Germany (EUR 3.5/USD 3.9 trillion). Average profit per MNE and year amounts to EUR 768 million and the total amount of global profits of all MNEs included in our data to roughly EUR 2.8 trillion annually. Of these, EUR 1.05 trillion are 'foreign' profits, i.e., they are booked outside the country of main residence. For comparison: Tørsløv et al. (2018) report that between 2016 and 2018, the amount of all foreign multinational profits was on average around EUR 2.0 trillion (USD 2.19 trillion) per year, which implies that our data cover more than half of the global foreign profits of all MNEs worldwide.[12] The MNEs covered by the CbC data pay EUR 167 million in taxes each year, implying an effective average tax rate of 21.7%. Most MNEs included in our sample have their headquarters in North America (27%), followed by the EU27 member states excluding Germany (24%). The highest profits are reported by North American MNEs, who make, on average, more than EUR 1 billion per year.

[10] For confidentiality reasons, we are not permitted to report results at the country level, the only exception being Germany.

[11] We lack information about a MNE's headquarters country for about 10% of the MNEs in our sample. The reason is that the corresponding CbC reports were shared with the German tax authority by a third country and not the MNE's headquarters country. The likely reason is that the MNE's headquarters country does not participate in the *Inclusive Framework on BEPS*.

[12] The figure is reported in an updated version of Tørsløv et al. (2018)'s paper, which can be found at https://missingprofits.world.

Table 1: Descriptive statistics by MNEs' headquarters regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Headquarter country	MNEs	CbC reports	Subsidiaries	Jurisdictions	Employees (1 000)	Tangible assets (mio. EUR)	External revenues (mio. EUR)	Internal revenues (mio. EUR)	Profit (mio. EUR)	Taxes paid (mio. EUR)
Germany	434	1 278	112.6	24.5	22.5	2 699.4	5 052.7	2 100.7	657.6	113.6
EU27 (w/o Germany)	872	2 190	163.2	30.1	23.6	2 468.9	4 740.6	2 266.6	725.0	134.1
East Asia & Pacific	449	1 071	180.1	27.9	35.2	1 182.7	1 594.1	878.9	393.5	174.6
Europe (w/o EU27) & Central Asia	260	423	191.3	31.6	29.7	2 289.8	4 584.0	1 965.0	751.0	164.2
North America	978	2 326	177.5	32.4	24.0	2 474.3	5 024.8	2 503.4	1 051.3	223.5
Other/unknown	642	1 088	204.9	33.0	45.1	2 434.9	4 440.0	2 270.7	755.8	172.1
Total	3 613	8 376	168.4	30.1	28.1	2 327.6	4 417.9	2 114.9	768.3	167.4

Notes: Column (1): total number of MNEs included in our sample that have their headquarters in the respective countries/regions; column (2): total number of CbC reports filed by these MNEs between 2016 and 2019; column (3): average number of subsidiaries per MNE and year; column (4): average number of jurisdictions with a tax presence; columns (5) to (10): average realizations of financial variables per MNE and year.

The most important advantage of CbC data compared to other data sets that are often used to assess the amount of profit shifting – especially balance sheet data provided by Bureau van Dijk – is their comprehensiveness. CbC reports provide complete coverage of MNEs' global activities, including those in tax haven countries which are typically not covered by firm-level data sets.[13] A second advantage of CbC data concerns the treatment of the activities of PEs. Most existing data sets report the profits PEs make, the taxes they pay, the revenues they generate, etc., at the level of company owning the PE. This is problematic in cases where a PE and the company owning it are located in different tax jurisdictions.[14] In such cases, a PE's financial information is reported in the residence jurisdiction of the company owning it. This false assignment of PEs' profits may lead to biases when estimating the extent of corporate profit shifting. In contrast, CbC data report PEs' activities in the jurisdictions where these activities take place.

One problem with CbC data concerns the treatment of dividend income. The OECD instructions for CbC reporting require MNEs to exclude payments received from affiliated firms that are treated as dividends in the payer's tax jurisdiction from the revenues they report (OECD, 2019). However, no corresponding instruction was provided with regard to profit/loss before taxes. Some jurisdictions amended the OECD's instructions and required MNEs to apply the same rule to profit/loss before taxes. Other jurisdictions, though, remained silent on this topic. Due to that, we cannot rule out that in some instances, dividends paid by a subsidiary may be included in the profit reported by its parent company. To make sure that this problem does not affect our profit shifting estimates, we address it in two different ways, which we explain in detail in section 4.1.[15]

[13] For instance, Tørsløv et al. (2018) compare MNEs' consolidated global profits from Bureau van Dijk's Orbis database to the sum of unconsolidated profits reported by MNEs' subsidiaries. The authors document that, on average, only 17% of MNEs' consolidated profits can be traced in unconsolidated Orbis information.

[14] A prominent example are so-called limited risk distributors, which are often located in high-tax countries while the companies owning them are located in low-tax countries. They typically employ a considerable number of workers and have large tangible assets, while the companies maintaining them mainly collect revenue. The revenues Amazon generates in the EU, for instance, are mainly collected by Amazon EU S.A.R.L., which is resident in Luxembourg. Amazon's warehouses and distribution centers, however, are spread all across the EU. These warehouses and distribution centers are branches of Amazon EU S.A.R.L. Balance sheet data would thus report the employees working at Amazon's warehouses and distribution centers as well as their tangible assets in Luxembourg, which implies an overstatement of the extent of economic activity located there.

[15] The OECD published a note on the limitations of CbC report statistics, explaining that a double counting of income can also stem from the inclusion of stateless income (OECD, 2021). However, this problem only pertains to the aggregate CbC report statistics published by the OECD. In the individual CbC reports, stateless income is reported separately, which allows us to exclude this type of income and, thus, prevents us from counting it twice.

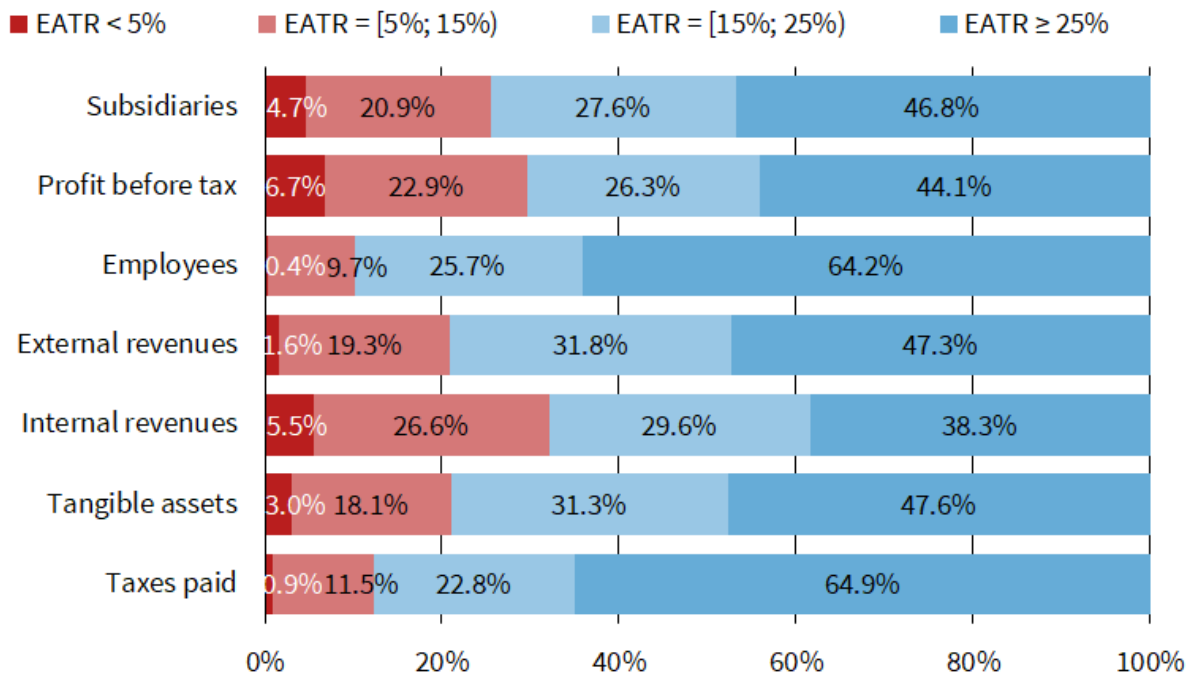
3 The global distribution of multinationals' economic activities

To get a first impression of how significant the extent of tax-motivated profit shifting is, it is instructive to compare the distribution of MNEs' profits to the distribution of 'real' economic activity across high and low-tax countries. This is what we do in figure 1. For our comparison, we divide the residence countries into four groups, depending on their effective average tax rates (EATRs): countries with an EATR below 5% (dark red bars); countries with an EATR between 5% and 15% (light red bars); countries with an EATR between 15% and 25% (light blue bars); and countries with an EATR of 25% and higher (dark blue bars).[16]

The figure demonstrates a substantial imbalance between the global distribution of MNEs' profits and factors of production. While only 0.4% of employees and 3% of tangible assets are located in low-tax countries (EATR below 5%), the share of pre-tax profits reported there is close to 7%. If we consider countries with an EATR of up to 15%, we find a share in global profits of roughly 30%, but only 10% of employees and 21% of tangible assets. In contrast, almost two thirds of all employees are located in high-tax countries (EATR at least 25%), but only 44% of profits are booked there. Another interesting insight from figure 1 is that the EATR is a positively related to the share of external revenues, but inversely related to the share of internal revenues. Arguably, this finding may indicate that MNEs strategically locate subsidiaries that mainly provide inputs for affiliated firms in low-tax jurisdictions, which would allow them to shift profits and reduce their tax burden. We will come back to this in section 6.

[16] We compute EATRs by dividing the sum of taxes paid by the MNEs included in our sample by the sum of their profits. When doing so, we restrict our attention to MNEs that report positive profits. We exclude jurisdictions where less than 10 MNEs report positive profits. Due to that, the number of jurisdictions decreases to 215. 33 of these jurisdictions have an EATR lower than 5%, 46 have an EATR between 5% and 15%, 63 have an EATR between 15% and 25%, and 73 have an EATR above 25%.

Figure 1: Global distribution of MNEs' activities

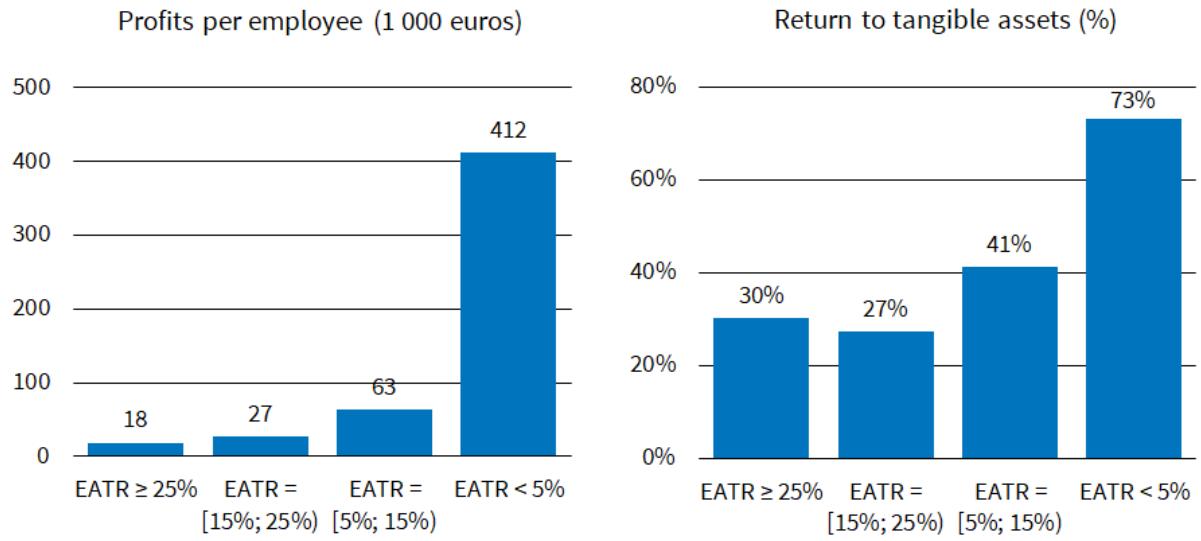


Notes: The figure shows the distribution of financial indicators across different country groups, whereas countries are grouped based on their EATRs. EATR stands for effective average tax rate.

