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Global Evidence on Profit Shifting Within Firms and Across Time

Fotis Delis, Manthos Delis, Luc Laeven and Steven Ongena

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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Abstract

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JEL Classification: F23, H25, H26, H32, M41

Keywords: Profit shifting, Multinational Enterprises, Nonparametric estimation, intangible assets, institutional quality, global sample

Fotis Delis - f.ntel7@gmail.com
University of Piraeus

Manthos Delis - m.delis@montpellier-bs.com
Montpellier Business School

Luc Laeven - luc.laeven@ecb.europa.eu
European Central Bank and CEPR

Steven Ongena - steven.ongena@bf.uzh.ch
University of Zurich and CEPR

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Fotis Delis
Department of Economics, University of Piraeus

Manthos D. Delis
Montpellier Business School and University of Montpellier

Luc Laeven*
European Central Bank, Tilburg University, and CEPR

Steven Ongena
University of Zurich, Swiss Finance Institute, KU Leuven, NTNU Business School and CEPR

* Corresponding author. Luc Laeven, European Central Bank, Sonnemannstrasse 20, 60314 Frankfurt am Main, Germany; email: luc.laeven@ecb.europa.eu.

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We provide the first global estimates of profit shifting within firms at the subsidiary-year level. Employing nonparametric estimation techniques within a mainstay model of profit shifting, we examine the responses by subsidiary-year of earnings to the composite tax indicator faced by all subsidiaries of a multinational firm. Our panel includes 26,593 subsidiaries across 95 countries for the period 2009–2017. Subsequently, we examine correlates of profit shifting, identifying that a key determinant is the subsidiaries' ratio of intangible assets, and this channel is stronger in countries with weaker institutions. Both our new database and our novel findings open important avenues to analyze the sources and effects of profit shifting.

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1. Introduction

Tax-motivated profit shifting refers to the tax planning strategies of multinational enterprises (MNEs) and their "shifting" of profits from a parent or subsidiaries located in high-tax jurisdictions to subsidiaries in low-tax jurisdictions with the aim of increasing their net income. The practice has attracted considerable interest in recent years from academics and policy makers. Alongside decreased tax fairness due to the consequent erosion of government revenue bases, profit shifting poses welfare and fiscal challenges. This has triggered efforts and policies from governments and international organizations to contain the practice. The most prominent of these efforts are the OECD's Base Erosion and Profit Shifting (BEPS) initiative and the June 2021 agreement among G7 finance ministers to seek a global minimum corporate tax rate of at least 15 percent (Rappeport, 2021).

According to OECD estimates, profit shifting practices cost governments 100-240 billion USD in lost tax revenue annually. These estimates are, however, very rough given the informationally challenging nature of profit shifting practices. The most common way to estimate profit shifting in the academic literature is from a model of the response of subsidiary profits to tax incentives, i.e., the differential taxation between the countries of the parent and subsidiaries or between the countries of the subsidiaries (Hines and Rice; 1994; Huizinga and Laeven, 2008; Dharmapala and Riedel, 2013). The assumption is that an increase in tax rate differences incentivizes subsidiaries to send more profit to the low tax jurisdiction. However, these models produce global estimates (a single parameter reflecting profit shifting intensity) that do not have both a cross-sectional (subsidiary) and temporal (year) variation. This limits the possibility to have an explicit variable of profit shifting with a panel (subsidiary-year) dimension.

We provide a new comprehensive global data set of profit shifting — henceforth referred to as the "global profit shifting database." The importance of having a panel variable

is threefold. First, such a variable can inform both academics and policy makers about the profit shifting intensity of each subsidiary in each year. In contrast, existing methods provide aggregate information for each sample (or subsample) used in the empirical analysis because they provide a single estimate of profit shifting (e.g., the response of subsidiary *i* profits to the tax difference between the subsidiary *i* country and all other affiliates *j* countries in Huizinga and Laeven, 2008). Thus, the subsidiary-year panel dimension remains largely unexplored.

Second, having panel data on profit shifting allows better modelling its determinants using straightforward econometric techniques. The current practice is to infer the determinants of profit shifting by interacting the response of subsidiary profits to tax incentives with the determinant of interest (e.g., worldwide vs. territorial taxation in Markle, 2016; the role of patents in Cheng et al., 2021; et cetera). A key problem with such approaches is endogeneity bias that comes in many forms and is not easy to overcome. For example, having one variable of interest interacted with the tax incentives variable in Huizinga and Laeven (2008) implies that many other control variables need to be included in interaction terms to limit omitted-variable bias. Standard solutions to omitted-variable bias such as difference-in-differences (DID) would require a triple interaction term (which is generally harder to identify, interpret, and test in a parallel trends fashion), while instrumental variable (IV) regressions would require several exogenous instruments (for each of the variables used in the interaction terms and the interaction terms themselves) making estimation impractical.[1] Therefore, identifying causal effects using existing approaches is very challenging.

Third, identifying outcomes of profit shifting (in models where profit shifting is the explanatory variable) is even more cumbersome. This especially holds if the outcome variable of interest is observed at the subsidiary-year level for which existing methods do not provide

[1] Other types of endogeneity bias, such as simultaneity or selection are equally difficult to overcome within existing models.

much information (we are unaware of studies examining outcomes of profit shifting). Instead, our new measure can simply be used as an explanatory variable in any empirical analysis.[2]

In this context, the development of our database is further motivated by several research questions, concerning the drivers and outcomes of profit shifting. First, how do certain firm characteristics affect profit shifting? Has the effect of these characteristics changed over time in line with policy efforts? Has the effect of alternative characteristics emerged as key to circumvent policy efforts? To what extent are these differences universal or country-specific, given country-specific differences in institutional quality? Does profit shifting affect specific firm outcomes, such as performance and financial decisions, and how? Even though we do not aim to identify a full set of causal effects underlying all these questions, we provide first results to validate our measure and reflect on future avenues for research by identifying significant unexplored correlates of profit shifting.

We use global data on all subsidiaries available in the Orbis database, covering a maximum of 95 countries and 26,593 subsidiaries for the period 2009–17. The maximum number of subsidiary–year observations for which we estimate profit shifting is 106,301. We derive subsidiary-year profit shifting by estimating the Huizinga and Laeven (2008) model using nonparametric techniques. The simplest of these techniques are those based on a nonparametric kernel regression, which mimics the parametric ordinary least squares (OLS). The key difference is that the nonparametric regression makes no assumptions regarding the slope of the regression in the full sample because estimation is carried out for local samples within "sliding windows" of observations.

Most importantly, the nonparametric regression allows obtaining profit-shifting estimates equal to the subsidiary-year observations in our sample. For example, for an estimate

[2] When our profit shifting variable is an explanatory variable, straightforward adjustment via an IV or a bootstrapping technique can be used to account for any measurement error introduced in the estimation process. When used as an outcome variable, measurement error is less a concern (Wooldridge, 2009).

on observation x_i (in our case reflecting the corporate tax differential between subsidiaries of the same multinational group), we use the observations closest to it (sliding window around x_i). In this way, we obtain an estimate on x_i for the observations in the corresponding window. Then, we move to the closest to x_i observation, x_j, and do the same analysis for x_j (estimation using the observations in the window around x_j). Thus, the estimation is carried out for each value of x using overlapping sliding windows, from which we obtain estimates equal to the number of observations (as long as we have dense observations around each x).

Consistent with expectations, we find that subsidiaries in the Cayman Islands, United Arab Emirates, Bermuda, and Oman engage in more aggressive profit shifting, especially in the initial years of our sample, while Bosnia and Herzegovina and Montenegro emerge as important profit shifting jurisdictions in the last few years of our sample. Among the developed economies, profit shifting in Ireland is the most prominent when considering the top 5 percent of profit shifting firms. In total, we find that subsidiaries shift approximately 160 billion USD globally during the period 2009-2017.

Concerning the time variation of profit shifting, we observe a gradual decline, consistent with the BEPS initiative and the emergence of more stringent policies. This especially holds for firms in the mining industries, which are among the most aggressive profit shifters. However, we also observe that the decreasing trend reverses after 2013 for firms across industries with the highest intangibles ratios, particularly firms in the education, financial, and information and communications technology sectors.

We next delve deeper into the drivers of profit shifting and find that intangible assets is a key determinant (e.g., Grubert, 2003; Grubert, 2012; Cheng et al., 2021). Unlike tangible fixed assets, intangible assets are not physical in nature, making it straightforward to locate them abroad in foreign subsidiaries. Our empirical analysis shows that a one standard deviation increase in the ratio of intangible assets to total assets increases profit shifting by approximately

3 percent. This makes the intangibles ratio the firm–year characteristic with the largest impact on profit shifting (per standard deviation of change in the characteristic). To identify a causal effect, we exploit (i) corporate events (mainly M&As) that substantially affect the MNEs' intangibles ratio, and (ii) corporate tax increases in specific states in the US where the MNEs are headquartered (unrelated to the corporate tax rates used to construct the subsidiary–year profit shifting indices). The results from these two empirical tests show that the effect of the intangibles ratio on profit shifting is substantially higher in years with such corporate events or in the year–state pairs with tax increases (for the former, the marginal effect is 4.4 percent; for the latter it increases to 9 percent).

Moreover, consistent with our hypotheses on the heterogenous effect of firms' intangibility on profit shifting, we find a weaker impact in countries with stronger institutions, especially when these are as measured by citizens' ability to participate in free elections and associations, and when the country has a "free" media (variable "Voice and accountability" from the World Governance Indicators). Our results show that a movement from an average value on the index of institutional quality to its third quartile indicating higher institutional quality almost eliminates the effect of firms' intangibility on profit shifting.

Our empirical analysis also uncovers some very interesting correlates of profit shifting. From a finance perspective, we find more profit shifting in countries with riskier banking sectors (as measured by the Z-score or earnings volatility). We also find an important independent role of institutions, consistent with previous literature on the issue (e.g., Sugathan and George, 2015). Lastly, we use our new measure as a determinant of firm-year outcomes and find significant correlations with firms' capital structure and liquidity decisions. We leave identifying causal effects between profit shifting and relevant firm and country characteristics for future research.

The main contribution of our paper is to develop a new method to estimate profit shifting at the subsidiary–year level. In this way, our paper relates most closely and builds on the influential papers by Hines and Rice (1994), Huizinga and Laeven (2008), and Dharmapala and Riedel (2013). These methods have been applied in many studies to estimate profit shifting around the world using firm data. While these papers introduced methods to estimate profit shifting at more aggregate levels, our paper is the first to present a method to estimate profit shifting at the subsidiary–year level. The resulting increase in granularity enhances identification and allows to simultaneously study profit shifting dynamics within firms and across time.[3]

Besides the studies estimating profit shifting, our paper also relates to a substantial empirical literature in economics and accounting that has focused on understanding the potential sources of profit shifting.[4] The majority of these studies infer the determinants of profit shifting from models of interaction terms between the tax incentives variable and the determinant (for a helpful overview, see Dharmapala, 2014). Our finding that intangibles are a key determinant of profit shifting builds on existing studies that have focused on the role of intangibles. Karkinsky and Riedel (2012) show that MNEs have incentives to locate their patents, especially those with opaque royalty payments, in low-tax affiliates to minimize the corporate tax burden. Beer and Loeprick (2015) use the tax differential between parents and subsidiaries and show that both the intangible asset endowment of subsidiaries and the supply-chain complexity of MNEs explain aggregate profit shifting trends. De Simone, Klassen, and Seidman (2022) develop a firm–year profit shifting score for US MNEs and also find that

[3] In contrast to estimating profit shifting using firm data, a recent paper by Tørsløv, Wier, and Zucman (2018) estimates profit shifting using country-level macro data. They estimate that close to 40 percent of multinationals' profits are shifted to tax havens globally.

[4] A non-exhaustive list includes Klassen et al. (1993), Overesch (2009), Dharmapala (2014), Sugathan and George (2015), Dyreng and Markle (2016), Clausing (2016), Markle (2016), Tørsløv et al. (2018), Koethenbuerger et al. (2019), Guvenen et al. (2019), and Joshi (2020).

intangible assets and intellectual property are one of the factors facilitating income shifting. We contribute to this literature by estimating profit shifting at the subsidiary–year level.

Finally, our paper also builds on studies of general responses of multinationals to international taxation, ranging from location decisions to capital structure choices (e.g., Desai, Foley, and Hines, 2004, 2006; Huizinga, Laeven, and Nicodème, 2008; Dharmapala, Foley, and Forbes, 2011; Barrios et al. 2012; Hasan et al. 2014).

The paper continues as follows. Section 2 discusses the empirical model used to identify profit shifting and its nonparametric estimation. Section 3 presents the estimates on the global profit shifting database. Section 4 uses our measure as either an outcome or an explanatory variable to infer correlates of profit shifting. Among these correlates, we emphasize the causal effect of intangible assets on profit shifting. Section 5 concludes and provides directions for future research.

2. Modelling profit shifting

2.1. Empirical model

The original model for identifying profit shifting was constructed by Hines and Rice (1994). At the core of their model is that the observed pre-tax income of an MNE's subsidiary that is located in a low-tax jurisdiction represents the sum of "true" and of "shifted" income (where the latter can be either positive or negative). A subsidiary's true income originates from production, which is approximated by a typical Cobb–Douglas production function including capital and labor as inputs. Shifted income is driven by the tax incentive to move income in or out of the subsidiary, in consideration of the differential tax rate between the parent's and the subsidiary's countries.

Huizinga and Laeven (2008) extend this tax motive by allowing for tax-rate differentials across countries of all subsidiaries of the same MNE. Profit reported by a low-tax subsidiary

that cannot be accounted for subsidiary's own labor and capital is attributed to profit shifting. Moreover, Huizinga and Laeven exploit panel data techniques to control for unobservable time-invariant determinants of corporate profits.