Figure 2 shows the implications of the imbalance regarding the global distribution of profits *vis-à-vis* the global distribution of real economic activity for the profitability in high-tax versus low-tax countries. The figure shows the ratio of profits to the number of employees (left panel) as well as the ratio of profits to tangible assets (right panel).[17] Subsidiaries located in low-tax countries (EATR below 5%) are far more profitable than subsidiaries located in high-tax countries (EATR equal to or above 25%). Profits per employee are almost 23 times larger in low-tax countries than in high-tax countries (EUR 412 000 versus EUR 18 000). The return to tangible assets is almost 2.5 times higher (73% versus 30%).

[17] The profitability measures are computed by dividing the sum of positive profits reported by all MNEs in each of these country groups by the number of employees and the value of tangible assets, respectively.

Figure 2: Profitability of MNEs across country groups



Notes: The figure shows the ratio of pre-tax profits to the number of employees (left panel) and the value of tangible assets (right panel) for different groups of tax jurisdictions. EATR stands for effective average tax rate.

4 The tax elasticity of multinationals' profits

To quantify the extent of profit shifting to low-tax jurisdictions, we first estimate how sensitive MNEs' profits react to changes in corporate tax rates. In the second step, we use these estimates to compute a counterfactual global distribution of corporate profits. This counterfactual distribution indicates how MNEs' profits would be distributed if tax rate differences were irrelevant for profit allocation or if the corporate tax burden was identical in all jurisdictions, respectively. The difference between the actual global distribution of MNEs' profits and the counterfactual distribution then yields our estimate of profits which are reported in a country for the purpose of reducing the corporate tax burden.

4.1 Empirical approach

In their meta-analyses, Beer et al. (2020) and Heckemeyer and Overesch (2017) review 37 and 27 empirical studies, respectively, that estimate the tax-sensitivity of MNEs' profits. Virtually all of those studies use a modified version of the empirical model proposed by Hines Jr and Rice (1994):[18]

[18] Not included in these meta-analyses is the study by Devereux et al. (2014), who exploit kinks in the UK tax corporate tax schedule to estimate the tax sensitivity of corporate profits.

$$log(y_{ict}) = \alpha_i + \beta_1 \tau_{ct} + \beta_2 K_{ict} + \beta_3 L_{ict} + \gamma' Country_{ct} + \delta_i + \epsilon_t + \zeta_{ict} \quad (1)$$

Index i may refer to the corporate group or affiliate, depending on the level of data aggregation. Index c refers the residence jurisdiction and t to the year. The dependent variable y_{ict} is pre-tax profits reported by the affiliate/corporate group in jurisdiction c and year t. The explanatory variable of main interest τ_{ct} is a measure of the corporate tax burden in jurisdiction c. β_1 measures by how many percent the profits reported by affiliate/corporate group i in jurisdiction c and year t change in response to a one percentage point (pp) increase in the corporate tax burden (tax semi-elasticity of corporate profits). The list of control variables includes measures of the endowment with capital (K_{ict}) and labor (L_{ict}) as well as, in most cases, characteristics depicting the country of residence (vector $Country_{ct}$).

Controlling for capital and labor input in eEquation (1) implies that the tax semi-elasticity of corporate profits is estimated while holding production factors fixed. This allows researchers to separate 'real' profits – i.e., profits that can be attributed to real economic activity – from 'shifted' profits – i.e., profits booked in a jurisdiction with the aim of minimizing the corporate tax burden (Dharmapala, 2014).

In recent years, the 'workhorse' empirical model represented by equation (1) has become subject to criticism. The criticism has mainly concentrated on two aspects: First, the model assumes that the tax semi-elasticity is constant across all jurisdictions, irrespective of the level of taxation. However, it has been argued that the importance of tax havens suggests that the semi-elasticity is larger, in absolute terms, the lower the corporate tax burden (Dowd et al., 2017). In other words, if a low-tax country raises its tax rate, then this may result in a (relatively) larger outflow of profits than if a high-tax country raises its tax rate. The second point of criticism refers to the treatment of observations with zero profits in the analysis. By taking the logarithm of the profit variable, cases in which MNEs report zero or negative profits in a country are dropped. This is problematic because zero profits can be the result of profit shifting and tax avoidance. For example, Bilicka (2019) and Bilicka and Scur (2022) show that there is a disproportionate clustering of near-zero profits in high-tax countries on the part of MNEs. We find a very similar pattern in our data, as demonstrated in figure B2 of appendix B, where we estimate the excess mass of profits around zero using the approach proposed by Chetty et al. (2011). Our estimates suggest that the excess mass around zero profits is as high as 811%, which is statistically significant at every reasonable level of significance (t-value: 19.3). As we show below, ignoring this distinct bunching leads to an underestimation of the tax semi-elasticity of MNEs' profits and, consequently, the amount of profit shifting.

We address these two issues in the following ways. To allow the tax semi-elasticity to vary with the level of taxation, we estimate the relationship between pre-tax profits and tax rates using restricted cubic spline functions. In this approach, the observations are divided into

intervals based on the realizations of the tax rate variable. For each of these intervals, a cubic function is then estimated describing the relationship between pre-tax profits and the level of taxation. At the interval borders (called 'nodes' or 'knots'), however, the transitions between the functions are smoothened so that the resulting overall function is continuous. We follow Harrell (2011) and use five knots/six intervals for our restricted cubic spline estimation. The knots correspond to the 5% percentile, the 27.5% percentile, the 50% percentile, the 72.5% percentile, and the 95% percentile of the tax rate variable. In the first and last interval, a constant marginal effect is assumed. Since the coefficients of the tax rate polynomials vary across tax rate intervals, the functional relationship between the tax rate and pre-tax profits can be estimated very flexibly. In contrast, in a 'global' cubic specification, the coefficients of the tax rate polynomials are constant.

To include MNE-country observations with zero profits in our analysis, we estimate our empirical model using pseudo-poisson maximum likelihood (PPML) estimation instead of OLS. Using PPML, the relationship between pre-tax profits and tax rates is estimated based on a multiplicative model. This yields an estimate of the tax semi-elasticity of pre-tax profits without logarithmizing the dependent variable. Importantly, cases in which a MNE reports zero profits are not excluded from the analysis, as PPML requires that the dependent variable is equal to or larger than zero. Thus, only cases in which MNEs report negative profits are dropped. Assuming that MNEs cannot perfectly control the amount of their profits so that they may incur a small loss in case they aim for zero profit, we set the profit variable to zero in case a MNE's return to sales is smaller than zero, but larger than -5%. Note that unlike OLS estimation in the case of a $log + 1$ transformation or tobit estimation, PPML yields consistent parameter estimates even when the error term of the regression is heteroskedastic, the dependent variable is continuous, and there is an excess number of zeros (Silva and Tenreyro, 2006). Because of these properties, the PPML method is widely used when estimating the so-called gravity model in trade economics.[19]

In our empirical specification, we use the value of tangible assets as a measure of capital input and the number of employees as a measure of labor input.[20] As country-specific characteristics, we include the log of PPP adjusted GDP per capita (as an indicator of the level of productivity), log population (as an indicator of the importance of the country as a market; both taken from the Penn World Table 9.1; cf. Feenstra et al. 2015), as well as Amnesty International's Corruption Perception Index (as an indicator of institutional quality). Moreover, as in equation

[19] Note that Silva and Tenreyro (2006) show that PPML provides consistent estimates even when the variance of the dependent variable is considerably larger than the expected value, which is typically the case in gravity models and also in our application.

[20] 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.

(1), our specification includes corporate group fixed effects (denoted by δ_i) and year fixed effects (θ_t). Standard errors are clustered at the corporate group and jurisdiction level.[21]

In our application, the tax variable τ_{ct} corresponds to the effective average tax rate (EATR) in country c. To compute EATRs, we divide the sum of taxes MNEs in our sample pay in jurisdiction c by the sum of profits they report in that jurisdiction.[22] To circumvent endogeneity problems, we follow Dowd et al. (2017) and determine the EATR for group i in jurisdiction c only based on the information about taxes paid and profits made by other MNEs in that jurisdiction. Also, we compute EATRs only for jurisdiction in which at least ten of the MNEs in our sample have affiliates to mitigate concerns that our results are based on few observations.

Using EATRs as a measure of the level of corporate taxation in a jurisdiction has advantages and disadvantages. An advantage is that, in contrast to headline statutory tax rates, EATRs are a much better indicator of the actual corporate tax burden. Many countries apply reduced tax rates to certain types of corporate income or exempt them from taxation, so that headline statutory tax rates are not very informative about the 'true' level of corporate taxation. Some tax haven countries, such as Barbados, Luxembourg, and Malta, for instance, actually have high statutory tax rates (25% in Barbados, 26% in Luxembourg, and 35% in Malta). A disadvantage of using the ratio of taxes paid to corporate profits as a measure of the EATR is that we obtain only one figure per country. However, since tax privileges typically only apply to certain corporate income types, a tax regime is typically best described by a range of EATRs rather than a single number.

To test the robustness of our results and to generate further insights, we modify our empirical specification in several ways. In a first set of modifications, we explore whether the tax semi-elasticity of pre-tax profits varies across MNEs. First, we test whether the tax semi-elasticity varies with the size of the MNEs included in our sample. This exercise is motivated by the fact that several existing studies document a positive relationship between firm size and profit shifting activities (Davies et al. 2018; Desai et al. 2006; Langenmayr and Liu 2020; Wier and Reynolds 2018). We group the MNEs included in our data set in deciles depending on their global revenues and estimate our restricted cubic spline specification separately for each decile. In a second modification, we estimate the tax semi-elasticity of corporate profits separately for MNEs headquartered in the different country groups listed in table 1.

In another set of modifications, we address the potential double counting of dividend income in pre-tax profits. As explained in section 2, we cannot rule out that for MNEs headquarted in some countries, dividends paid by a subsidiary may be included in the profit reported by

[21] Note that we do not include country fixed effects to our specification since there is virtually no variation in the tax variable and controls across the four sample years. However, even studies that cover longer time spans rarely control for country fixed effects.

[22] We only consider observations with positive profits when computing EATRs.

its parent company. Arguably, if dividends are double counted, then this will mainly affect the profits reported by the MNE's ultimate parent entity, as the parent entity is at the top of the ownership structure, and/or the profits reported in those countries in which a holding company is located. Therefore, we modify our empirical model in the following ways. In a first modification, we add a vector that includes one dummy variable for each headquarters country and interact this vector with a another dummy variable that takes the value one if the observation refers to the MNE's headquarters country. Thus, our empirical specification includes one dummy that takes the value one if the observation refers to the activities of a German MNE in Germany, another dummy that takes the value one if the observation refers to the activities of a French MNE in France, and so on.[23] These interaction terms allow us to measure whether MNEs report excessively large profits in their headquarters countries, which would be the case if dividend income is double counted. By including these interaction terms, profits reported in MNEs' headquarters countries are not taken into account when estimating the tax semi-elasticity of corporate profits. In a second modification, we additionally interact the vector of headquarters country dummies with a dummy variable that takes the value one if the observation refers to a country in which the MNE has a holding company. This yields a separate dummy variable for each combination of a headquarters country and a holding company's residence country. I.e., the first dummy takes the value one if an observation refers to a country in which a German MNE has a holding company, the second dummy takes the value one if an observation refers to a country in which a French MNE has a holding company, and so on. Including these interaction terms implies that our estimate of the tax semi-elasticity of corporate profits does not reflect profits reported in countries in which a MNE has a holding company.

In a final set of modifications, we check whether our results are sensitive to the definition of the tax variable. First, we use statutory tax rates instead of EATRs. Second, we use a different approach to compute EATRs. We draw a 20% random sample of MNEs and only use information about their profits and tax payments in different jurisdictions to calculate EATRs. We repeat this procedure 500 times, each time estimating the tax semi-elasticity of profits excluding the 20% of MNEs used to calculate EATRs. Then, we compute the average realizations of the coefficient estimates.

4.2 Results

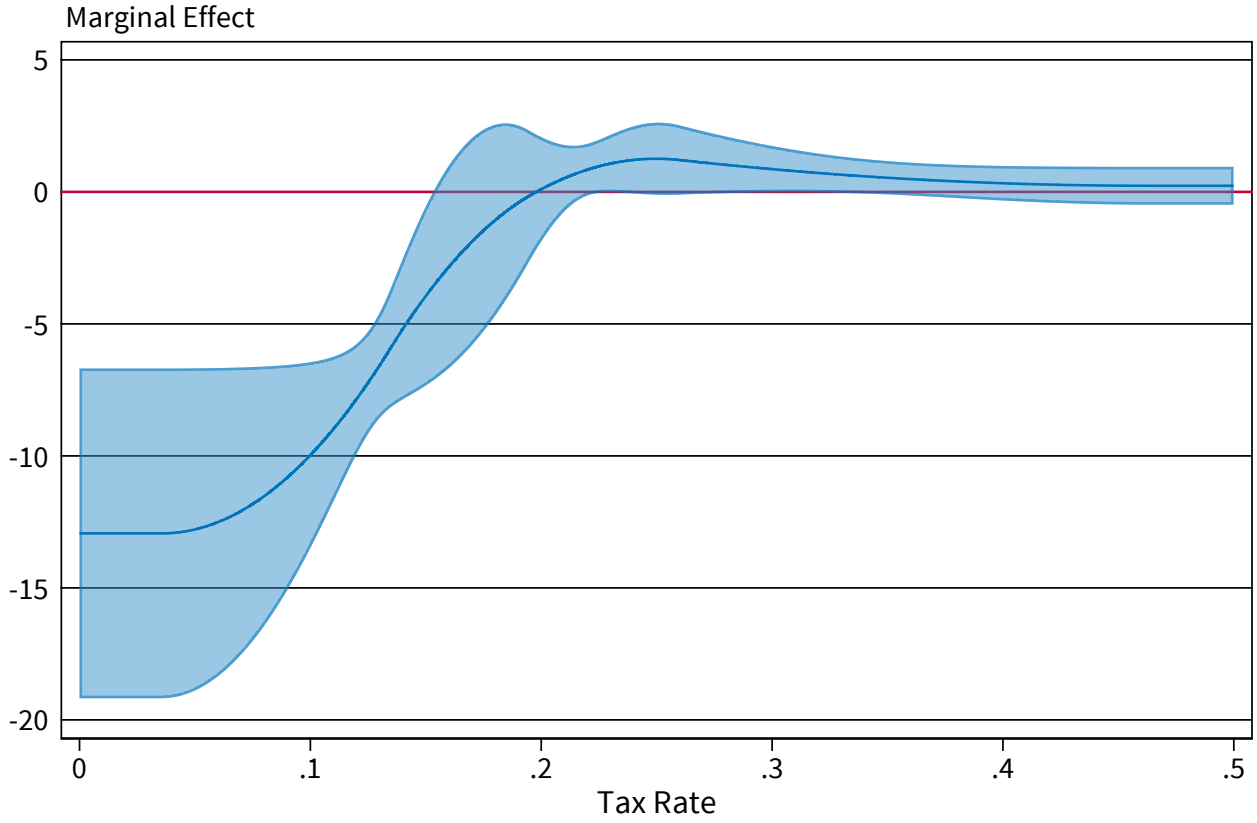
Figure 3 graphically illustrates the results of the restricted cubic spline PPML estimation. The figure shows the estimated tax semi-elasticity of corporate profits (y-axis) as a function of the EATR (x-axis). The shaded area represents the 90% confidence interval. Our results indicate

[23] These interaction terms allow us to account for the possibility that different jurisdictions may have different rules in place with regard to the treatment of dividend income.

that there is a positive association between the tax semi-elasticity of corporate profits and EATRs as long as the EATR is not too large. This implies that the smaller a country's EATR, the larger is the expected outflow (inflow) of corporate profits in case of an increase (decrease) in the country's corporate tax burden. The maximum effect (in abolute terms) is -13 for a EATR below 5%, which means that if a country's EATR is smaller than 5%, then a one pp increase in that country's EATR leads to a reduction in reported profits by 13%.

However, when the EATR becomes sufficiently large, the size of tax semi-elasticity becomes economically negligible and statistically insignificant. According to our estimates, this point is reached when the EATR grows to a level of roughly 15% to 20%. Arguably, there are two ways to interpret this finding. The first interpretation is that it is mainly low-tax countries that compete for MNEs' 'paper profits'. If a high-tax country reduces the corporate tax burden, then this does not lead to a large profit inflow, possibly because the country is still unattractive as a destination for shiftable profits. Accordingly, countries with EATR above 15% do not seem to be destinations of tax-motivated profit shifting. Another interpretation of the result is that the effective tax burden is an important factor for the global distribution of multinational profits only if it is sufficiently low. Above a certain EATR level, other factors are more important for the allocation of MNEs' profits. One potential factor is the headquarter bias, that is, the tendency of multinational firms to report higher profits at the headquarter (Dischinger et al., 2014). Many high-tax countries are important locations for corporate headquarters, despite the tax disadvantage.

Figure 3: Estimated tax semi-elasticity of corporate profits



Notes: The figure shows the estimated tax semi-elasticity of pre-tax profits for different realizations of the effective average tax rate. The shaded area represents the 90% confidence interval. The semi-elasticity is estimated using pseudo-poisson maximum likelihood based on a restricted cubic spline specification with five knots. The knots are placed at the 5%, 27.5%, 50%, 72.5%, and 95% percentile of the tax variable. Standard errors are clustered at the level of the MNE and tax jurisdiction.

How do our results compare to other studies? In their meta-analyses, Beer et al. (2020) and Heckemeyer and Overesch (2017) report average tax semi-elasticities of -1 and -0.8, respectively. However, most of the studies included in these meta-analyses estimate the association between pre-tax profits and tax rates based on linear specifications equivalent to equation 1. If we estimate equation 1, we obtain a tax semi-elasticity of about -0.6, which is somewhat smaller. However, our results suggest that the association between pre-tax profits and tax rates is highly non-linear. As figure 3 demonstrates, ignoring this non-linear relationship leads to a severe underestimation of the tax-sensitivity of corporate profits, especially in low-tax countries. Dowd et al. (2017) account for non-linearities in two different ways: first, by estimating a quadratic specification. Second, by interacting the tax variable with a dummy taking the value one in case a country's tax rate is in the bottom decile. In both cases, the authors obtain a minimum tax semi-elasticity of -4 for zero-tax countries, which is notably larger than the minimum effect of -13 that we find.[24] When we estimate equation 1 adding the square

[24] Note that Dowd et al. (2017) actually use the net-of-tax rate $(1-\tau)$ as an explanatory variable.

of the tax variable, we obtain a minimum tax semi-elasticity of -4.7, which is very close to the one reported by Dowd et al. (2017).[25] Thus, limiting the flexibility of the functional relationship between pre-tax profits and the corporate tax burden conceals the true extent of the tax-sensitivity of corporate profits.

Another novel feature of our empirical analysis is that we account for observations with zero profits by estimating the association between pre-tax profits and tax rates by PPML. How does this modification affect our results? The answer is provided in figure B3 of appendix B, where we compare the estimated tax semi-elasticity from PPML regression to the estimated tax semi-elasticity from OLS regression. In the OLS regression, we use the log of profits as our dependent variable, which implies that observations with zero profits are dropped from our analysis. For tax rates between 0% and 20%, the tax semi-elasticities estimated by OLS are smaller than the semi-elasticities estimated by PPML (in absolute terms). Consequently, omitting observations with zero profits will also yield a smaller estimate for the extent of profit shifting (see section 5) .

Turning to our robustness tests, we find that replacing EATRs with statutory tax rates yields statistically insignificant estimates for the tax semi-elasticity of corporate profits, irrespective of whether we estimate a restricted cubic spline specification (see figure B4 of appendix B) or a linear specification.[26] As we explain above, we believe that this finding indicates that headline statutory tax rates are an inaccurate measure for the actual tax burden in a jurisdiction. The coefficient of correlation between the EATR and the statutory tax rate is only 0.36 in our sample.

Estimating EATRs based on randomly selected 20% subsamples of MNEs and excluding these MNEs from the regression analysis hardly affects our estimates, as demonstrated in figure B5 of appendix B.

We refrain from discussing the results of the remaining robustness tests described in section 4.1 – i.e., estimating heterogeneous tax semi-elasticities for different MNEs and accounting for a potential double counting of profits in our empirical specification – at this point because comparing the shapes of the different elasticity curves is not very informative. Instead, we elaborate on the implications of these modifications for our estimate of the amount of profit shifting in the section 5.

[25] Results available on request.

[26] In a linear model, we obtain an estimate of 0.2 for the tax semi-elasticity (standard error: 0.5).

5 How much profit is shifted?

Based on the estimated tax semi-elasticities, we can now calculate the amount of tax-motivated profit shifting. To do so, we proceed in two steps. In the first step, we determine for each MNE covered by the CbC data the amount of profits shifted into each residence country. For this purpose, we gradually raise the residence countries' EATRs in steps of one percentage point and calculate the (hypothetical) profit decrease in the residence countries resulting from this tax hike by multiplying the profits reported in these countries by the EATR-specific semi-elasticities depicted in figure 3. We raise the EATRs until the corresponding tax semi-elasticity is zero.[27] When completing this step, we obtain an estimate of the amount of profit each MNE i has shifted into each residence country c. Aggregating these MNE and country-specific profit shifting estimates yields an estimate of the total amount of shifted profits.

The results of the first step are reported in panel A of table 2. The first column shows how much profit the MNEs included in our sample report on average per year, the second column how much of this profit we consider shifted. The third column shows the ratio between these two figures. Our findings suggest that our sample of large MNEs shift on average EUR 242 billion per year to low-tax jurisdictions, with the aim of reducing the corporate tax burden. This corresponds to almost 16% of the total profits these MNEs make.