The empirical model is the following:

$$log\,\pi_{it} = a_1 CT_{it} + a_2\, log\, K_{it} + a_3 log L_{it} + \gamma\, C_{it} + \mu_i + \delta_t + \varepsilon_{it}. \quad (1)$$

In equation 1, π_{it} represents the observed pre-tax income of subsidiary *i* in year *t*; K_{it} represents the subsidiary's capital (measured by fixed tangible assets); L_{it} is labor (measured by employment compensation); C_{it} is a vector of subsidiary-level controls; μ_i represents subsidiary fixed effects (which control for time-invariant unobserved characteristics of subsidiary *i*); δ_t represents year fixed effects (which control for time-varying unobserved common changes in the profitability of all subsidiaries); and ε_{it} is the error term. Using natural logarithms excludes subsidiaries with negative profits.[5]

The tax incentive variable CT_{it} is defined as:

$$CT_{it} = \frac{1}{(1-\tau_i)} \frac{\sum_{k\neq i}^{n} (\frac{B_k}{1-\tau_k})(\tau_i - \tau_k)}{\sum_{k=1}^{n} (\frac{B_k}{1-\tau_k})}, \quad (2)$$

where τ_i is the statutory tax rate of the subsidiary's country; τ_k the statutory tax rates of all the affiliated subsidiaries' countries; and B_k are subsidiaries' sales (or assets in the case where sales data are too distorted by profit shifting), used to proxy for an MNE's scale of activities in different locales.

Changes in the tax rate differential between subsidiary *i* and other subsidiaries of the same MNE are typically generated by tax reforms in either subsidiary *i*'s country or in the countries of the MNE's other subsidiaries. Thus, they are unlikely to be attributed directly to the subsidiary's own behavior or choices. The related literature distinguishes between effective and statutory tax rates when calculating the tax rate differential CT_{it}. Several tax deductions

[5] Excluding loss-making subsidiaries may obscure the profit shifting that occurs when real losses exceed the shifted income from affiliates (De Simone et al., 2017).

offered by different national tax systems tend to differentiate effective tax rates from statutory ones. Given that effective tax rates relate to endogenous corporate choices (e.g., use of depreciation, amortization, debt, or other deductible expenses), we prefer statutory tax rates. Moreover, MNEs shift profits among affiliates across countries in which they already operate. Thus, they exploit tax allowances, which depend on differences in the statutory (and not the effective) tax rate (Deveraux and Mafini, 2007; Huizinga and Laeven, 2008).

The coefficient of main interest in equation 1, a_1, reflects the extent to which the MNEs' subsidiaries shift profits into or out of subsidiary *i* due to a marginal change in tax rates, ceteris paribus. A negative a_1 in equation 1 implies that an increase (decrease) in τ_i leads to an increase (decrease) in CT_{it}, which leads subsidiaries to send more profit abroad (receive more profit from abroad) and thus reduces (increases) π_{it}, the pre-tax income of subsidiary *i* in year *t*.

To further clarify, consider the example in Figure 1. Affiliate 1 shifts profits to its low-tax subsidiaries of the same MNE (IP Holdco and the Service Centre). In the estimation approach, a change in the tax rate differential CT_{it} between Affiliate 1 and the other subsidiaries of the same MNE via an increase in Germany's statutory tax rate leads Affiliate 1 to send more profit abroad and thus reduces its *Subsidiaries' earnings before taxes* (π_{it}). This response is captured by $a_1 < 0$. Related to this example, but also more generally, our model captures profit shifting between subsidiaries. It does not capture profit shifting from parent to subsidiaries. This is a limitation driven by data availability because unconsolidated data on parent firms are not available.

[Please insert Figure 1 about here]

Note that the coefficient a_1 is an aggregate estimate (given that it is a point estimate) and thus does not have cross-sectional (subsidiary) or temporal (year) variation. This coefficient simply provides an average estimate of profit shifting for a given sample of firms (for which the coefficients in equation 1 are estimated).

Previous studies aiming to examine determinants of profit shifting, augment equation (1) with an interaction term between *CT* and the determinant of interest (say *Z*). The coefficient on the interaction term suggests on average how much subsidiaries profits increase or decrease for every change in *CT* at every one of the infinite values of Z, thus indirectly inferring the effect of *Z* on profit shifting (by affecting the slope a_1). We highlight in the introduction three key reasons reflecting why a subsidiary-year variable is needed besides this approach (to allow direct subsidiary-year inferences and alleviating endogeneity concerns), and additionally note that having an explicit variable allows using profit shifting as an explanatory variable in simple empirical models (with some adjustment for measurement error).

2.2. Estimation of profit shifting by subsidiary–year

To estimate profit shifting by subsidiary–year, we estimate subsidiary–year responses $a_{1,it}$ in equation 1. We do so by using nonparametric models, also called varying coefficient models because they allow coefficients to vary by observation (for an introduction, see, e.g., Loader (1999)). These models do not require the specification of functional forms for the estimation; the data itself informs the resulting model.

For example, ordinary least squares (OLS) estimate the unknown parameters in a regression equation between an outcome variable *y* and a predictor variable *x*. In graphical form, OLS estimation fits a regression line with a unique slope through the full sample (i.e., globally). In equation 1, this naturally implies constant estimates for a_1. In contrast, the nonparametric models make no assumption that the slope is the same for the full sample, but rather that the slope has a locally specific value around each observation. Although nonparametric regression is a way of obtaining varying estimates that are robust to functional form misspecification, this robustness comes at a cost. We need many observations and more time to compute the estimates; this is referred to as the curse of dimensionality. However, given the large number

of available observations on subsidiaries, the curse of dimensionality is not a problem in our study.

In general form, the regression model of outcome *y* is:

$$y_i = v_i\beta + g(x_i) + \varepsilon_i. \quad (3)$$

The $v_i\beta$ part is the usual parametric regression for explanatory variables *v*, the function g is unknown (obtains its shape from the data), x_i equals CT_{it} in equation 1, and ε is the error term. We estimate equation 3 using nonparametric kernel regression, which estimates a regression for a subset of observations for each point in our data (Fan and Gijbels, 1996).

To clarify, let us provide an example with the help of a graph (Figure 2) that plots the observations for a sample in the *y*-*x* space. Now, consider estimating the mean of *y* given that *x* = A when *x* is continuous and A is a value observed for *x*. Because *x* is continuous, the probability of any observed value being exactly equal to A is 0. Therefore, we cannot compute an average for the values of *y* for which *x* is equal to a given value A. We use the average of *y* for the observations in which *x* is close to A to estimate the mean of *y* given that *x* = A. Specifically, we use the observations for which $|x - A| < h$, where *h* is small. The parameter *h* is the bandwidth. In a nonparametric kernel regression, a bandwidth determines the amount of information we use to estimate the conditional mean at each point A. The circles in Figure 2 delimit the values of *x* around A for which we are computing the mean of *y*. The square is our estimate of the conditional mean using the observations inside the first circle. Then we move to the next observation. To avoid complicating the figure by taking the observation closest to A, we focus on another observation we label B. The estimation is carried out again for the observations in the window around B.

[Please insert Figure 2 about here]

Doing this estimation for each point in our data produces a nonparametric estimate of the mean for a given value of the covariates. This process is repeated several times for each of

the observations (fitting points) in this example, each time solving the minimization problem for the nonparametric part, given by:

$$\sum_{i=1}^{n} W\left(\frac{x_i - x}{h}\right)\left(y_i - \left(a_0 + a_{1,i}(x_i - x)\right)\right)^2. \quad (4)$$

The constant a_0 in equation 4 is the conditional mean at a specified point *x*. The slope parameter $a_{1,i}$ is the derivative of the mean function with respect to *x*. The size of the bandwidth, *h*, determines the shape and smoothness of the estimated conditional mean function because the bandwidth defines how many observations around each point are used. A too-large bandwidth includes too many observations, so the estimate is biased but it has a low variance. A too-small bandwidth includes too few observations, so the estimate has little bias, but the variance is large. In other words, the optimal bandwidth trades off bias and variance. Many alternatives have been proposed for the derivation of the optimal bandwidth (e.g., Greene, 2018; Li and Racine, 2004), and we choose the one that minimizes the integrated mean squared error of the prediction (cross-validation method). We find that our results are not overly sensitive to the bandwidth that is employed (unless the choice we make is far from the one chosen by cross validation). *W* is the kernel function that assigns weights to observations x_i based on how much they differ from *x* and based on the bandwidth, *h*. The smaller *h* is, the larger the weight assigned to points between x_i and *x*.[6]

Estimation of equation 1 using this method yields estimates of profit shifting $a_{1,it}$ with a panel (subsidiary-year) dimension that have both a cross-sectional (subsidiary) and temporal (year) variation (from this point onward referred to as *Profit shifting*).

3. Global estimates of profit shifting

3.1. Data and variables

[6] We use an Epanechnikov weight; results are robust to using other weight functions (e.g., Gaussian weights). As we show later, results are also robust to using spline-based nonparametric estimation instead of kernel-based.

We provide the full step-by-step details of our data collection and management process in the appendix. We use an initial firm–year panel of 58,805 subsidiaries and 4,758 parents from across 110 countries, for the period 2009–17. The total number of subsidiary–year observations is 375,958 and all monetary variables are expressed in US dollars (USD). We list the countries and the country-specific observations in appendix Table A1.

Our main data source is Orbis, which has worldwide coverage of firm–year accounting data as well as detailed information on firms' ownership structure.[7] We measure π_{it} in equation 1 using subsidiaries' observed earnings before taxes in logs (*Subsidiaries' earnings before taxes*). We further use *Subsidiaries' assets* (B_k) in equation 2. For the calculations in equation 2, we use the statutory tax rate of the subsidiary's country (τ_i) and the statutory tax rates of all the affiliated subsidiaries' countries (τ_k). We obtain these tax rates from Ernst &Young's Worldwide Corporate Tax Guides.[8] Explicit definitions of all variables and data sources can be found in Table 1 and the summary statistics are in Table 2.

[Please insert Tables 1 and 2 about here]

As discussed above, for the estimation of tax incentive *Profit shifting*, we expect a negative effect of CT_{it} on *Subsidiaries' earnings before taxes* (π_{it})—that is, the estimates of $a_{1,it}$ are expected to be negative in equation 1. This is the case for 106,301 observations, corresponding to 26,593 subsidiaries across 95 countries. We end up with this number of observations because the other responses are positive, which implies that we are dealing with subsidiaries that do not send profits abroad (receive profits from abroad) when tax rates in the host country increase (decrease). Thus, for these observations there is no tax-motivated profit shifting (Dharmapala and Riedel, 2013; Huizinga and Laeven, 2008). Further, we drop all the

[7] Orbis data has the drawback that firms' ownership structure is only available for the last reported date. There may therefore be some concerns about misclassification bias as the ownership structure may have been modified during the sample period. Nevertheless, in consonance with previous papers, this would downward bias our estimates, so that if anything the identified profit shifting will be less potent (Budd et al., 2005).
[8] https://www.ey.com/gl/en/services/tax/worldwide-corporate-tax-guide---country-list.

missing observations of the composite tax variable CT_{it}. Such is the case for all the subsidiaries of our sample that do not have affiliated subsidiaries in the same multinational group.

Estimating profit shifting at the subsidiary level is not free of limitations (Tørsløv et al., 2018). Importantly, even though Orbis provides accurate information about the global consolidated profits of most of the world's multinationals (Cobham and Loretz, 2014), multinational companies are generally not required to publish their profits country by country (or subsidiary by subsidiary). Tørsløv et al. (2018) give the example of Apple, which reports large profits (billions) at the consolidated level even though summing the subsidiary profits yields a just few millions. This discrepancy arises because Orbis has limited coverage for some countries. To address this limitation of the data, we compare our baseline results with those of a robustness test in which we also control for differences between profits at the consolidated level and the aggregated profits of subsidiaries; the resulting profit shifting index (*Profit shifting 2*) does not vary significantly from our first index (*Profit shifting*). Importantly, we examine the correlation between MNEs' consolidated assets and the sum of the assets of subsidiaries in the same MNE group. The two variables have a very high correlation coefficient of 86 percent.

Our main explanatory variable of interest, the *Subsidiary's intangibles ratio*, is defined as the ratio of intangible assets over total assets. Intangible assets include goodwill, brand recognition, and intellectual property, such as patents, royalties and licenses, trademarks, and copyrights. We focus on the information on the book value of all intangible assets. We do not have information on the breakdown across different categories of intangible assets. As profit shifting incentives may vary across different types of intangible assets, if anything our estimates of the sensitivity of profit shifting to intangible assets can be regarded as a lower bound. There is much variation in the data in the *Subsidiary's intangibles ratio*. On average, intangible assets constitute 5 percent of total assets, but this varies from a low of 0 percent to a high of 99 percent, with a standard deviation of 11 percent (Table 2).

3.2. Profit shifting estimates

In the first specification of Table 3, we estimate a standard OLS regression to compare our results with those of Huizinga and Laeven (2008). The second specification reports mean coefficient estimates (mean of $a_{1,it}$) and standard errors from the estimation of equation 1, given the assumptions about the model type, the method for bandwidth selection, and observation density. We only retain the negative observations (the ones theoretically suggesting tax motivation as in our discussion of equation 1). At the lower end of each column, we also report the total of observations (the total number of observations we use in the regressions).

[Please insert Table 3 about here]

In our baseline specification (specification 2), we estimate a semi-parametric model with an Epanechnikov kernel and cross validation for optimal bandwidth selection. In line with our expectations, the composite tax variable CT_{it} is negative and statistically significant at the 1 percent level, showing that subsidiary earnings are negatively related to a weighted average of international tax rate differences between this country and all other countries in which the multinational is active. The mean estimates reported in column 2 closely resemble the estimate of column 1, validating our profit-shifting estimates against the average estimate of the standard Huizinga and Laeven (2008) model.