In the second step, we determine where the EUR 242 billion of shifted profits originate by reallocating them across MNEs' residence countries. In the current debate, the prevailing view seems to be that a 'fair' distribution of profits should be based on the global distribution of real economic activity. Reflecting this view, we reallocate the shifted profits among residence countries based on the weighted sum of the number of employees, the value of tangible assets, and the residence countries' GDP per capita.[28] To determine the weights, we regress pre-tax profit on the three variables. We use the estimated regression coefficients as weights.

The results of the second step are reported in panels B and C of table 2, where we show the amount of reported and shifted profits separately for different country groups. In panel B, we group residence countries into geographic regions, in panel C we group them based on their EATRs. Positive figures indicate that a country group benefits from tax-motivated profit shifting, negative figures indicate that overall, it experiences a tax base loss due to profit shifting.

Our estimates suggest that the MNEs included in our sample shift EUR 10.9 billion out of Germany each year. This corresponds to 8.1% of the profits these MNEs report in Germany. For the remaining EU countries (excluding European tax havens), the ratio of profits shifted

[27] In our baseline specification, the corresponding EATR is roughly 20%, which is close to the median EATR in our sample (19.9%). The EATRs of countries with EATRs equal or larger than 20% are not changed.

[28] We include GDP per capita as a proxy for the productivity of the labor force.

out to reported profits is 13.7%, and for East Asian and Pacific countries, it is 17.9%. With a ratio of profits shifted out to reported profits of 12%, North American countries are located somewhere in between this range.[29] Unsurprisingly, European and non-European tax havens are beneficiaries of tax-motivated profit shifting.[30] In European tax havens, the increase in the tax base due to tax-motivated profit shifting by the MNEs included in our sample is EUR 73.9 billion per year, which corresponds to 33% of the profits reported there. Non-European tax havens gain EUR 59.1 billion per year, or 44.3%. In low-tax countries (EATR is below 5%), the increase in the tax base due to tax-motivated profit shifting is almost 70%, while high-tax countries (EATR is equal or above 25%) lose 14.4% of their tax base due to profit shifting.

[29] This result may appear surprising since some previous studies that focus on the U.S. suggest that in the past, the tax revenue loss due to tax-motivated profit shifting amounted to 25%–45% of the collected corporate income tax (Clausing, 2016). In contrast, Tørsløv et al. (2018) document a tax revenue loss of 'only' 10% in 2015. What is more, recent research indicates the the 'Tax Cuts and Jobs Act' of 2017 has notably reduced profit shifting out of the U.S. See, for instance, Clausing (2020) and Suárez Serrato (2018). Our results for North America may thus reflect that our data was partly collected after 2017.

[30] A list of countries classified as Euoprean tax havens and non-European tax havens is provided in table B1 of appendix B. Menkhoff and Miethe (2019) provide a summary of the classifications of tax havens used in six different publications. For our analysis, we decided to include only those countries that are labeled accordingly in all of the six publications reviewed by Menkhoff and Miethe (2019) to our list of tax havens.

Table 2: Reported vs. shifted profits

Country/country group	(1) Reported profits (bn. EUR p.a.)	(2) Shifted profits (bn. EUR p.a.)	(3) Shifted profits (% of reported profits)
Panel A: Global amount of reported and shifted profits			
Total	1560.0	242.4	15.5%
Panel B: Reported and shifted profits for different geographical groups			
Germany	134.6	-10.9	-8.1%
EU27 (w/o Germany & European tax havens)	234.4	-32.2	-13.7%
Europe (w/o EU27) & Central Asia	118.4	-1.1	-0.9%
East Asia & Pacific	194.8	-34.9	-17.9%
North America	373.5	-45.0	-12.0%
European tax havens	223.7	73.9	33.0%
Non-European tax havens	133.5	59.1	44.3%
Rest of the world	147.0	-9.2	-6.2%
Panel C: Reported and shifted profits for different EATR groups			
EATR $< 5\%$	105.2	72.1	68.5%
EATR $= [5\%; 15\%)$	387.9	78.5	20.2%
EATR $= [15\%; 25\%)$	425.6	-58.3	-13.7%
EATR $\geq 25\%$	641.3	-92.5	-14.4%

Notes: The table shows the sum of profits reported in (column (1)) and shifted out of/to (column (2)) different country groups, as well as the ratio of shifted to reported profits (column (3)). The figures represent yearly averages. Shifted profits are calculated based on the results of restricted cubic spline PPML estimation and reallocated across jurisdictions on the basis of the weighted sum of employees, tangible assets, and GDP per capita. EATR stands for effective average tax rate.

Table 3 shows the consequences of profit shifting for the tax payments of the MNEs included in our sample (panel A) as well as the tax revenues of different country groups (panels B and C). To compute the tax revenue effects, we multiply the amount of shifted profits by residence countries' EATRs. According to our results, the MNEs covered by our data are able to reduce their tax burden by almost EUR 53 billion per year by shifting profits to low-tax countries. This equals 15% of their tax payments. The biggest losers in terms of relative tax revenue loss are countries in East Asia and the Pacific region (-17.4%), followed by the member states of the EU27 excluding Germany and European tax haven countries (-15.2%). North American countries lose 11.2% in corporate income taxes due to profit shifting, Germany 7.8%.

Table 3: Taxes paid vs. taxes avoided

Country/country group	(1) Taxes paid (bn. EUR p.a.)	(2) Taxes avoided (bn. EUR p.a.)	(3) Taxes avoided (% of taxes paid)
Panel A: Global amount of paid and avoided taxes			
Total	350.0	52.7	15.1%
Panel B: Paid and avoided taxes for different geographical groups			
Germany	26.1	-2.0	-7.8%
EU27 (w/o Germany & European tax havens)	45.5	-6.9	-15.2%
Europe (w/o EU27) & Central Asia	26.2	-2.2	-8.5%
East Asia & Pacific	72.3	-12.6	-17.4%
North America	98.9	-11.1	-11.2%
European tax havens	20.8	3.1	14.7%
Non-European tax havens	8.9	0.8	9.5%
Rest of the world	51.4	-8.0	-15.6%
Panel C: Paid and avoided taxes for different EATR groups			
EATR $< 5\%$	3.1	0.4	13.1%
EATR $= [5\%; 15\%)$	44.2	3.8	8.5%
EATR $= [15\%; 25\%)$	85.7	-12.1	-14.1%
EATR $\geq 25\%$	217.0	-31.1	-14.3%

Notes: The table shows the sum of taxed paid (column (1)) and taxes avoided due to profit shifting (column (2)) for different country groups, as well as the ratio of taxes avoided to taxes paid (column (3)). The figures represent yearly averages. To compute the amount of avoided taxes, we multiplied profits shifted with the residence countries' EATRs. EATR stands for effective average tax rate.

How does accounting for zero profits affect our results? The answer can be found in table B2 of appendix B, which shows profit shifting estimates when we estimate the tax semi-elasticity of corporate profits by OLS and, thus, omit country-year observations with zero profits as we logarithmize the dependent variable. It turns out that disregarding zero profits yields considerably smaller profit shifting estimates. Based on OLS, we obtain an estimate for shifted profits of EUR 170 billion per year, which is EUR 72 billion (30%) smaller than the estimate based on PPML. Our findings thus suggest that disregarding subsidiaries that make zero profits when estimating the tax-sensitivity of corporate profits leads to a severe understatement of profit shifting.

In table B4 of appendix B, we show profit shifting estimates that account for a potential double counting of dividend income. Columns (1a) and (1b) of table B4 report estimates when accounting for a potential double counting of dividend income in MNEs' headquarters countries. In columns (2a) and (2b), we additionally account for a potential double counting in countries where holding companies are located. Our updated profit shifting estimates vary between EUR

225 billion and EUR 267 billion per year, which is reasonably close to our baseline estimate of EUR 242 billion reported in table 2. Thus, even if dividend income is counted double for MNEs headquartered in some countries, this does not appear to affect our results, at least not to a notable extent.

In table B4 of appendix B, we report profit shifting estimates when allowing the tax semi-elasticity of corporate profits to vary with MNE size (measured by global consolidated revenues). We find that, first, estimating size-specific tax semi-elasticities increases our estimate of the global amount of shifted profits to EUR 270 billion. Second, we detect a positive association between the size of a MNE and its propensity to shift profits to low-tax jurisdictions. I.e., the larger a MNE, the more heavily it tends to engage in profit shifting. While the smallest 10% of the MNEs included in our sample 'only' shift 5% of their profits to low-tax countries, the largest 10% shift 17%. Reflecting the higher propensity to shift profits as well as the fact that larger MNEs also make higher profits, the largest MNEs in our sample are responsible for the bulk of the profits we identify as shifted. Almost 60% (EUR 159 billion out of EUR 270 billion) of total shifted profits are shifted by the largest 10% of the MNEs covered by our data.

Table B4 of appendix B shows profit shifting estimates when estimating separate tax semi-elasticities for MNEs headquartered in different country groups. Our results indicate that MNEs headquartered in Europe (excluding EU27 countries) and Central Asia exhibit the highest profit shifting propensity. According to our estimates, 29% of the profits they report are shifted to low-tax countries with the aim of reducing the tax burden. MNEs headquartered in North America are not far behind. They shift almost one quarter of their profits to low-tax countries. The propensity to avoid taxation appears to be particularly low for German MNEs, who only shift about 7% of their profits.

Based on data from Bureau van Dijk's Orbis database, the OECD (2015) and Johansson et al. (2017) report a global tax revenue loss due to profit shifting of 4% to 10% of corporate income tax revenues.[31] Our estimate of 15% is notably higher. There are at least two possible explanations for this discrepancy. First, our data set only covers very large MNEs, which tend to be more active in profit shifting. Second, the estimates by the OECD (2015) and Johansson et al. (2017) are based on a linear empirical model that resembles equation 1. The smaller estimated tax revenue loss may thus be driven by the lack of consideration of a non-linear association between pre-tax profits and the corporate tax burden.

In a recent paper, Tørsløv et al. (2018) estimate the amount of corporate profit shifting by combining national accounts data with information from the OECD's foreign affiliates statistics and balance of payments data. According to the authors' estimates, 36% of MNEs' *foreign* profits are shifted to tax havens each year. If we divide the EUR 133 billion of profits the MNEs included in our sample shift to European and non-European tax havens each year (cf.

[31] The authors extrapolate their results in order to account for missing information in the Orbis database.

panel B of table 2) by the foreign profits they report (which equal, on average, EUR 1 048 billion per year), we obtain a share of 13%, which is notably smaller.

One possible explanation for the difference between the number presented in Tørsløv et al. (2018) and our result relates to the assumed counterfactual distribution of profits. The counterfactual tells us how profits would be distributed globally if there was no profit shifting.[32] In our approach, the counterfactual is a world in which tax rate differences do not matter for the global distribution of MNEs' profits. Instead, the profit distribution is determined by the realizations of the control variables included in our regression analysis, which include firm-level indicators of 'real' economic activity – employment and tangible assets – and host country characteristics like GDP and population. In Tørsløv et al. (2018), the counterfactual is that the profit-to-payroll ratio of foreign MNEs' tax haven subsidiaries is the same as that of domestic non-MNEs.