In addition to reporting summary statistics for the variables used in our analysis, Table 2 also reports the summary statistics of *Profit shifting*. We multiply *Profit shifting* by -1 so that higher values reflect more aggressive profit shifting. The results show substantial heterogeneity across the firms in our sample. Concerning *Profit shifting*, we report an average of 1.46 and a range between 0 and 36.40.

We consider the estimated values to be indices that track firms' profit shifting in a standardized way (i.e., estimates of the responses of pre-tax profits to the composite tax

variables CT_{it}). The variable CT_{it}, however, is not a direct tax policy variable. Thus, it is useful to see what our profit-shifting indices imply about the responses of reported pre-tax profits to actual tax rates. We first estimate how profit shifting by each subsidiary is affected by the tax policy change. We follow Huizinga and Laeven's (2008) discussion on semi-elasticities of pre-tax profits to tax rate changes, and give a monetary interpretation, such as a dollar value, to our profit-shifting indices. We estimate the average semi-elasticity of reported profits with respect to tax rates to be 1.52.[9] Based on our average semi-elasticity we find that a one standard deviation increase in tax rates (in our sample 0.06) results in a 9 percent decrease in subsidiaries' profits due to profit shifting. Total subsidiaries' profits in our sample add to 1.76 trillion USD, so in total we find that subsidiaries shift approximately 160 billion USD during the period 2009-2017.

3.3. Country and time variation of profit shifting

In Table A2 of the appendix, we report average profit shifting estimates by country–year using *Profit shifting*. The index ranges from 0.12 in Hong Kong in 2012 to 14.61 in Oman in 2012. Notably, we find that subsidiaries in the Cayman Islands, United Arab Emirates, Bermuda, Oman, and some Balkan countries (Bosnia and Herzegovina, Montenegro, and Bulgaria) engage in more aggressive profit shifting. These countries were often singled out as notable tax havens during our sample period, hence the fact they obtain higher estimated values validates our index.[10] Specifically, the OECD's April 2009 progress report identifies jurisdictions under the heading "Jurisdictions that have committed to the internationally agreed tax standard, but have not yet substantially implemented." The Cayman Islands and Bermuda are categorized as tax havens. While the United Arab Emirates is listed in the OECD's April 2009 report as

[9] Huizinga and Laeven (2008) estimate it to be 1.43, whereas Dowd et al. (2017) find an average semi-elasticity of reported profit of 1.4.

[10] The EU removed the Cayman Islands and Oman from its "non-cooperative jurisdictions for tax purposes" list in 2020 after these countries implemented several reforms to improve their tax-policy frameworks.

"substantially implementing the internationally agreed tax standard," subsequent reviews (from 2011 onward) identify significant deficiencies in its legal and regulatory framework. Bulgaria is widely considered a European offshore jurisdiction, while Montenegro and Bosnia are appealing to many entrepreneurs and businesses because of their low corporate tax rates.[11] Other countries on these lists also display notable profit shifting in our index.

To illustrate differences between countries' levels of in-country profit shifting, we also report the standard deviation of *Profit shifting* for each country. We find that subsidiaries in the United Arab Emirates, Bermuda, Oman, and Montenegro—which lead the way in terms of aggressive profit shifting behavior—also report the largest in-country variation in profit shifting.

To illustrate the international picture, we construct a global map for *Profit shifting* (Map 1). For expositional brevity, we map a ranking of countries (as opposed to the mean profit shifting values), which creates a clearer differentiation. The countries with high profit shifting have a dark, purple color and those with low profit shifting a light, green color. The map shows that subsidiaries in Bulgaria, the United Arab Emirates, Bosnia and Herzegovina, Fiji, and Oman are engaged in more aggressive profit shifting. The Cayman Islands, Bermuda, and the Isle of Man also have most profit shifting but are not visible on the map due to their small size.

[Please insert Map 1 about here]

In Table A3 of the appendix, we report average estimates of *Profit shifting* by country using only the most aggressive profit shifting subsidiaries (top 5 percent). These firms shift profit to 61 countries. Repeatedly, we find that subsidiaries in the Cayman Islands, United Arab Emirates, Bermuda, Oman, and some Balkan countries (Bosnia and Herzegovina, Montenegro, North Macedonia, and Bulgaria) are engaged in more aggressive profit shifting. A notable

[11] See the Study entitled "*European initiatives on eliminating tax havens and offshore financial transactions*" by the *Policy Department Budgetary Affairs of the Directorate-General for Internal Policies of the Union (European Parliament)* which was published in 2013.

addition is Ireland, which is the only high-income country in this group.[12] This is in line with anecdotal evidence that very aggressive profit shifters favor Ireland due to its low corporate tax rate but also its stable institutions and high level of economic development. To better visualize these results, we construct a second global map for *Profit shifting* (Map 2) for these 61 countries. Once again, we map a ranking of countries as opposed to the mean profit shifting values. The countries with high profit shifting have a dark, purple color and those with low profit shifting a light, green color. This map clearly demonstrates the tax haven status of Ireland, along with that of the other usual suspects. The Cayman Islands and Bermuda also have a high level of profit shifting but are not visible on the map due to their small size.

[Please insert Map 2 about here]

Profit shifting varies considerably not only across countries and geographical areas but also across different sectors, and this has important welfare and policy implications. Sectors with more profit shifting lower their average cost of capital and are thus able to attract more investment, potentially overperforming compared to sectors less able to dodge taxes. To the extent that multinationals compete over market share and input factors, this heterogeneity translates into profit shifting acting as a subsidy to specific industries.

In Table A4 of the appendix, we report the average values of *Profit shifting* by industry.[13] The results show that mining and quarrying firms engage aggressively in profit shifting activities. These firms are engaged in the mining of coal and lignite, the extraction of crude petroleum and natural gas, the mining of metal ores, and other mining and quarrying activities. The mining industry has two specific characteristics that favor profit shifting. First, it has many foreign-owned companies because reserves (fossil fuel and other reserves) and

[12] This finding concurs with Tørsløv et al. (2018), who designate Ireland as the number one profit shifting destination among a group of mostly developed countries for the year 2015. Following the June 2021 agreement among G7 finance ministers, Ireland has come out reluctantly in favor of a global minimum corporate tax rate of at least 15 percent.

[13] Average values of our profit shifting index by industry-year are available on request.

refineries are usually in different locations than the parent. Second, in most major mining countries firms are not obliged to disclose the financial accounts of their subsidiaries. In Figure 3, we compare the trend of *Profit shifting* for subsidiaries in the mining sector with the trend for subsidiaries in industries with the highest intangibles ratios. The trend for the mining sector is generally negative, but we observe a trend reversal for firms across industries with the highest intangibles ratios after 2013.

[Please insert Figure 3 about here]

In Figure 4, we show the annual average of *Profit shifting*, as well as equivalent regional averages. The trend for the full sample is negative from 2011 onward, but this is only driven by Western European and other developed countries, possibly reflecting the increased stringency of taxation policies in these countries (Buettner et al., 2018) and the introduction of the OECD's Base Erosion and Profit Shifting (BEPS) initiative in 2013.[14] In contrast, profit shifting increases in Eastern European/central Asian countries as well as in East Asian and Pacific countries. Figure 5 shows the cross-sectional (subsidiary) variation of our profit-shifting measure during 2009-2017. Evidently, subsidiaries differ substantially in their profit-shifting behavior in the early years of our sample, especially in 2011 and 2012. In contrast, the variation decreases toward the end of our panel.

[Please insert Figures 4 & 5 about here]

3.4. Additional robustness tests

We examine several different indices—based on different assumptions when estimating the nonparametric regressions. Specifically, we use a Gaussian kernel (instead of the Epanechnikov), and we select the bandwidth using the Akaike information criterion (AIC) (instead of cross validation). Using different methods to select the optimal bandwidth, or

[14] See OECD (2013).

different kernel functions, provides very similar indices (very high correlations with our baseline indices). We also experiment with different splines and with different assumptions within the spline-based methods. Finally, we experiment with computationally more involved, fully nonparametric methods (all explanatory variables enter the regression nonparametrically); we do not favor a fully nonparametric model only because it adds considerable estimation time without a gain in our inferences. In general, all of the above robustness tests yield very similar inferences.

4. Intangible assets and profit shifting

4.1. Empirical model and data

Given the subsidiary–year estimates of profit shifting (*Profit shifting*), in this section we empirically establish that intangible assets are a key determinant. We estimate the following equation:

$$Profit\ shifting_{it} = b' + b_1 Subsidiaries'\ intangible\ ratio_{it} + b_2 C_{ct} + b_3 F_{it} + \varepsilon_{ict}, \quad (5)$$

where *Profit shifting* is as estimated in the previous section; *Subsidiaries' intangibles ratio* is the ratio of intangible assets to total assets; C and F are sets of country and firm controls, respectively; and ε is the stochastic disturbance. Our focus is on coefficient b_1, which captures the effect of intangible assets on subsidiaries' profit shifting.

Table 1 thoroughly defines all variables used in equation 5 and Table 2 provides summary statistics. Concerning the country–year controls, *C*, we include in our baseline specifications a country's *GDP growth*, *Population*. We subsequently include additional country control capturing the country's level of institutional and economic development, obtained from the QOG data set of Teorell et al. (2021).

Further, following the literature (e.g., Huizinga and Laeven, 2008; Dharmapala and

Riedel, 2013), the vector F includes controls for firm size measured by the log of total assets, leverage (the ratio of total liabilities to total assets), and cost of employees (the ratio of subsidiaries' cost of employees to subsidiaries' earnings before taxes). Again, we use several additional firm–year controls (obtained from Orbis), which we find to have a residual role in explaining profit shifting and do not affect the estimate on b_1.

Moreover, the vector b' indicates subsidiary, year, and (in some specifications) country–year fixed effects. The subsidiary fixed effects control for time-invariant subsidiary characteristics (e.g., corporate culture, corporate governance, production technology, industry characteristics, and time-varying country characteristics). The year and country–year fixed effects control for unobserved annual or annually varying country unobserved shocks (e.g., crises, country-specific policies, etc.).

The subsidiaries' intangibles ratio has a relatively low average value of 0.05, but also has a maximum value of almost 1. As shown in Table A5 of the appendix, the ratio varies considerably by industry. As expected, we observe that firms in services—such as education, water supply and waste management, financial and insurance activities, information and communication technologies, and the arts, entertainment, and recreation—invest more in intangible assets.[15]

In Figure 6, we show the time trend in the annual averages of *Subsidiaries' intangibles ratio* and *Subsidiaries' intangibles ratio 1*. *Subsidiaries' intangibles ratio 1* includes the annual average for only the first six industries in Table A5 of the appendix (those with the highest average values of *Subsidiaries' intangibles ratio* by industry). For *Subsidiaries' intangibles ratio* the trend is negative, with the only exception being 2011–12, when it reverses. However, the line for *Subsidiaries' intangibles ratio 1* shows that there is an upward trend in intangibles,

[15] The highest value is observed for the "Public administration and defense; compulsory social security" industry. There are only 100 observations in this industry, and, from these, five companies display high values. All these companies are non-government owned multinationals in the aerospace and intelligence industries.

driven by some sectors (mainly service industries). This relation is more explicit in Figure 7, which shows a positively sloped line from the bivariate regression between the industry averages of *Profit shifting* and *Subsidiaries' intangibles ratio*.[16] Thus, these figures provide clear visual evidence that despite an overall decreasing trend in profit shifting, firms with high levels of intangible assets conduct more profit shifting. In the next section, we aim to establish a causal effect.

[Please insert Figures 6 & 7 about here]

4.2. The effect of intangible assets on profit shifting

Table 4 reports our baseline results from the estimation of equation 5.[17] We begin in the first specification with OLS estimates with standard errors clustered by subsidiary and without including any fixed effects. In columns 2 to 3, we sequentially add subsidiary, year, and subsidiary country × year fixed effects.

[Please insert Table 4 about here]

The results show that asset intangibility is a key firm–year determinant of profit shifting. Economically, based on the results of column 3, a one standard deviation increase in *Subsidiaries' intangibles ratio* (equal to 0.11) increases profit shifting by approximately 3.1 percent (= 0.11 × 0.282). The results on the firm-specific controls are intuitive. Large firms conduct more profit shifting, consistent with the premise that large firms achieve economies of scale in tax planning (Rice, 1992; Rego, 2003).[18] Also, firms with aggressive profit shifting have a higher cost-to-earnings ratio, consistent with the premise that these firms pay higher salaries.

[16] We use the NACE two-digit numerical code.

[17] Being an estimate, profit shifting has a measurement error. Using profit shifting as the dependent variable implies that OLS estimates still satisfy the Gauss–Markov assumptions so that the coefficients on the variables are consistent (but the constant term may be biased). The measurement error in the dependent variable only results in larger error variance, which if anything produces slightly higher p-values.

[18] This is in contrast to early evidence by Zimmerman (1983) suggesting that large firms avoid tax avoidance strategies because they face greater political costs.

In columns 4 to 7, we keep the firm and year fixed effects and sequentially include country–year controls that the literature has proposed as being potentially important determinants of profit shifting (definitions in Table 1 and summary statistics in Table 2). This analysis serves as a validation of our profit shifting index, but also informs the subsequent analysis on potential heterogeneity in the effect of intangible assets on profit shifting due to specific country–year characteristics. We find more profit shifting in countries with higher growth rates and worse institutions, as measured by *Voice and accountability*, *Democratic conditions*, and *Government integrity*. These results are consistent with Sugathan and George (2015), who analyze how freedom of expression, governmental effectiveness, and political stability affect income shifting. Specifically, in high-tax countries, institutions dissuading and limiting negative externalities of business activities are likely to increase the costs of shifting transactions and thus reduce profit shifting. We also find that the effect of the intangibles ratio is not affected by the addition of these variables.

In columns 8 and 9, we report equivalent estimates using the *Bank Z-score* to measure financial soundness. We find that this measure is amongst the most important conditional correlates of profit shifting, with profit shifting being higher in relatively risky banking systems. As the Z-score is the ratio of equity capital plus ROA over the standard deviation of ROA, in untabulated regressions we also use separately the equity capital ratio and ROA. We find a negative and significant coefficient on bank capitalization but with a much smaller statistical significance compared to the *Bank Z-score*. The coefficient on bank profitability is insignificant. Thus, we attribute most of the impact of *Bank Z-score* on profit shifting on the volatility of ROA.

This is a very interesting result, with three potential implications. First, debt shifting, a key source of profit shifting, comes from banks in the subsidiary countries. As debt shifting can be more volatile than other sources of debt directed to productive purposes (e.g., credit lines

and terms loans), the banks' revenues are also more volatile in tax heavens. Second, profit-shifting firms might establish themselves in countries with banks with less regulatory supervision and laxer regulations that are willing to hold less capital and give riskier loans (including loans for debt shifting). Third, banks in tax heavens might also do more profit shifting themselves, again yielding a more volatile revenue base for these banks. The fact that the significance of *Bank Z-score* disappears in column 10, where we do not include a subsidiary fixed effect, denotes the importance of the temporal variation in profit shifting in identifying its sources. Overall, the relation between finance and profit shifting is a very fruitful avenue for future research.

In column 10, we include a dummy variable for the mining industry (and thus we must drop the subsidiary fixed effect). We find that mining and quarrying firms engage in more profit shifting than the average firm in other industries. This finding is consistent with the industry-specific summary statistics reported in Table A4. This is also consistent with the nature of the mining industry, in which MNEs have subsidiaries in many locations where they also have reserves. This finding is also interesting for future research to establish the links between profit shifting and economic sustainability.

We provide additional robustness tests in the appendix. Specifically, in Table A6 we use *Profit shifting 2* as the dependent variable and find results very similar to those of Table 4. Thus, we infer that controlling, in the estimation of profit shifting, for the difference between profits at the consolidated level and the aggregated profits of subsidiaries does not significantly affect our results. We also obtain similar results when using profit shifting estimates from models with different bandwidths, splines, or fully nonparametric methods. Moreover, in Table A7, we cluster standard errors by subsidiary country, industry, or subsidiary country and year. Our inferences are again very similar.

As noted in section 2, an alternative modelling approach to identify the role of firm-year

variables in profit shifting would be a variant of equation 1 that includes the interaction term between *CT* and that variable. We use the *Subsidiaries' intangible ratio* as that variable because this is a key profit-shifting determinant. Appendix Table A8 reports the results, showing that the interaction term is positive and statistically significant at the 5 percent level across different specifications that include different fixed effects or control variables. These findings are consistent with those in our analysis so far, indicating more profit sifting for firms with higher intangible assets ratios.[19]

It is also possible that small absolute values of *CT* might not provide a full scale of incentives to shift profit because profit shifting carries costly risks related to reputational and regulatory issues. If this were the case, then we would expect that the relation between intangible assets and profit shifting is stronger for larger values of *CT*. In Table A9, we show that omitting the smallest 5 percent (column 1) or 10 percent (column 2) of the *CT* values, indeed increases the economic impact of intangible assets on profit shifting compared to our baseline specifications (in column 2 this increase is large as 13 percent). This holds linearly across higher values of *CT*, as is evident from the relevant marginal effects.

4.3. Inference from instrumental variables and events

In this section, our aim is to strengthen our causal inferences on the variable that appears as the key determinant of profit shifting, the *Subsidiaries' intangibles ratio*, and in doing so further validate our measure. Thus, our analysis offers an intuitive solution to identification problems raised in section 2. We use two alternative identification approaches and report the results in Table 5.

In the first specification, we estimate a two-stage least squares (2SLS) regression, using *Industry cost* as the instrument, defined as the industry-year median of the cost of employees

[19] As also noted in Section 2, inferring a causal effect from such models is more cumbersome. Endogeneity effects might arise from observed firm-year variables not interacted with CT, unobserved firm-year variables, etc.

scaled by total assets. This instrument is directly obtained from the literature (Garmaise, 2008; Campello and Giambona, 2013). The relevance assumption for the validity of the instrumental variable (IV) suggests that industries with higher labor costs also have higher intangible assets levels due to the personnel expertise needed to handle intangible assets (e.g., handling research and development as opposed to handling physical capital). The exclusion restriction states that *Industry cost* affects profit shifting only via *Subsidiaries' intangibles ratio* (Campello and Giambona, 2013). This assumption is intuitive, especially because any direct effects of industry-specific labor costs should be controlled for by the firm-specific *Subsidiaries' cost ratio*, leaving the industry effects to be exogenous shocks correlated to asset tangibility.

[Please insert Table 5 about here]

The first-stage results include a highly significant coefficient on *Industry cost*, associated with weak-identification and under-identification tests with very small p-values. The second-stage results still show a positive and statistically significant coefficient on *Subsidiaries' intangibles ratio*. Both the estimate and the standard error are higher, pointing to some bias associated with the IV model. Given the strong identification tests, this bias is most probably due to observations of the endogenous variable being at the firm–year level while observations of the instrument are at the industry-year level.

In column 2, we exploit important corporate events to infer the effect of the intangibles ratio on profit shifting. These events, mostly vertical M&As, produce abrupt changes in intangible assets and create an experiment from which we can infer causal inference for the effect of intangible assets on profit shifting. Using such events would be invalid if the corporate events are endogenous to profit shifting (i.e., MNEs acquire firms to expand their profit shifting network). However, we have two reasons to believe that such concerns are unwarranted. First, using vertical M&As limits this possibility because vertical M&As, in contrast to horizontal M&As, take place between companies in different industries and at different stages of

production, making it less straightforward to shift profits. Moreover, when we model the probability of observing a corporate event as a function of profit shifting and the intangible ratio (adding our controls and fixed effects), we find that profit shifting enters with a statistically insignificant coefficient (with a high p-value of 0.754). Thus, it is highly unlikely that these events occur due to profit-shifting reasons.

We use a binary variable named *Corporate events* that is equal to 1 in the firm–year observations in which these events occur. We use specifications without year fixed effects (column 2) and with year fixed effects (column 3), and we keep the controls of specification 5 of Table 4. The interaction term *Corporate events* × *Subsidiaries' intangibles ratio* is positive and statistically significant at the 1 percent level.[20] In the years of these events, the marginal effect of *Subsidiaries' intangibles ratio* equals 0.398 (= 0.223+0.175), considerably larger than the effect identified in specification 5 of Table 4 (equal to 0.295) and equal to a 4.4 percent increase in profit shifting. Thus, sharp increases in intangible assets following relevant corporate events trigger significantly higher profit shifting intensity. We maintain this identification approach based on corporate events for estimations in our subsequent analysis.

Differences in top marginal corporate tax rates across the Unites States and changes introduced by some US states in specific years also create a setting via which to study the relation between intangible assets and profit shifting. These events are suitable because they represent changes in the corporate taxes on MNEs that do not directly enter into equations 1 and 2. These equations include subsidiaries' tax rates and not the taxation of the parent company. Of particular importance are tax increases that increase the incentives of US- based parent firms to shift profit into foreign jurisdictions. We identify five such events during our sample period, in Connecticut (2009), North Carolina (2009), Illinois (2011), Connecticut

[20] Adding the interaction term *Corporate events* × *Subsidiaries' assets* to control for general firm size effects of the event does not affect our inferences. This is also the case when adding interaction terms between *Corporate events* and the rest of the firm–year controls.

(2012), and Oregon (2009). The information comes from Heider and Ljungqvist (2015) but we also cross-check for other events during the most recent years of our sample. We use a binary variable (named *State tax increases*) that is equal to 1 in the years of these events, matching the MNEs' headquarters with the states.

In specifications 4 and 5 of Table 5, the interaction term *State tax rises* × *Subsidiaries' intangibles ratio* is positive and statistically significant, showing that tax increases in the state of the parent company induce larger effects of the intangibles ratio on profit shifting. The marginal effect of the intangibles ratio when there is an increase in state corporate taxes equals a sizeable 0.802, which constitutes a 9 percent increase in profit shifting for a one standard deviation increase in the *Subsidiaries' intangibles ratio*.

Figure 8 provides an illustrative validation of our events-based analyses. Specifically, we graph the predicted values of *Profit shifting* as a function of *Subsidiaries' intangibles ratio* for each value of *Corporate events* and *State tax rises* (columns 3 and 5 of Table 5 for the two graphs, respectively). Both graphs show very similar effects of *Subsidiaries' intangibles ratio* on *Profit shifting* for low values on the *Subsidiaries' intangibles ratio*, and considerable variation for the treated and untreated observations as this ratio increases. Thus, for both the treated and untreated groups there is a positive relation between the level of intangible assets and profit shifting, but this relation is significantly stronger for the treated groups in the two graphs.

[Please insert Figure 8 about here]

4.4. The role of institutional quality in the relation between profit shifting and intangibles

In this section, we examine the role of institutional quality of the host country in the relation between intangible assets and profit shifting. To this end, we build on the model including the double interaction term *Subsidiaries' intangibles ratio* × *Corporate events* (specification 3 of

Table 5) and add triple terms with several variables reflecting institutional quality. We expect that the relation between intangible assets and profit shifting is weaker in countries with stronger institutional quality, ceteris paribus.

Column 1 of Table 6 shows that the triple term including *Voice and accountability* is negative and significant at the 1 percent level. The marginal effect of the specification with respect to *Voice and accountability* equals -0.47, at the mean value of *Subsidiaries' intangibles ratio* and setting *Corporate events* equal to 1. Most importantly, by setting the derivative of the specification with respect to *Subsidiaries' intangibles ratio* equal to zero and *Corporate events* equal to 1, we find that the positive effect of *Subsidiaries' intangibles ratio* × *Corporate events* is eliminated for values on the *Voice and accountability* index equal to 1.42 or higher. That value is a bit higher than the third quartile of the index (see summary statistics in Table 2).

[Please insert Table 6 about here]

In specifications 2 to 4 of Table 6, we return very similar results when using *Control of corruption*, *Government effectiveness*, and *Rule of law*, instead of *Voice and accountability*. We abstain from using all these variables in the same specification due to multicollinearity concerns (the correlation across these variables is at least 80 percent). We find that the effect of intangible assets is eliminated for substantially high values on all these three, institutional-quality reflecting indicators. Given that institutional development goes hand-in-hand with economic development, in the last specification of Table 6 we include the natural logarithm of GDP per capita in the triple interaction term. As in the case of institutional development, we find that the effect of asset intangibility on profit shifting is less potent in more economically developed countries. Horseracing institutional development with economic development is not possible because the institutional characteristics are more than 80 percent correlated with economic development and the results show clear signs of multicollinearity.

These findings are consistent with a large literature in institutional economics and

political science showing that tax avoidance is lower in countries with higher institutional quality (e.g., Kanagaretnam et al., 2018; Bilicka and Seidel, 2020; Olson, 2000), but these findings are novel concerning the nexus between asset tangibility and profit shifting. Our findings that this relationship is prevalent in countries with weaker institutions suggests that institutional quality and enforcement mitigate the ability of MNEs with large shares of intangible assets to shift profits for tax-related purposes.

4.5. Profit shifting as an explanatory variable of firm outcomes

Although existing literature studies some of the determinants of profit shifting with special emphasis on taxation (Dharmapala and Riedel, 2013; Weichenrieder 2009; Klassen et al., 1993), there is a dearth of evidence on how profit shifting affects important subsidiary-level characteristics, such as firms' performance and capital structure. A key advantage of our profit shifting measure is that it can be directly used as an explanatory variable of firm-year outcomes.

First, our results in the first column of Table 7 show that more profit shifting is significantly correlated with firms' capital structure decisions. Specifically, we find that higher profit shifting is positively linked to *Subsidiaries' leverage* (the basic debt to assets ratio). This finding is consistent with Huizinga et al. (2008), who show that a multinational firm's indebtedness in a country depends on a weighted average of national tax rates and differences between national and foreign tax rates.

Working capital and the *Liquidity ratio* measure a company's liquidity, operational efficiency, and short-term financial health. If a company has substantial positive working capital and liquidity, then it should have the potential to pay off current obligations without raising external capital, invest, and grow. Consistent with the results in column 1, the results in columns 2 and 3 of Table 7 link more profit shifting to lower subsidiary working capital and liquidity. These findings are fully consistent with the hypothesis that subsidiaries are present in

low-tax countries not for fully productive purposes but for profit-shifting activities and access to riskier loans. The negative coefficient on the number of employees also corroborates this view.[21]

[Please insert Table 7 about here]

5. Conclusions and directions for future research

This paper constructs the first global profit shifting database with subsidiary–year estimates of profit shifting for a maximum of 26,593 subsidiaries across 95 countries for the period 2009 to 2017. This new database shows that (i) the countries in which subsidiaries receive the largest amounts of profit shifting are the usual suspects (tax havens); (ii) the profit shifting average gradually declines after 2011, but not for firms with intangible assets, which display an increase in profit shifting after 2013.

This latter observation sets our pathway to a formal empirical analysis, which shows that the ratio of intangible assets to total assets is the most important predictor of profit shifting. Our most favored specification and rather conservative estimate shows a 4.4 percent increase in profit shifting following a one standard deviation increase in the intangible assets to total assets ratio. We also show that this effect is significantly stronger in countries with lower institutional quality. In fact, the effect of firms' intangibility on profit shifting is almost eliminated when moving from average values of institutional quality to its third quartile reflecting higher institutional quality.