To illustrate the importance of the assumed counterfactual, we adopt a different approach to determine a counterfactual profit distribution: a world where the global distribution of MNEs' profits matches the distribution of payroll.[33] If the counterfactual distribution of large MNEs' profits covered by the CbC data corresponded to the distribution of payroll, we would obtain an estimate for the profits shifted to tax haven countries of EUR 229 billion per year, which is almost twice as much as the estimate reported in table 2. The resulting ratio of profits shifted to tax havens to foreign profits is 22%.

6 How do multinationals shift profits?

The previous sections have shown that MNEs shift a notable fraction of their profits to low-tax countries for the purpose of reducing their tax burden. An open question is which instruments they use for profit shifting. Among the channels that are frequently discussed in the existing literature are (see, for instance, Buettner and Wamser (2013); Dischinger and Riedel (2011); Dyreng and Hanlon (2020); Fuest et al. (2011); Griffith et al. (2014); Hines Jr (2014)):[34]

- The *interest rate channel*: subsidiaries located in low-tax jurisdictions extend loans to affiliates in high-tax jurisdictions and receive interest payments in return.
- The *IP channel*: MNEs transfer intellectual property (IP) rights – e.g., trademark rights, patent rights, licenses, or licensing rights – to subsidiaries in low-tax jurisdictions. Af-

[32] See Dyreng and Hanlon (2020) for a more thorough discussion of the relevance of counterfactuals for the estimation of profit shifting.

[33] We proxy payroll by the factor of the number of employees and the level of PPP adjusted real GDP per capita in the residence countries as the CbC reports do not contain information about payroll.

[34] Another profit shifting channel that is prominently discussed is transfer mispricing. However, we are not able to test the relevance of this channel based on CbC data.

filiates located in high-tax jurisdictions then pay fees or royalties for the use of these intangibles.

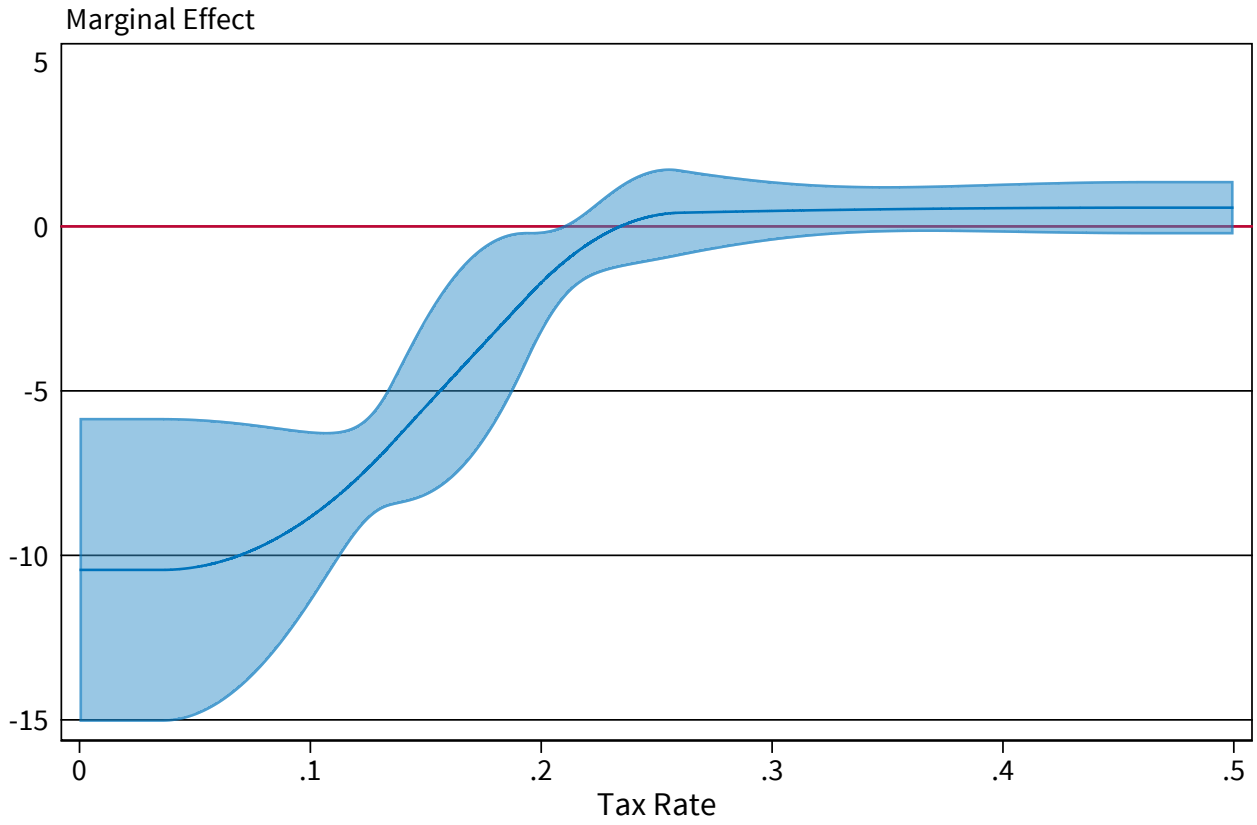
- The *treaty shopping channel*: MNEs divert equity and/or dividend income through countries that tax these income sources at a preferential rate or not at all. To do so, MNEs establish subsidiaries in these countries holding shares and/or equity.

Testing the relevance of these channels would require information about the quantity and quality of cross-border transactions between affiliated companies. Unfortunately, CbC reports do not entail such information. However, CbC data allows us to assess the importance of these channels indirectly. We do so in two different ways. First, we re-estimate our restricted cubic specification using a different dependent variable: we replace pre-tax profits by the sum of revenues the subsidiaries of MNE i located in country c generate through transactions with affiliated firms. An inverse relationship between this variable and the level of taxation in a country would provide evidence for the relevance of the aforementioned profit shifting channels because the variable includes payments for intra-company services, royalties, and interest payments.

The results of this regression are presented in figure 4. The shape of the elasticity curve closely resembles the one depicted in figure 3, which shows the estimated tax semi-elasticity of pre-tax profits. There is a pronounced positive association between the tax semi-elasticity of intra-firm revenues and the corporate income tax burden as long as the EATR is lower than around 20%. Once the EATR exceeds this level, the tax semi-elasticity becomes statistically indistinguishable from zero.

The tax-sensitivity of intra-firm revenues clearly indicates that MNEs organize their global activities in a way to shift income to low-tax countries. Consequently, this finding corroborates our conclusion that the association between pre-tax profits and EATRs results from corporate tax avoidance.

Figure 4: Estimated tax semi-elasticity of intra-firm revenues



Notes: The figure shows the estimated tax semi-elasticity of intra-firm revenues for different realizations of the effective average tax rate. The shaded area represents the 90% confidence interval. The semi-elasticity is estimated using pseudo-poisson maximum likelihood based on a restricted cubic spline specification with five knots. The knots are placed at the 5%, 27.5%, 50%, 72.5%, and 95% percentile of the tax variable. Standard errors are clustered at the level of the MNE and tax jurisdiction.

A second way of testing the relevance of different profit shifting channels based on information from CbC reports is to check whether business activities that are conducive for profit shifting are more profitable when performed in low-tax countries. For this purpose, we estimate the following equation using OLS:

$$\begin{aligned} log(y_{ict}) = \alpha_i + \beta_1' BA_{ict} + \beta_2' EATR\,group_{ct} + \beta_3' (BA_{ict} \times EATRgroup_{ct}) \\ + \beta_4 K_{ict} + \beta_5 L_{ict} + \gamma' Country_{ct} + \delta_i + \epsilon_t + \zeta_{ict} \end{aligned} \tag{2}$$

The dependent variable is the log of pre-tax profits MNE i reports in country c and year t. As before, we control for the value of tangible assets (K_{ict}), the number of employees (L_{ict}), real GDP per capita, population size, and perceived corruption (all included in the vector $Country_{ct}$) as well as MNE (δ_i) and year-fixed effects (ϵ_i). The vector BA_{ict} includes twelve binary variables, each of which indicates the prevalence of a subsidiary of MNE i in country c

performing one of the twelve business activities described in section 2.[35] I.e., the first dummy takes the value one if at least one of MNE i's subsidiaries in country c engages in research and development, the second dummy takes the value one if there is at least one subsidiary that holds or manages IP, and so on. The vector $EATR\,group_{ct}$ includes two dummy variables. The first one takes the value one if country c's EATR is below 5%, the second dummy takes the value one if country c's EATR is between 5% and 15%. Countries with EATRs above 15% serve as a reference.

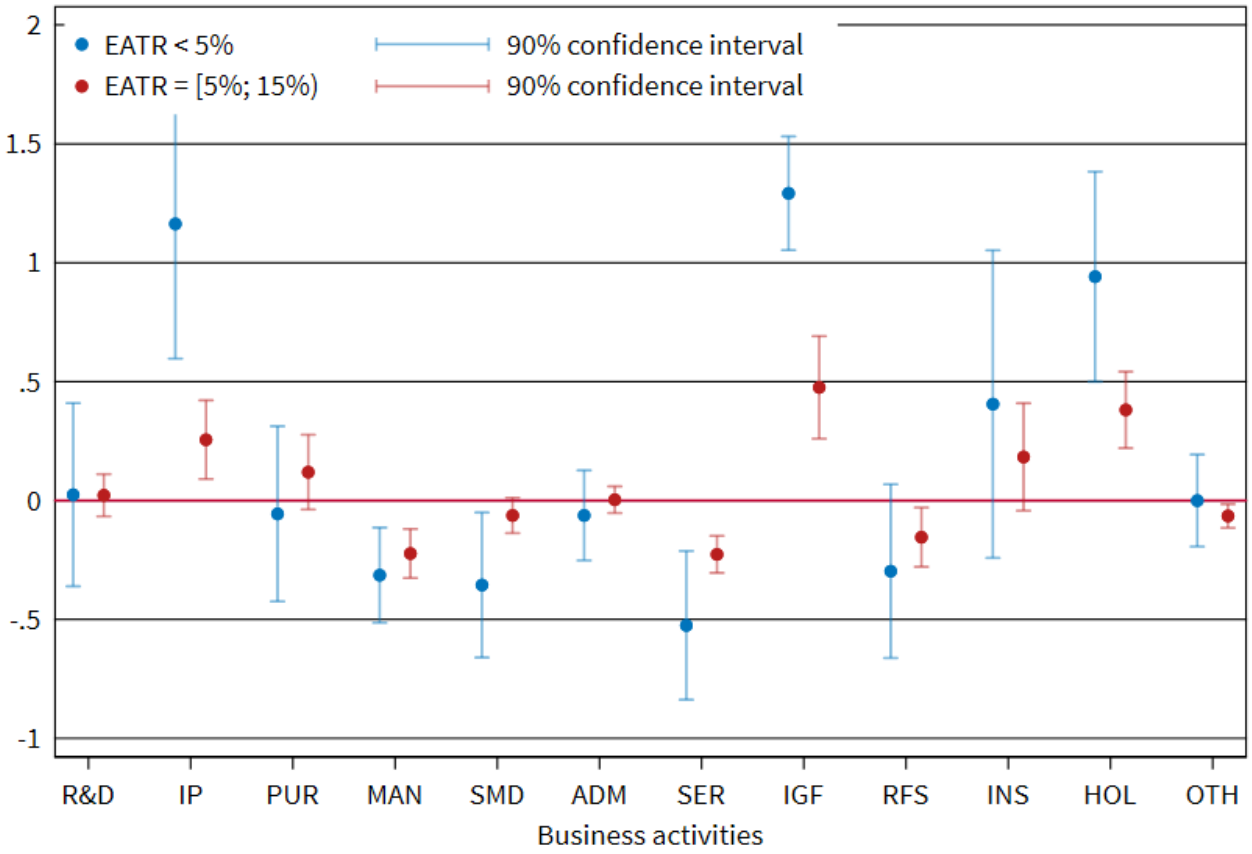
Our variables of main interest are the interaction terms $BA_{ict} \times EATRgroup_{ct}$. Their coefficients indicate whether business activities create higher (the coefficient's sign is positive) or lower (the coefficient's sign is negative) profits when performed in a country in which the corporate tax burden is very low (EATR below 5%) or low (EATR between 5% and 15%) compared to a country in which the corporate tax burden is high (EATR above 15%). Since we control for real economic activity and MNE-specific profitability differences through the inclusion of MNE-fixed effects in our empirical model, the coefficient estimates can be interpreted as measures of the tax-motivated excess profitability that can be attributed to a certain business activity.