These findings are only a first step to uncovering the potential of this database for analyzing profit shifting at the firm or aggregate level. The global profit shifting database and

[21] There is also little understanding of how profit shifting differs across firm size. Wier and Reynolds (2018) investigate the link between firm size and profit shifting. They estimate that firms owned by a parent in a tax haven avoid taxation on as much as 80 percent of their true income. However, this aggregate tax loss conceals large differences across firms. Most firms shift little income to tax havens, while a few large firms shift a lot. The top decile of foreign-owned firms accounts for 98 percent of the total estimated tax loss.

its updates, which we aim to provide, can be used by researchers to analyze either the factors causally affecting profit shifting or the causal effects of profit shifting on firm-specific or country-specific characteristics. We show that several aspects of institutional quality are very promising country-specific determinants of profit shifting. We also find a strong correlation between the presence of fossil fuel activity and profit shifting, which establishes a pathway to a thorough examination of the link between environmental economics and profit shifting.

Finally, we find inferior financial soundness of banks in subsidiary countries with aggressive profit shifting, which can have important implications for the role of credit (and overall corporate finance) in firms' profit shifting behavior (an issue largely unexplored in the literature). On the same line, the literature of firm-specific outcomes of profit shifting is very limited, with our preliminary results showing an important correlation with firms' capital structure and liquidity decisions. Naturally, future research might also be interested in the macroeconomic outcomes of profit shifting, especially regarding the labor market, investment, innovation, climate change, and economic growth.

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Table 1. Variable definitions and sources

Variable	Definition	Source
Profit-shifting indices		
Profit shifting	The estimates $a_{1,it}$ from the estimation of equation 1 using the semiparametric local linear regression. We use an Epanechnikov kernel and select the bandwidth with cross-validation. The control variables include *Subsidiaries' assets* and *Subsidiaries' cost of employees*.	Own estimations
Profit shifting 2	The estimates $a_{1,it}$ from the estimation of equation 1 using the semiparametric local linear regression. We use an Epanechnikov kernel and select the bandwidth with cross-validation. The control variables include *Subsidiaries' assets, Subsidiaries' cost of employees* and the differences in profits at the consolidated level with the aggregated profits of subsidiaries.	Own estimations
Dependent variables		
Subsidiaries' earnings before taxes	Subsidiary's observed earnings before taxes (log).	Orbis
Explanatory variables: Firm characteristics		
Composite tax variable	Composite tax variable that summarizes all information about subsidiaries' profit-shifting tax-incentives in year t.	Orbis, EY Tax Guide
Subsidiaries' assets	Subsidiary's total assets (log).	Orbis
Subsidiaries' cost of employees	Subsidiary's cost of employees (log).	Orbis
Subsidiaries' cost ratio	The ratio subsidiaries' cost of employees / subsidiaries' earnings before taxes.	Orbis
Subsidiaries' leverage	Subsidiary's leverage, defined as total debt/ total assets.	Orbis
Subsidiaries' intangibles ratio	Subsidiary's intangibles ratio, defined as intangible assets/ total assets. Intangible assets include goodwill, brand recognition and intellectual property, such as patents, trademarks, and copyrights. Intangible assets exist in opposition to tangible assets, which include land, vehicles, equipment, and inventory.	Orbis
Corporate events	Dummy variable equal to 1 if the MNE reports large company size increases via M&As (sometimes involving spinoffs, MBOs, and LBOs).	Thomson One Banker
Explanatory variables: Country characteristics		
Statutory tax rates	Statutory tax rate of the subsidiary's country.	EY Tax Guide
	Statutory tax rates of all the subsidiaries' countries in the same group.	EY Tax Guide
GDP per capita	GDP per capita in constant prices.	WDI
GDP growth	Annual GDP growth rate.	WDI
Population	Subsidiary country's population in logs.	WDI
State tax rises	Dummy variable equal to one if a state in the United States in which the MNE has its headquarters increased the top marginal corporate income tax rate in a specific year during the period 2009-2017. These states are Connecticut-2009, North Carolina-2009, Illinois-2011, Connecticut-2012, Oregon-2009.	Heider and Ljungqvist (2015)
Democratic conditions (Polity)	Ranges from 0 to 10, with 0 indicating no institutional democracy and 10 indicating a maximum level of institutional democracy.	Polity IV Project (2018)
Government integrity	Scale from 0 to 100, where 100 indicates very little corruption. The score for this index is derived from Transparency International's Corruption Perceptions Index (CPI), which measures the level of corruption in 183 countries.	QOG data set of Teorell et al. (2021)

Bank Z-score	Z-score (defined as the sum of capital to assets and return on assets, divided by the standard deviation of return on assets) is used to measure financial stability. It explicitly compares buffers (capitalization and returns) with the potential for risk (volatility of returns). The z-score has a direct link with the probability of default.	GFD
Voice and accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e., ranging from approximately -2.5 to 2.5.	Worldwide Governance Indicators
Government effectiveness	Combines into a single grouping response on the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies. The main focus of this index is on" inputs" required for the government to be able to produce and implement good policies and deliver public goods.	Worldwide Governance Indicators
Control of corruption	Captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	Worldwide Governance Indicators
Rule of law	Captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	Worldwide Governance Indicators

Table 2. Summary statistics of key variables

The table reports the number of observations, the mean, standard deviation, minimum, maximum, first quartile, third quartile, and median of the variables used to estimate our profit-shifting index and the variables used in our baseline OLS specification (6) in Table 4 (plus the additional variables used in Tables 4 to 6). The variables are defined in Table 1 and the sample period is 2009-2017.

	Obs.	Mean	St. Dev.	Min.	Max.	Q1	Q3	Median
Profit shifting	106,301	1.46	1.01	0	36.40	0.90	1.80	1.44
Subsidiaries' earnings before taxes	106,301	7.24	2.17	-9.63	17.58	5.87	8.63	7.25
Composite tax variable	106,301	0.03	0.08	-0.39	0.60	0	0.07	0.03
Subsidiaries' assets	106,301	9.83	2.07	-6.61	18.38	8.45	11.18	9.76
Statutory tax rates	106,301	0.27	0.06	0	0.40	0.24	0.31	0.28
Subsidiaries' cost of employees	106,301	8.21	1.85	-6.70	15.90	7.06	9.39	8.21
Profit shifting	50,182	1.43	0.86	0.00	17.68	0.91	1.77	1.43
Subsidiaries' intangibles ratio	50,182	0.05	0.11	0.00	0.99	0	0.04	0.01
Subsidiaries' assets	50,182	10.24	1.89	1.82	18.12	8.97	11.48	10.17
Subsidiaries' leverage	50,182	0.58	0.43	-0.44	58.72	0.37	0.77	0.58
Subsidiaries' cost ratio	50,182	0.00	0.02	0.00	3.46	0	0	0
GDP growth	50,074	1.37	2.01	-14.80	25.56	0.58	2.26	1.50
Population	50,074	17.27	1.08	12.94	21.02	16.23	17.99	17.89
GDP per capita	50,074	10.45	0.59	7.20	11.60	10.36	10.70	10.60
Voice and accountability	50,080	1.14	0.33	-0.71	1.74	1	1.35	1.17
Democratic conditions (Polity)	50,067	9.46	1.06	0	10	9	10	10
Government integrity	50,080	64.32	16.13	21.9	95	21.9	95	69
Bank Z-score	50,005	14.89	5.96	0.06	47.57	10.60	18.12	14.72
Government effectiveness	49,999	1.17	0.55	-0.83	2.24	0.67	1.57	1.35
Control of corruption	49,999	1.08	0.77	-1.13	2.40	0.27	1.67	1.31
Rule of law	49,999	1.18	0.60	-0.86	2.10	0.62	1.65	1.41
Corporate events	49,999	0.29	0.45	0	1	0	1	0
State tax rises	49,999	0.01	0.09	0	1	0	0	0
Profit shifting 2	49,873	1.45	0.89	0	17.50	0.92	1.78	1.44

Table 3: Estimation of profit shifting

The table reports coefficient estimates and standard errors (in parentheses) from the estimation of equation 1. Dependent variable is *Subsidiaries' earnings before taxes* and all variables are defined in Table 1. The first specification is estimated with OLS. The second specification is estimated with the semiparametric local linear regression and produces *Profit shifting*. We report White's (1980) heteroskedasticity-consistent standard errors in parentheses for specification 1. For specification (2), the standard errors are from bootstrapping. Total observations refer to the total number of observations we use in the regressions. Negative profit shifting is the number of observations for which our profit shifting estimates (the subsidiary–year coefficients on the *Composite tax variable*) are negative. The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level, respectively.

	(1) OLS estimation	(2) Profit shifting
Composite tax variable	-0.660***	-0.646***
	(0.033)	(0.030)
Subsidiaries' assets	0.763***	0.763***
	(0.003)	(0.002)
Subsidiaries' cost of employees	0.165***	0.164***
	(0.003)	(0.002)
Total observations	166,979	166,979
Negative profit shifting		106,301

Table 4. Key determinants of profit shifting

The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting*. We define all variables in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. The lower part of the table denotes the type of fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Subsidiaries' intangibles ratio	0.253***	0.299***	0.282***	0.297***	0.295***	0.299***	0.302***	0.293***	0.294***	0.215***
	(0.050)	(0.093)	(0.090)	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)	(0.051)
Subsidiaries' assets	-0.010***	0.033*	0.030*	0.032*	0.033*	0.033*	0.035*	0.033*	0.037**	-0.014***
	(0.003)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.003)
Subsidiaries' leverage	0.009	0.005	0.003	0.007	0.006	0.007	0.006	0.003	0.003	0.001
	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
Subsidiaries' cost ratio	0.050***	0.069***	0.056***	0.062***	0.063***	0.065***	0.059***	0.048***	0.043***	0.017
	(0.007)	(0.005)	(0.012)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.010)
GDP growth				0.009**	0.014***	0.013***	0.014***	0.014***	0.015***	-0.006
				(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Population				-1.261*						
				(0.706)						
Voice and accountability					-0.436***					
					(0.144)					
Democratic conditions						-0.098**			-0.095**	-0.001
						(0.046)			(0.044)	(0.016)
Government integrity							-0.009***		-0.008***	0.003***
							(0.002)		(0.002)	(0.000)
Bank Z-score								-0.020***	-0.018***	0.000
								(0.002)	(0.002)	(0.001)
Mining sector										0.146**
										(0.063)
Observations	54,531	50,218	50,182	50,074	50,080	50,067	50,080	50,005	49,992	54,299
Adjusted R-squared	0.002	0.430	0.455	0.428	0.431	0.430	0.431	0.430	0.430	0.009
Subsidiary effects	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Year effects	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sub.Country-year effects	N	N	Y	N	N	N	N	N	N	N
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary

Table 5. Evidence from instrumental variables and shocks

The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting*. We define all variables in Table 1. Estimation method is 2SLS for the first specification and OLS for the other four specifications with standard errors clustered by subsidiary. The lower part of the table denotes the type of fixed effects. All specifications include the main control variables of Table 4. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Subsidiaries' intangibles ratio	1.092**	0.244**	0.223**	0.298***	0.285***
	(0.541)	(0.095)	(0.094)	(0.094)	(0.093)
Corporate events		0.023**	-0.014		
		(0.010)	(0.011)		
Corporate events × Subsidiaries' intangibles ratio		0.162**	0.175**		
		(0.079)	(0.079)		
State tax rises				0.017	-0.003
				(0.032)	(0.033)
State tax rises × Subsidiaries' intangibles ratio				0.492**	0.517**
				(0.223)	(0.228)
First stage					
Industry cost	0.073***				
	(0.007)				
Observations	55,873	49,999	49,999	49,999	49,999
Adjusted R-squared	-	0.421	0.426	0.421	0.426
Subsidiary effects	N	Y	Y	Y	Y
Year effects	Y	N	Y	N	Y
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary

Table 6. The role of institutions in the relation between profit shifting and intangibles

The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting*. We define all variables in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. All specifications include *Subsidiaries' assets*, *Subsidiaries' leverage*, *Subsidiaries' cost ratio*, *GDP growth* and *Population* as control variables. The lower part of the table denotes the type of fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Subsidiaries' intangibles ratio	0.629	0.243	0.331	0.361	4.917
	(0.849)	(0.245)	(0.345)	(0.356)	(4.172)
Corporate events	-0.054	-0.016	-0.009	-0.011	-0.351*
	(0.043)	(0.019)	(0.026)	(0.025)	(0.200)
Corporate events × Subsidiaries' intangibles ratio	1.713***	0.573**	0.839**	0.745**	8.621**
	(0.631)	(0.224)	(0.338)	(0.323)	(3.451)
Voice and accountability	-0.426***	-0.437***	-0.433***	-0.467***	-0.426***
	(0.138)	(0.150)	(0.138)	(0.145)	(0.136)
Voice and accountability × Subsidiaries' intangibles ratio	-0.328				
	(0.665)				
Corporate events × Voice and accountability	0.036				
	(0.034)				
Voice and accountability × Subsidiaries' intangibles ratio × Corporate events	-1.280***				
	(0.496)				
Control of corruption		-0.009			
		(0.053)			
Control of corruption × Subsidiaries' intangibles ratio		-0.020			
		(0.156)			
Corporate events × Control of corruption		0.003			
		(0.013)			
Control of corruption × Subsidiaries' intangibles ratio × Corporate events		-0.313**			
		(0.144)			
Government effectiveness			-0.052		
			(0.056)		
Government effectiveness × Subsidiaries' intangibles ratio			-0.087		
			(0.235)		
Corporate events × Government effectiveness			-0.003		
			(0.019)		
Government effectiveness × Subsidiaries' intangibles ratio × Corporate events			-0.521**		
			(0.236)		
Rule of law				0.081	
				(0.071)	
Rule of law × Subsidiaries' intangibles ratio				-0.108	
				(0.234)	
Corporate events × Rule of law				-0.001	
				(0.017)	
Rule of law × Subsidiaries' intangibles ratio × Corporate events				-0.429**	
				(0.217)	
GDP per capita					0.350
					(0.256)
GDP per capita × Subsidiaries' intangibles ratio					-0.443
					(0.391)
Corporate events × GDP per capita					0.033*
					(0.019)
GDP per capita × Subsidiaries' intangibles ratio × Corporate events					-0.803**
					(0.325)
Observations	49,999	49,999	49,999	49,999	49,999
Adjusted R-squared	0.429	0.429	0.429	0.429	0.430
Subsidiary effects	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary

Table 7. Profit shifting as an explanatory variable of firm outcomes

The table reports coefficients and t-statistics (in brackets). The dependent variable is denoted in the second line of the table and all variables are defined in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. Subsidiary fixed effects are used in each specification. The explanatory variable is *Profit shifting*. Each regression (in each column) includes *Subsidiaries' assets*, *Subsidiaries' leverage*, and *Subsidiaries' cost of employees* as control variables. We also report the number of observations and the adjusted-R-squared of each regression. The ***, **, and * marks denote statistical significance at the 1%, 5%, and 10% level, respectively.

	(1) Subsidiaries' leverage	(2) Working capital	(3) Liquidity ratio	(4) Number of employees
Profit shifting	0.002***	-0.029***	-0.103***	-0.012***
	[3.426]	[-3.824]	[-4.239]	[-3.084]
Observations	100,213	29,170	34,427	30,930
Adjusted R-squared	0.789	0.877	0.537	0.934
Subsidiary effects	Y	Y	Y	Y
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary

Figure 1: Profit shifting flows based on equation 1

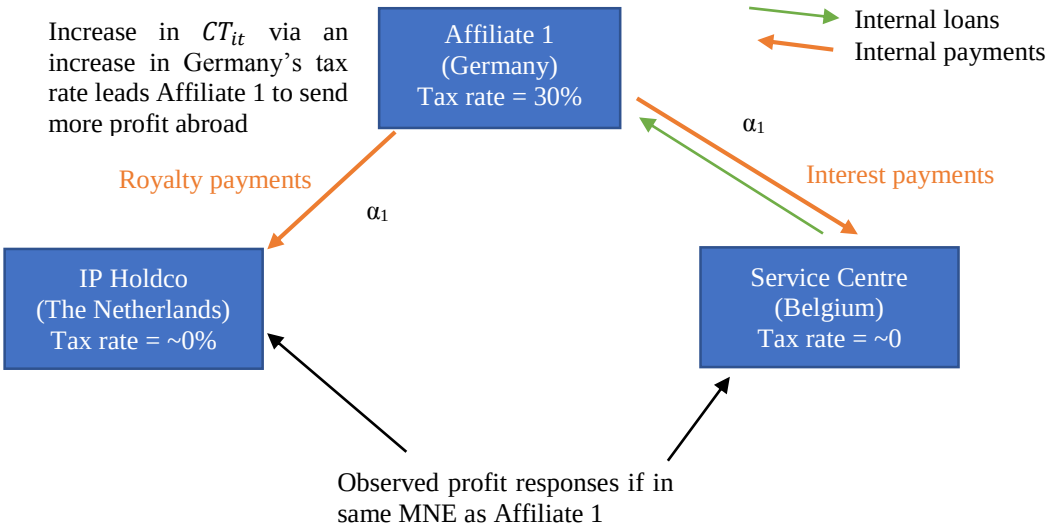


Figure 2: Nonparametric estimates at two points

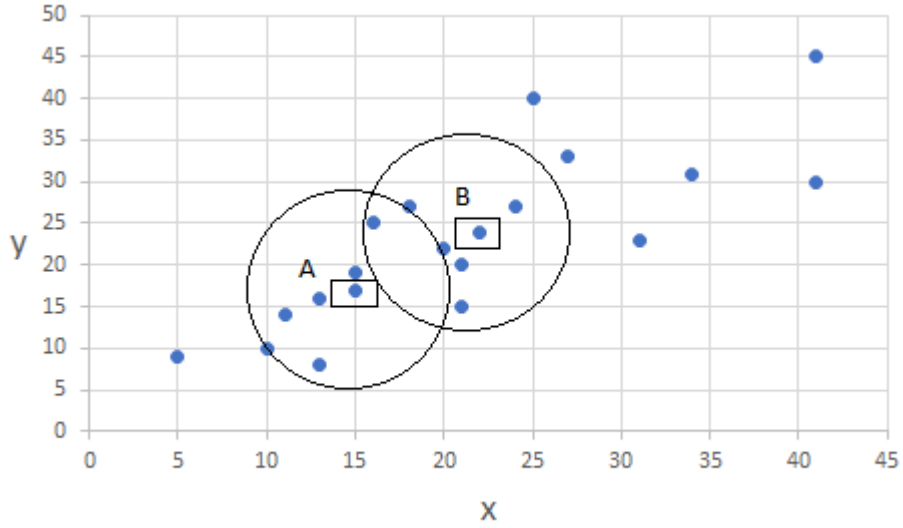


Figure 3: Profit-shifting Trends (Mining vs Intangibles)

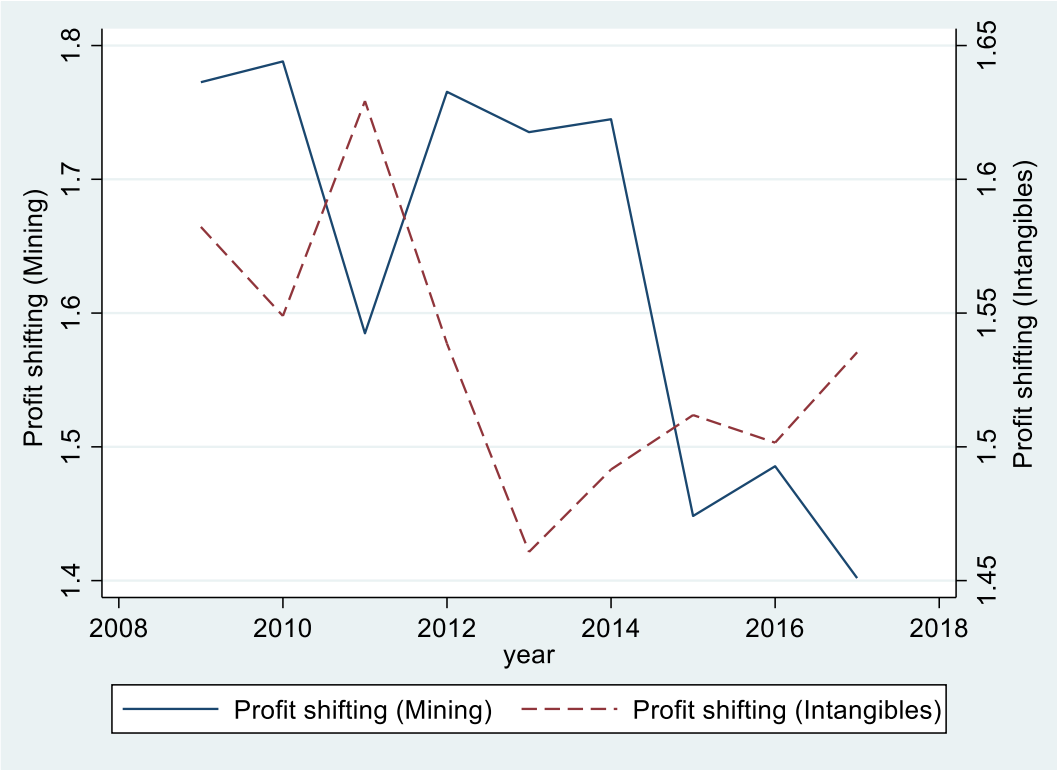
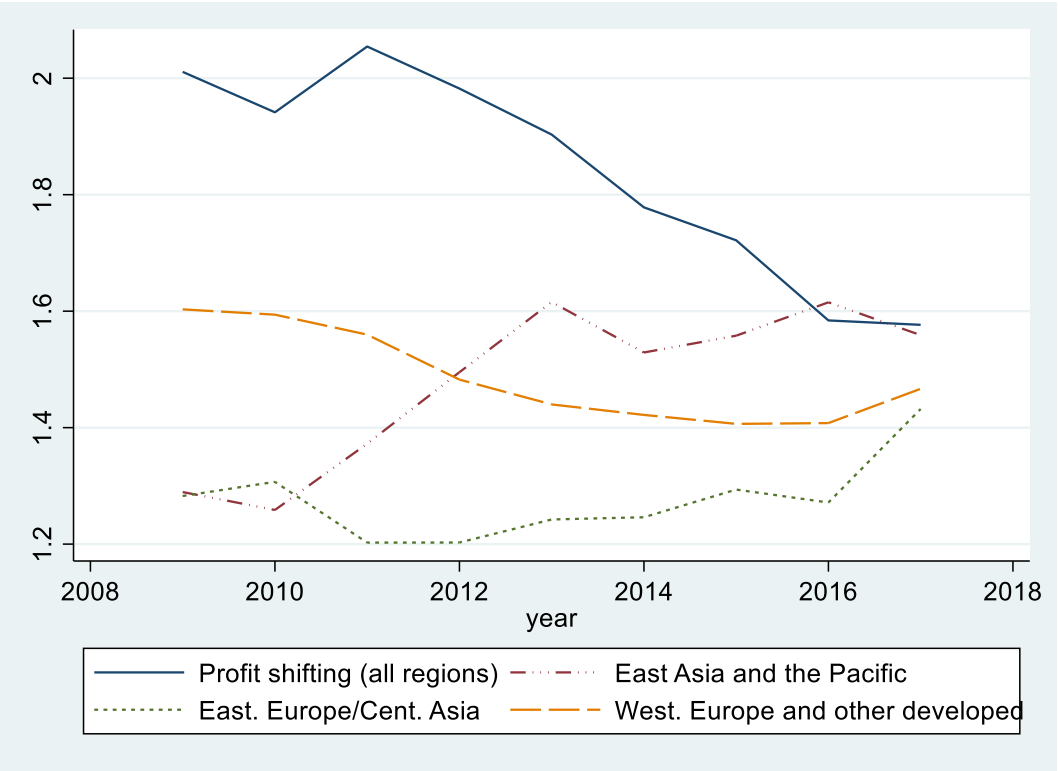