Figure 5 graphically illustrates the coefficient estimates of the interaction terms. The estimates provide strong evidence for the importance of all three aforementioned profit shifting channels. The effects are to be interpreted as follows: Assume a MNE has at least one subsidiary in a country with a very low (low) tax rate that holds or manages IP and at least one subsidiary in a high-tax country performing the same function. In that case, the profits reported in the very low-tax (low-tax) country exceed the profits reported in the high-tax country by on average 120% (25%) even when the extent of real economic activity is held fixed. The discrepancies in profitabilities are even more pronounced for internal group finances (IGF). Profits reported in very low-tax (low-tax) countries are 130% (50%) higher than they are in high-tax countries in case they host subsidiaries extending loans to affiliated firms. For subsidiaries that hold shares or equity (HOL), profits in very low-tax (low-tax) countries are almost 100% (around 40%) higher than they are in high-tax countries.

Since our empirical model includes MNE-fixed effects, the patterns that we observe cannot be driven by unobserved characteristics of the MNEs included in our sample or sector specific differences. Also, a glance at the remaining estimates suggests that these effects are not driven by productivity differences across residence countries pertaining, for instance, to 'knowledge work' or financial activities. We do not find statistically significant profitability differences when it comes to R&D activities, regulated financial services (RFS), or insurance services (INS).

[35] We do not include a dummy for 'dormant' subsidiaries as, per definition, they are inactive. Note that the dummies capturing different business activities are not disjunct.

Figure 5: Profitability of different business activities across country groups



Notes: The figure shows estimates of the profitability of different business activities. The estimates are based on an OLS regression. The dependent variable is the log of pre-tax profits. The independent variables are interaction terms between two dummy variables that take the value one if the effective average tax rate in a jurisdiction is below 5% and between 5% and 15%, respectively, and a set of dummy variables that take the value one in case a MNE has a subsidiary in that jurisdiction performing one of twelve different business activities. The business activities are (i) research and development (R&D), (ii) holding or managing intellectual property (IP), (iii) purchasing or procurement (PUR), (iv) manufacturing (MAN), (v) sales, marketing or distribution (SMD), (vi) administrative, managing or support services (ADM), (vii) provision of services to unrelated parties (SER), (viii) internal group finance (IGF), (ix) regulated financial services (RFS), (x) insurance (INS), (xi) holding shares or other equity instruments (HOL), and (xii) other activities (OTH). The vertical lines represent 90% confidence intervals. Standard errors are clustered at the level of MNEs and jurisdictions.

7 Conclusions

Our analysis uses firm-level data from country-by-country reports of more than 3 600 multinational groups operating in 238 jurisdictions to assess the amount of tax-motivated global corporate profit shifting and to identify the main channels and instruments used to shift profits. A simple comparison of the distribution of profits and the distribution of indicators of real economic activity like employees or tangible assets reveals an imbalance related to taxation. The companies in our sample report 7% (30%) of their global profits in countries with effective average tax rates below 5% (15%), but only 0.4% (10%) of their employees and 3% (20%) of their tangible assets are located there. We find that globally, these firms reduce their tax burden by EUR 53 billion (15% of their overall tax payments) by shifting profits to low tax

countries. Losses of the EU 27 member states are similar to the global average, losses of the US and Canada are slightly lower. However, there is variation within the EU. In Germany, for instance, the losses are smaller, amounting to just 8% of the profits reported there. Globally, 60% of profit shifting is carried out by the 10% largest multinational firms, suggesting that tax avoidance policies should focus on larger firms. We show that taking into account non-linearities in profit shifting and firms reporting zero profits is of key importance for accurate estimates of profit shifting. We also investigate profit shifting channels and provide evidence suggesting that the location of IP and equity in low-tax countries as well as the provision of loans to entities in high-tax countries play a key role for tax planning.

Our estimates happen to be in the middle of the range of previous estimates, which find tax base losses due to profit shifting between 5% and 30%. Our analysis underscores that the data as well as the methods used to asses the amount of profit shifting matter a lot for the results. In particular, linear or quadratic specifications of profit shifting equations and logarithmic specifications which drop firms with zero or negative profits may strongly bias the results.

In terms of policy implications, our analysis suggests that the current initiative to introduce a global minimum corporate profit tax of 15% for large multinational firms indeed targets the key actors in international tax avoidance through corporate profit shifting. To some extent, this also applies to the carve-outs for activities with economic substance because our analysis shows that profit shifting is driven significantly by intra-group payments and holding companies.

One important limitation of our analysis is that our sample only includes multinational groups with a presence in Germany. Since Germany is one of the world's largest economies and a central location in Europe, most large multinational firms have a presence in Germany, but certainly not all of them. It would be highly desirable to make all globally available data from country-to-country reporting available for economic analysis to generate an even more comprehensive basis for understanding the patterns of international profit shifting.

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A The OECD BEPS initiative and the CbC reporting mechanism

Transparency is a main topic in the context of the OECD's *Base Erosion and Profit Shifting* (BEPS) initiative. This initiative is a multilateral approach to combat harmful tax practices of multinational enterprises (MNEs) and formally started with a first report in 2013 (OECD, 2013). The report included an action plan recognizing the increased profit shifting opportunities of MNEs due to globalization and listed 15 Actions to address this issue. BEPS Action 13 provided for the introduction of country-by-country (CbC) reporting.[36] Under these regulations, MNEs with global revenues of at least EUR 750 million (or an equivalent amount in a another currency) have to prepare and file a CbC report, provided that the country where its headquarters are based takes part in the OECD/G20 Inclusive Framework on BEPS and has introduced a corresponding reporting obligation into national legislation (*parent filing obligation*). However, a country may also require constituent entities of an MNE that are resident in that country for tax purposes to file a CbC report if there is no such obligation for the MNE in the country where it is headquartered, provided that the MNE meets the revenue threshold. 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 November 2021, 141 countries joined the Inclusive Framework on BEPS, 100 of which already introduced a CbC reporting obligation into national legislation.

The main approach to detect base erosion and profit shifting activities is to identify imbalances between the distribution of real economic activity on the one hand and MNEs' profits on the other hand across tax jurisdictions. Consequently, CbC reports include indicators of economic activity and financial performance at the level of the jurisdictions in which MNEs operate. The information is spread across three tables (OECD, 2015). Table 1 comprises key financial indicators: unrelated party revenues, related party revenues, total revenues, profit before income tax, income tax paid (on a cash basis), current year income tax accrued, stated capital, accumulated earnings, number of employees, and the value of tangible assets other than cash and cash equivalents. These figures have to be disclosed on an aggregate basis for each tax jurisdiction the MNE operates in. This means that if a MNE has more than one entity located in a jurisdiction, the figures provided in table 1 of the CbC report reflect the combined activities of all entities in that jurisdiction. Table 2 of the CbC reports contains a list of all affiliated legal entities of a MNE by tax jurisdictions along with their country of incorporation (if different from resident jurisdiction) and their main business activities. More precisely, MNEs have to

[36] See Cockfield and MacArthur (2015) for an overview of the development of CbC reporting.

indicate which of the following 13 activities each affiliated entity pursues (multiple answers are allowed): research and development; holding or managing intellectual property; purchasing or procurement; manufacturing or production; sales, marketing or distribution; administrative, managing or support services; provision of services to unrelated parties; internal group finance; regulated financial services; insurance; holding shares or other equity instruments; dormant; other activities. This section of the CbC report aims at providing additional information on the group structure and on the business activities performed in the resident jurisdictions. Proportionately consolidated companies are to be shown in the CbCR on a pro rata basis. Table 3 allows for additional information and comments the MNEs deem relevant for tax authorities.

Upon receipt, tax authorities share the CbC reports with the tax authorities of other jurisdictions in which the MNEs report to operate in. Due to that, each tax authority has, in principle, access to the CbC reports of all MNEs – domestic and foreign – operating in the country. The main purpose of CbC reporting is to allow tax administrations to assess BEPS-related risks. However, countries agreed that CbC reports may also be used by tax administrations for the statistical analysis of MNEs' global activities and BEPS practices.

31 countries, including Germany, signed the *Multilateral Competent Authority Agreement for the automatic exchange of CbC reports* (CbC MCAA) on 27 January 2016. By January 2021, this number had grown to 92.[37] As of March 2022, there are more than 3 000 bilateral relationships for the exchange CbC reports. This includes exchanges between the 92 signatories of the CbC MCAA, exchanges between EU Member States under EU Council Directive 2016/881/EU, and exchanges between signatories of bilateral competent authority agreements for exchanges under Double Tax Conventions or Tax Information Exchange Agreements, including 41 bilateral agreements with the United States. Germany currently has 81 exchange relationships with other jurisdictions.

The first automatic exchange of CbC reports took place in June 2018 and covered CbC reports referring to the fiscal year 2016. While the CbC reports are shared between tax authorities, they are not made publicly available. Before receiving a CbC report, jurisdictions have to ensure the confidentiality and appropriate use of any information included in the reports. However, on 28 September 2021, the Council of the European Union and on 11 November 2021, the European Parliament reached a political agreement on a new Directive which obliges parent entities of MNE groups as well as standalone entities, whose annual turnover exceeds EUR 750 million, to disclose to the general public some key business numbers broken down by the countries where they have business units (Schoen, 2021).

The information contained in CbC reports is usually not included in other data sets or at

[37] A complete list of all signatories can be found here: https://www.oecd.org/tax/beps/CbC-MCAA-Signatories.pdf.

least does not offer the same extent of geographical coverage. Therefore, the uniqueness of the CbC data lies in its extensive geographic coverage, in the combination of key figures in one single data source and in the possibility to connect the activities of entities located in different jurisdictions to the MNE to which they belong. MNEs are required to report activities in every single jurisdiction of the world where they operate, including jurisdiction for which coverage in other data sets is poor. This allows us to provide a complete coverage of MNEs' global activities, including activities in countries known for their lack of transparency and willingness to reveal corresponding information.