Figure 4: Annual averages of profit shifting



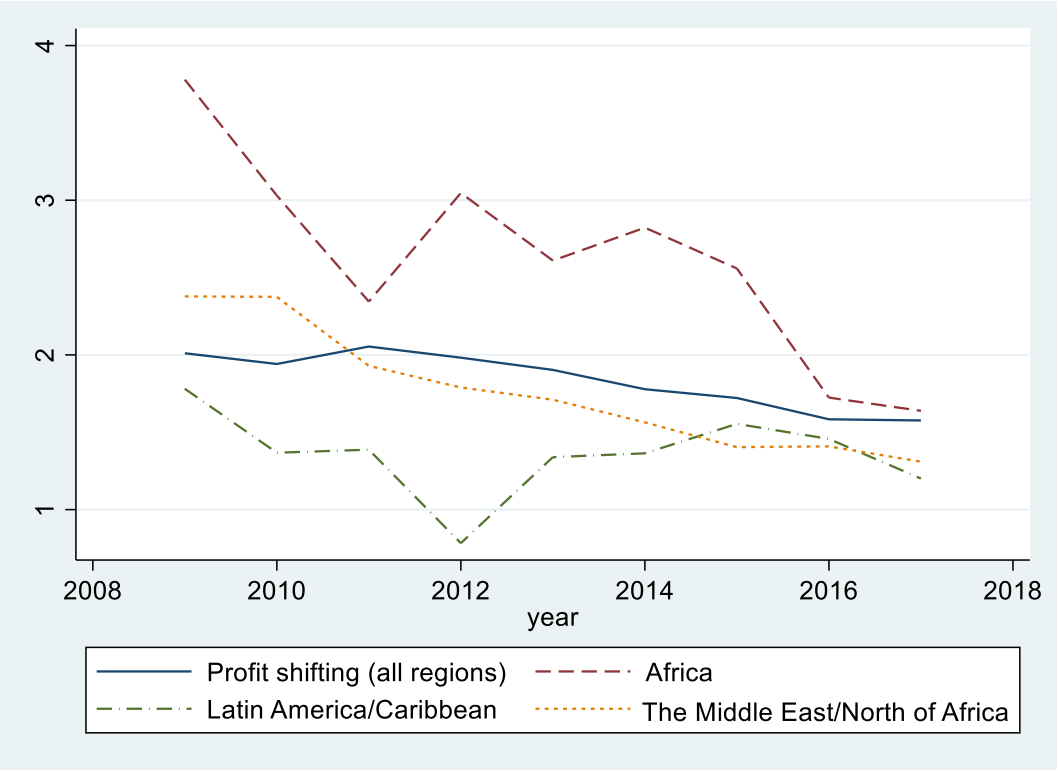


Figure 5: Cross-sectional variation of profit shifting in a year

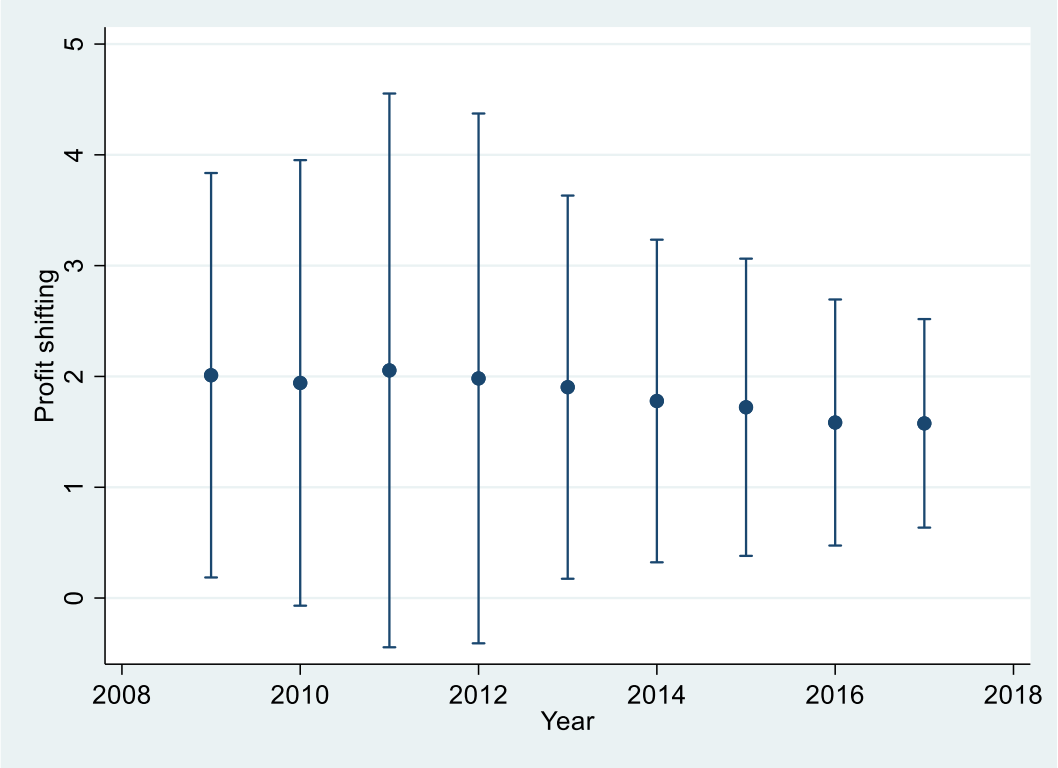


Figure 6: Annual averages of the subsidiaries' intangibles ratio

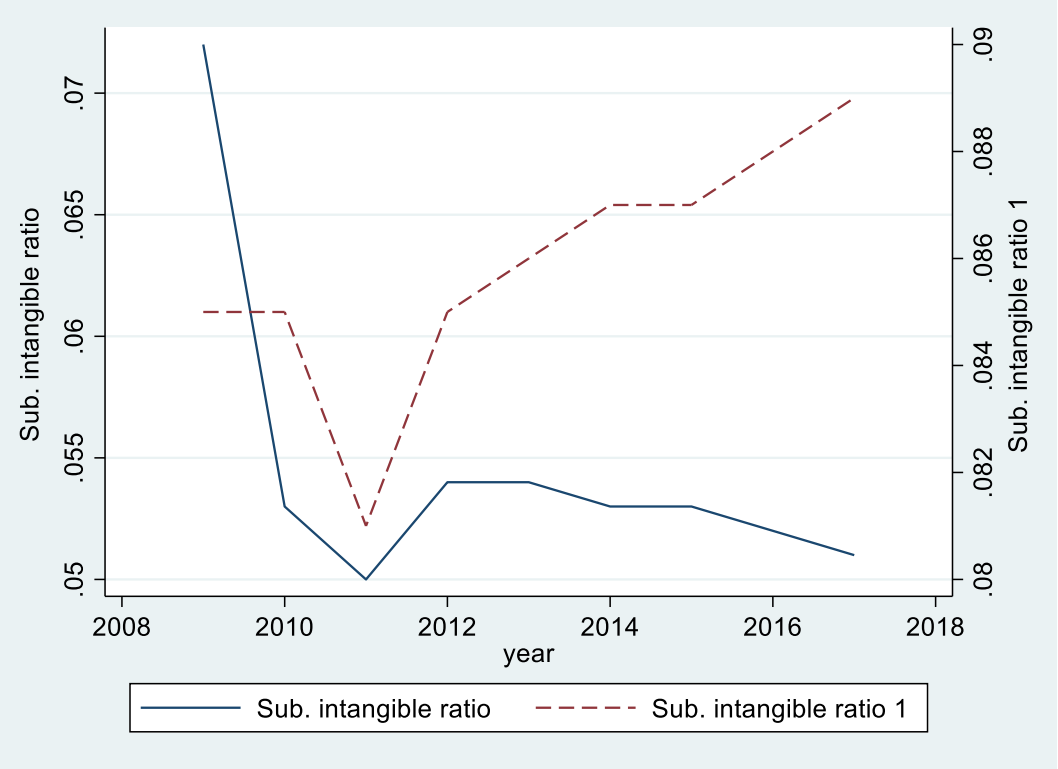


Figure 7: Profit shifting and subsidiaries' intangibles ratio across industries

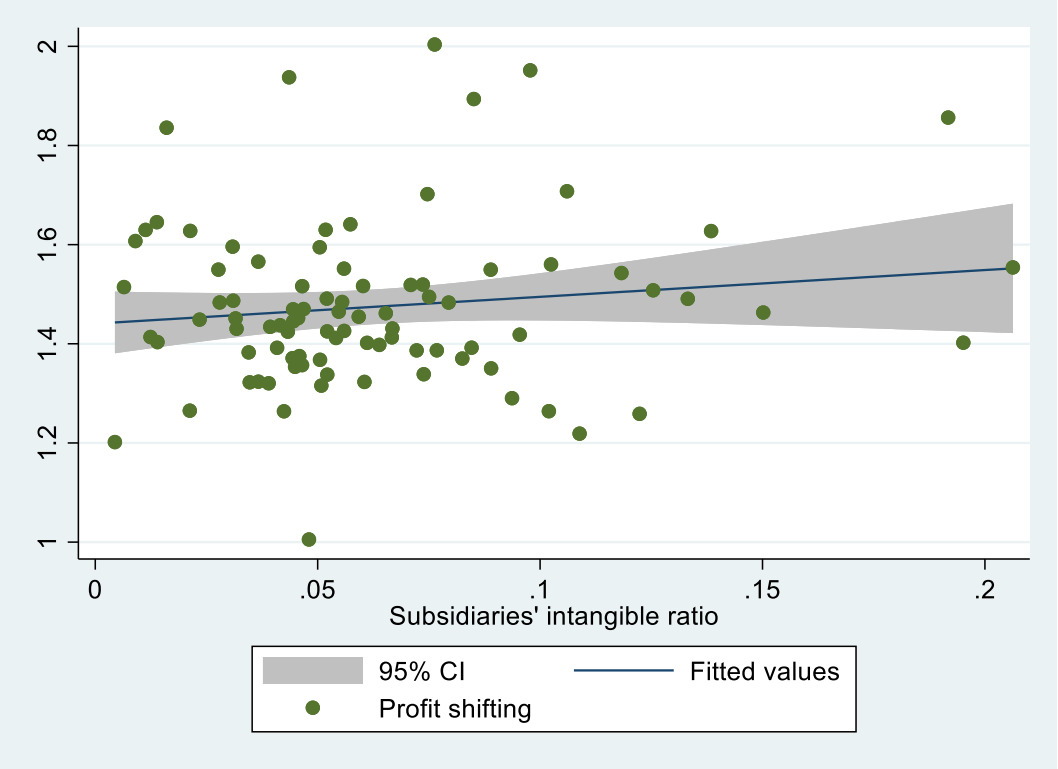
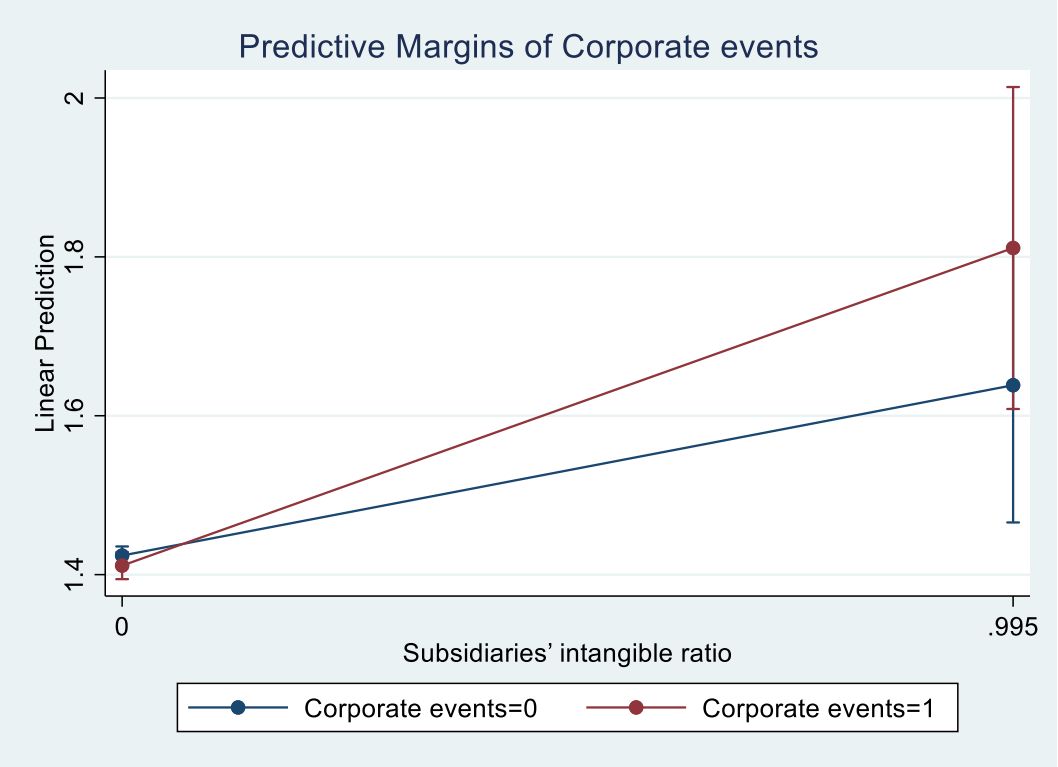
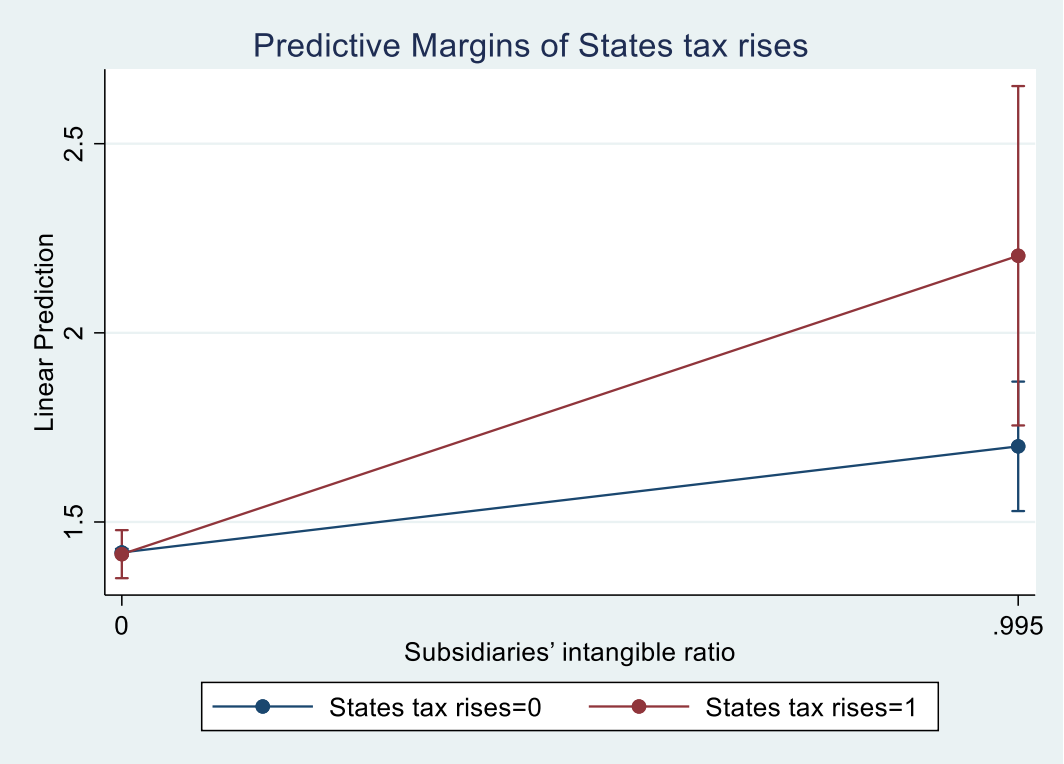
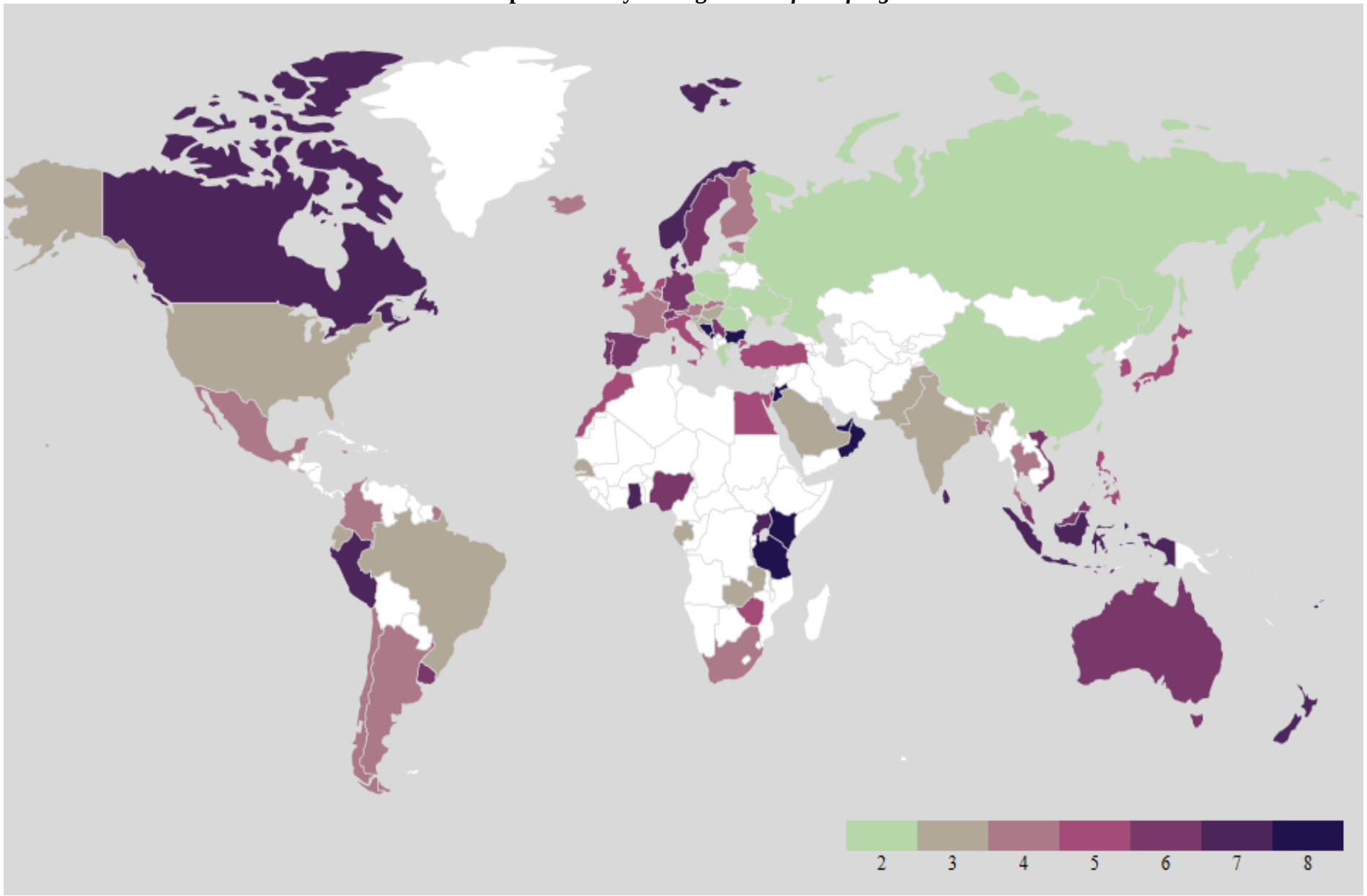