B Additional figures and tables

Figure B1: CbC reporting template

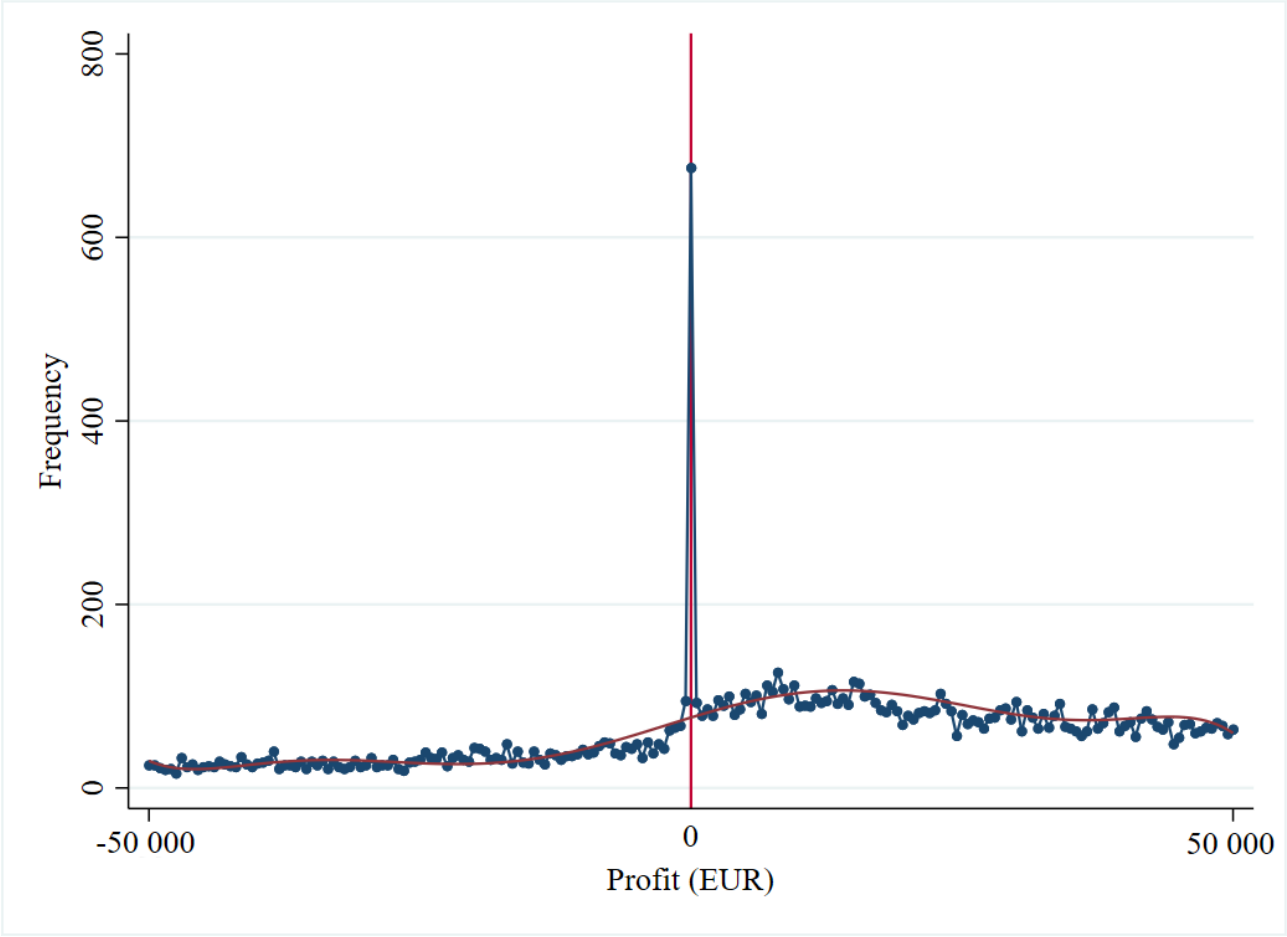
Name of the MNE group: Fiscal year concerned: Currency used:										
Tax Jurisdiction	Revenues			Profit (Loss) before Income Tax	Income Tax Paid (on Cash Basis)	Income Tax Accrued – Current Year	Stated Capital	Accumulated Earnings	Number of Employees	Tangible Assets other than Cash and Cash Equivalents
	Unrelated Party	Related Party	Total							

Name of the MNE group: Fiscal year concerned:															
Tax Jurisdiction	Constituent Entities Resident in the Tax Jurisdiction	Tax Jurisdiction of Organisation or Incorporation if Different from Tax Jurisdiction of Residence	Main Business Activity(ies)												
			Research and Development	Holding or Managing Intellectual Property	Purchasing or Procurement	Manufacturing or Production	Sales, Marketing or Distribution	Administrative, Management or Support Services	Provision of Services to Unrelated Parties	Internal Group Finance	Regulated Financial Services	Insurance	Holding Shares or Other Equity Instruments	Dormant	Other[1]
	1.														
	2.														
	3.														
	1.														
	2.														
	3.														

Name of the MNE group: Fiscal year concerned:
Please include any further brief information or explanation you consider necessary or that would facilitate the understanding of the compulsory information provided in the Country-by-Country Report.

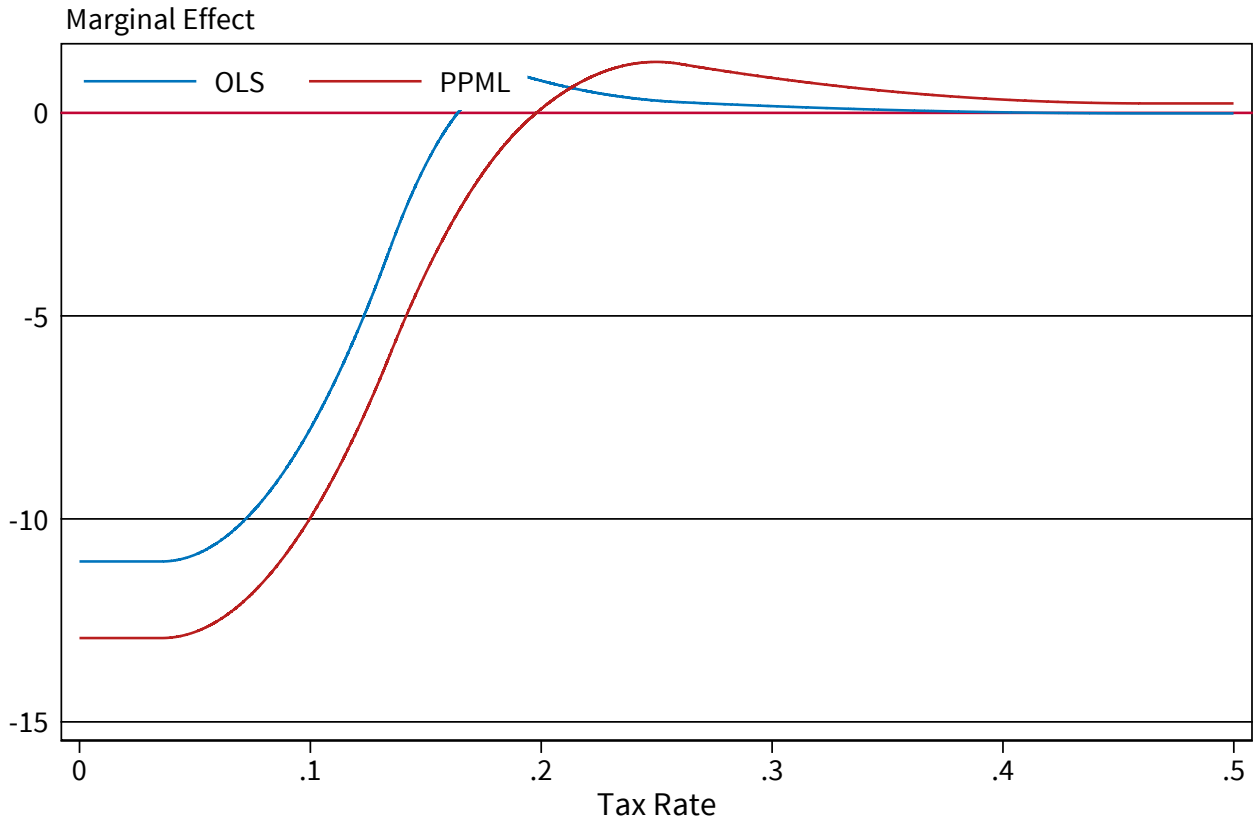
Source: OECD (2015: 29f).

Figure B2: Bunching of pre-tax profits around zero



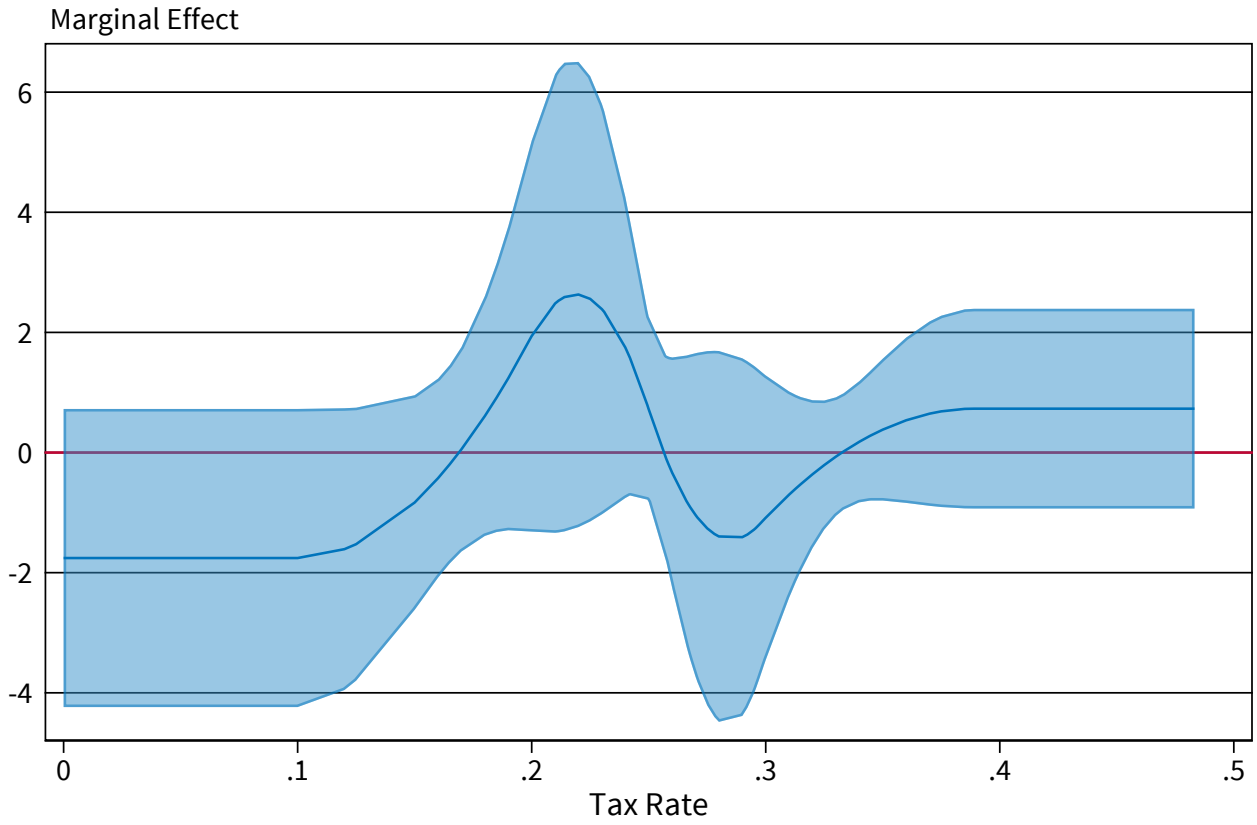
Notes: The figure shows the distribution of profits for the range between minus EUR 50 000 and plus EUR 50 000 (blue line and dots). The observations were divided into 200 groups with a width of EUR 500. Observations without employees as well as without sales to third parties and without sales to affiliated companies were not taken into account. The dot on the vertical red line describes the number of observations with a profit between minus and plus 250 euros. The red line shows the estimated distribution of profits for the hypothetical case in which there is no bunching (Chetty et al., 2011). The estimated distribution is based on a seventh-degree polynomial excluding two groups below and above zero. The method of Chetty et al. (2011) allows estimating the excess mass, i.e., the additional density of the distribution around the bunching point compared to the estimated distribution without bunching. For the distribution of gains shown in the figure, the excess mass is 811%. This bunching of observations with zero profits is statistically highly significant (t-value: 19.3).

Figure B3: Estimated tax semi-elasticity of corporate profits – PPML vs. OLS



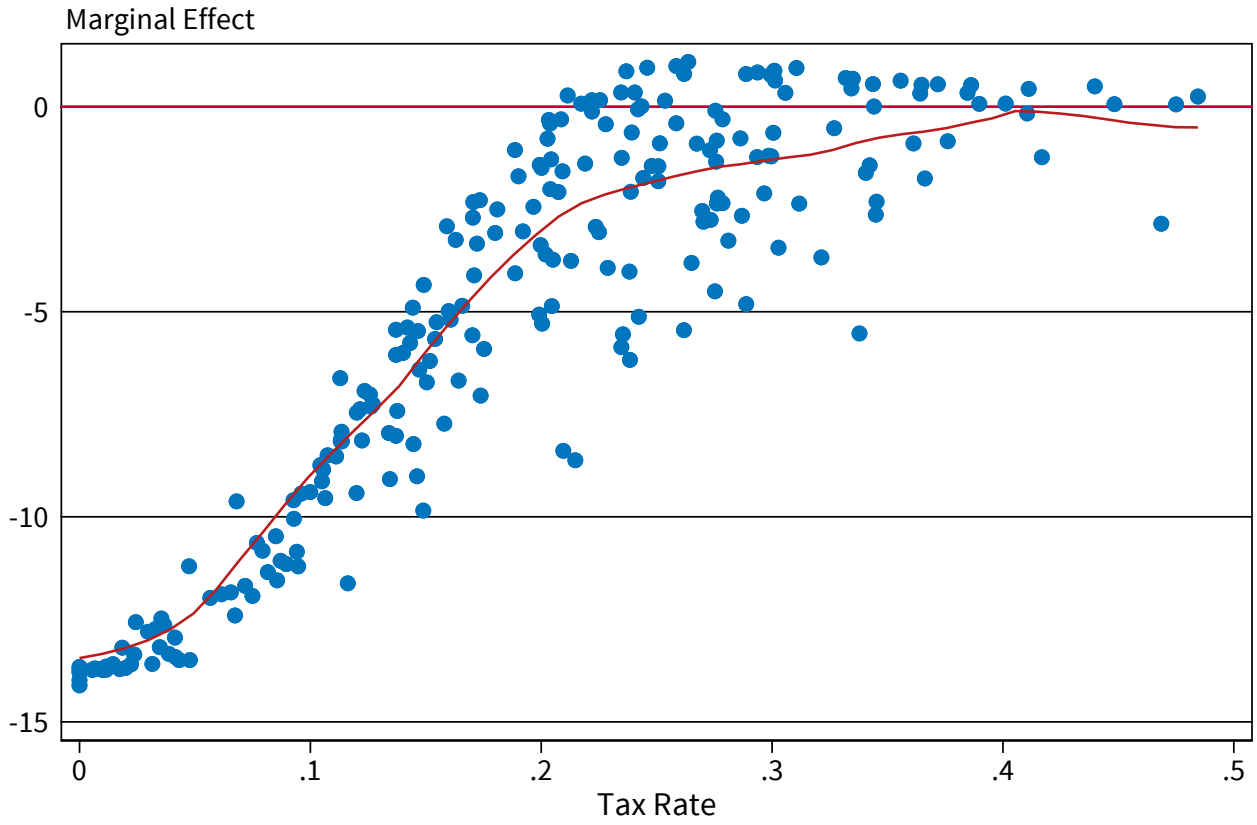
Notes: The figure shows the estimated tax semi-elasticity of pre-tax profits for different realizations of the effective average tax rate. The red line shows the tax semi-elasticity based on pseudo-poisson maximum likelihood estimation, the blue line based on OLS estimation. Estimates are based on a restricted cubic spline specification with five knots. The knots are placed at the 5%, 27.5%, 50%, 72.5%, and 95% percentile of the tax variable.

Figure B4: Estimated tax semi-elasticity of corporate profits – statutory tax rates



Notes: The figure shows the estimated tax semi-elasticity of pre-tax profits for different realizations of the statutory tax rate. The shaded area represents the 90% confidence interval. The semi-elasticity is estimated using OLS based on a restricted cubic spline specification with five knots. The knots are placed at the 5%, 27.5%, 50%, 72.5%, and 95% percentile of the tax variable. Standard errors are clustered at the level of the MNE and tax jurisdiction.

Figure B5: Estimated tax semi-elasticity of corporate profits – alternative EATR measure



Notes: The blue dots represent average tax semi-elasticities for each residence country in our dataset. To calculate the averages, we proceed as follows: first, we compute EATRs based on a 20% random subsample of MNEs. Then, we estimate the tax semi-elasticity of pre-tax profits excluding the 20% of randomly selected MNEs. We repeat this procedure 500 times. Tax semi-elasticities are estimated using pseudo-poisson maximum likelihood based on a restricted cubic spline specification with five knots. The knots are placed at the 5%, 27.5%, 50%, 72.5%, and 95% percentile of the tax variable. The red curve shows a locally smoothed polynomial fit.

Table B1: List of tax havens

Category	**Countries**
European tax havens	Cyprus, Gibraltar, Ireland, Liechtenstein, Luxembourg, Malta, Netherlands, Switzerland
Non-European tax havens	Antigua and Barbuda, Bahamas, Bahrain, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Curacao, Grenada, Guernsey, Hong Kong, Isle of Man, Jersey, Liberia, Montserrat, Panama, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Singapore, Sint Maarten, Turks and Caicos Islands, Vanuatu

Notes: The classification is based on IMF (2016) and Menkhoff and Miethe (2019).

Table B2: Reported vs. shifted profits (OLS estimation)

Country/country group	(1) Reported profits (bn. EUR p.a.)	(2) Shifted profits (bn. EUR p.a.)	(3) Shifted profits (% of reported profits)
Panel A: Global amount of reported and shifted profits			
Total	1560.0	170.1	10.9%
Panel B: Reported and shifted profits for different geographical groups			
Germany	134.6	-7.7	-5.7%
EU27 (w/o Germany)	234.4	-24.6	-10.5%
Europe (w/o EU27) & Central Asia	118.4	-5.7	-4.8%
East Asia & Pacific	194.8	-24.7	-12.7%
North America	373.5	-32.2	-8.6%
European tax havens	223.7	51.0	22.8%
Non-European tax havens	133.5	48.2	36.1%
Rest of the world	147.0	-4.6	-3.1%
Panel C: Reported and shifted profits for different EATR groups			
EATR $< 5\%$	105.2	63.7	60.6%
EATR $= [5\%; 15\%)$	387.9	43.5	11.2%
EATR $= [15\%; 25\%)$	425.6	-42.0	-9.9%
EATR $\geq 25\%$	641.3	-65.4	-10.2%

Notes: The table shows the sum of profits reported in (column (1)) and shifted out of/to (column (2)) different country groups, as well as the ratio of shifted to reported profits (column (3)). The figures represent yearly averages. Shifted profits are calculated based on the results of restricted cubic spline OLS estimation and reallocated across jurisdictions on the basis of the weighted sum of employees, tangible assets, and GDP per capita. EATR stands for effective average tax rate.

Table B3: Reported vs. shifted profits – accounting for a potential double counting of profits

Country/country group	(1) HQ-specific effects		(2) HQ & holding-specific effects	
	(1a) Shifted profits (bn. EUR p.a.)	(1b) Shifted profits (% of reported profits)	(2a) Shifted profits (bn. EUR p.a.)	(2b) Shifted profits (% of reported profits)
Panel A: Global amount of reported and shifted profits				
Total	266.7	17.7%	224.9	14.4%
Panel B: Reported and shifted profits for different geographical groups				
Germany	-9.0	-6.7%	-12.1	-9.0%
EU27 (w/o Germany)	-29.4	-12.6%	-23.8	-10.1%
Europe (w/o EU27) & Central Asia	-3.9	-3.3%	-3.7	-3.1%
East Asia & Pacific	-56.8	-29.2%	-41.2	-21.1%
North America	-30.8	-8.2%	-55.9	-15.0%
European tax havens	98.5	44.1%	89.8	40.2%
Non-European tax havens	79.1	59.3%	73.2	54.8%
Rest of the world	-44.8	-30.4%	-24.3	-16.5%
Panel C: Reported and shifted profits for different EATR groups				
EATR $< 5\%$	83.1	79.0%	82.8	78.7%
EATR $= [5\%; 15\%)$	112.9	29.1%	96.0	24.7%
EATR $= [15\%; 25\%)$	-65.5	-15.4%	-55.8	-13.1%
EATR $\geq 25\%$	-127.7	-19.9%	-120.9	-18.9%

Notes: The table shows the sum of profits reported in (column (1)) and shifted out of/to (column (2)) different country groups, as well as the ratio of shifted to reported profits (column (3)). The figures represent yearly averages. Shifted profits are calculated based on the results of restricted cubic spline PPML estimation and reallocated across jurisdictions on the basis of the weighted sum of employees, tangible assets, and GDP per capita. ETR stands for effective average tax rate.

Table B4: Shifted profits by MNE size

MNE size (deciles)	(1) Shifted profits (bn. EUR p.a.)	(2) Shifted profits (% of reported profits)
Decile 1	0.9	4.5%
Decile 2	1.9	7.0%
Decile 3	2.9	10.3%
Decile 4	3.2	9.3%
Decile 5	2.6	5.5%
Decile 6	6.1	10.2%
Decile 7	10.7	12.2%
Decile 8	28.0	19.3%
Decile 9	53.9	20.6%
Decile 10	159.4	17.2%
Total	269.7	17.3%

Notes: The table shows the sum of shifted profits (column (1)) as well as the share of shifted to total profits (column (2)) for MNEs of different size (indicated by their global revenues). Shifted profits are calculated based on the results of restricted cubic spline PPML estimation and reallocated across jurisdictions on the basis of the weighted sum of employees, tangible assets, and GDP per capita.

Table B5: Shifted profits by MNEs' headquarters country groups

Headquarters country (group)	(1) Shifted profits (bn. EUR p.a.)	(2) Shifted profits (% of reported profits)
Germany	14.0	6.7%
EU27 (w/o Germany)	45.9	11.6%
Europe (w/o EU27) & Central Asia	23.0	29.2%
East Asia & Pacific	11.5	10.9%
North America	138.1	24.3%
Other/unknown	51.2	25.2%
Total	283.7	18.2%

Notes: The table shows the sum of shifted profits (column (1)) as well as the share of shifted to total profits (column (2)) for MNEs with different headquarters countries. Shifted profits are calculated based on the results of restricted cubic spline PPML estimation and reallocated across jurisdictions on the basis of the weighted sum of employees, tangible assets, and GDP per capita.