Figure 8: Predictive margins of corporate events and states tax rises



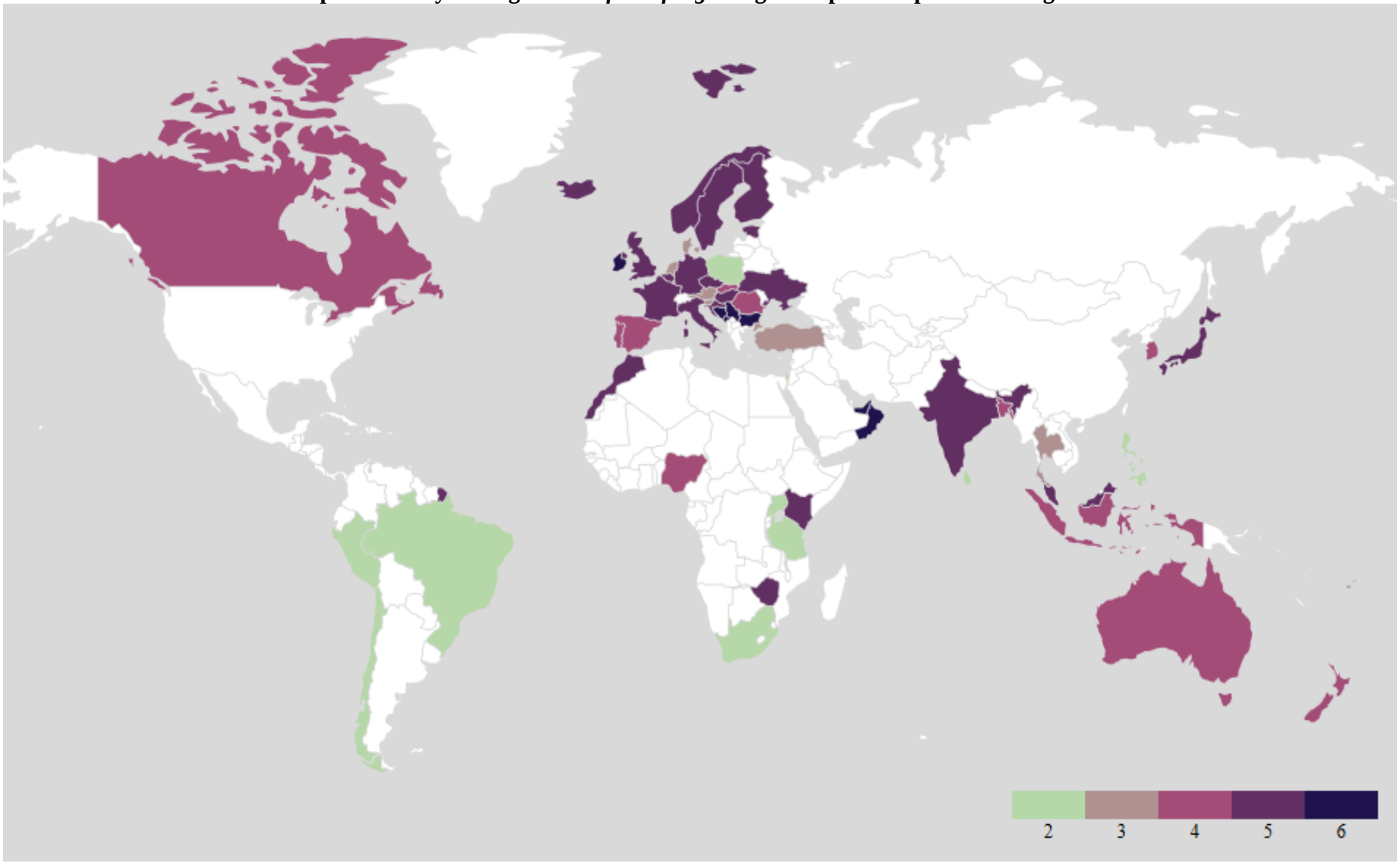


Map 1. Country averages of *Profit shifting*



*Cayman Islands, Bermuda and Isle of Man take the highest value but are not visually depicted on the map due to their small size.

Map 2. Country averages of *Profit shifting* using the top 5% of profit-shifting firms



*Cayman Islands and Bermuda take the highest value but are not observable on the map due to their small size.

Appendix
Global Evidence on Profit Shifting Within Firms and Across Times

This appendix, intended for online use only, includes more information on our sample construction, the average values of our profit-shifting index by country–year and by industry, the average estimates of profit shifting by country using the top 5% of subsidiaries according to their profit-shifting estimates, the average values of intangible assets by industry, and additional robustness tests.

Sample construction

We begin with the full worldwide set of subsidiaries with listed global ultimate owners (GUOs) in Orbis.[22] This search strategy provides detailed accounting data for the subsidiaries (and not for the GUO). Next, we create a data set for GUO, for which we search for shareholders with foreign subsidiaries anywhere in the world (excluding firms for which the country is not listed). For subsidiaries, we rely on unconsolidated statements; for GUOs we rely on consolidated statements (there are very few unconsolidated statements for GUOs). Consolidated data net out potential profit-shifting movements among affiliates of a multinational group. We then merge the data sets by GUO and year. Both the subsidiaries and their GUO are of one of the following types: (i) Very large or large companies, active, with recent detailed financials, (ii) medium-sized companies, active, with recent detailed financials, (iii) small companies, active, with recent detailed financials. We exclude public authorities.

Our criterion for specifying a subsidiary is the existence of a GUO that owns at least 25.01% of the subsidiary. Note also that the minimum percentage of 25.01% includes both the ultimate owner's direct and indirect holdings, in case there are chains of ownership among the related firms of a specific group. Unlike previous studies, we relax the restriction that GUOs owning at least 51% of their foreign subsidiaries, as one might expect that even lower but still strong ownership could provide an incentive for profit shifting. Relaxing this restriction allows wider coverage. However, all of our results are robust to majority ownership, which might important to avoid results due to "tunneling" (i.e., the phenomenon of individual or family shareholders who control a group of firms shifting income from firms in which they own a relatively small stake to firms in which they own a relatively large stake).

To construct our composite tax variable (equation 2), we collect statutory tax rates from Ernst & Young's Worldwide Corporate Tax Guide. Deveraux and Mafini (2007) and many

[22] Following Orbis, we use the more technical term *GUO*; however, this is the same as our description of an MNE.

others henceforth use statutory (as opposed to effective) tax rates and justify this as follows. Multinationals shift profits among affiliates they already operate. Thus, they exploit tax allowances, which depend on differences in statutory (and not effective) tax rates. If multinationals were to decide where to produce (country, location) or measure an investment's value via the margin, effective average tax rate is preferred.

From this initial sample, we exclude subsidiaries in the same countries as their GUOs in order to capture the propagation of earnings among related subsidiaries in different countries due to tax differences. As discussed for the estimation of *Profit shifting*, we are interested in the negative responses of *Subsidiaries' earnings before taxes* (π_{it}) to CT_{it} in equation (1). This yields a sample of 26,593 subsidiaries in 95 countries from 2009 to 2017. The total number of subsidiary–year observations is 106,301. We disregard cases of positive responses, i.e., responses when the subsidiary does not send profits abroad (receive profits from abroad) when tax rates in the host country increase (decrease). By using logs, we drop all earnings before taxes of unprofitable subsidiaries, because they deal with zero tax rates, so they have no incentive for profit shifting activities if the local tax authorities do not authorize loss offsets. Further, we drop all the missing observations of the composite tax variable CT_{it}. That is the case for all the subsidiaries of our sample that do not have affiliated subsidiaries in the same multinational group.

Table A1. Country list

This Table reports the number of observations by country in our initial subsidiary–year level dataset. The total number of observations is 375,958.

Country	Observations	Country	Observations	Country	Observations
Albania	22	Hungary	5,618	Saint Martin	16
Argentina	68	Iceland	365	Saudi Arabia	9
Australia	6,523	India	3,268	Senegal	16
Austria	4,890	Indonesia	181	Serbia	1,667
Bahrain	7	Ireland	9,012	Singapore	18,106
Bangladesh	45	Isle of Man	9	Slovakia	4,392
Belgium	20,204	Israel	84	Slovenia	1,472
Bermuda	151	Italy	22,003	South Africa	92
Bolivia	1	Jamaica	18	Spain	17,073
Bosnia and Herzegovina	441	Japan	798	Sri Lanka	36
Botswana	9	Jersey	18	Sweden	13,744
Brazil	1,499	Jordan	63	Switzerland	34
Bulgaria	2,783	Kazakhstan	74	Taiwan	176
Canada	212	Kenya	77	Thailand	10,381
Canary Islands	265	Kosovo	10	Trinidad and Tobago	4
Cayman Islands	319	Latvia	1,609	Tunisia	9
Ceuta	20	Lithuania	694	Turkey	637
Chile	148	Luxembourg	1,392	Uganda	9
China	13,239	Macedonia	224	Ukraine	1,619
Colombia	4,379	Malaysia	915	UAE	17
Croatia	1,844	Malta	390	United Kingdom	71,037
Cyprus	19	Marshall Islands	8	Tanzania	4
Czech Republic	7,813	Martinique	3	United States	368
Côte d'Ivoire	79	Mauritius	4	Uruguay	63
Denmark	6,111	Mexico	198	Vietnam	1,696
Dominica	2	Montenegro	87	Virgin Islands	22
Ecuador	14	Morocco	1,136	Zambia	11
Egypt	18	Netherlands	14,267	Zimbabwe	27
El Salvador	4	New Zealand	2,080		
Estonia	1,758	Nigeria	96		
Faroe Islands	9	Norway	10,343		
Fiji	18	Oman	22		
Finland	4,539	Pakistan	176		
France	32,603	Peru	95		
Gabon	9	Philippines	58		
Georgia	3	Poland	9,378		
Germany	7,526	Portugal	7,793		
Ghana	54	South Korea	6,262		
Greece	1,290	Reunion	6		
Guadeloupe	7	Romania	6,857		
Hong Kong	21	Russia	8,564		

Table A2. Average estimates of *Profit shifting* by country–year

This Table reports average estimates of Profit shifting by country–year using *Profit shifting* (semi-parametric) and the number of observations by country. The total number of observations is 106,301.

Country	Obs.	2009	2010	2011	2012	2013	2014	2015	2016	2017	Mean	St. Dev.
Argentina	7					1.428		1.816	1.054	1.040	1.334	0.368
Australia	2,430	1.595	1.757	1.863	1.497	1.458	1.440	1.340	1.412	1.319	1.520	0.185
Austria	1,744	0.634	1.212	1.275	1.441	1.419	1.479	1.502	1.672	1.812	1.383	0.335
Bahrain	7			0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.133	0.000
Bangladesh	16	0.646	1.165	2.214	1.443	1.470	1.943	1.109	0.398	1.878	1.363	0.601
Belgium	9,449	1.468	1.447	1.429	1.331	1.319	1.280	1.252	1.213	1.233	1.330	0.096
Bermuda	41	4.310	4.569	5.617	7.644	8.439	4.710	4.602	6.180	3.190	5.474	1.686
Bosnia and Herzegovina	145	2.439	2.432	2.676	2.639	3.960	3.586	4.169	4.027	3.360	3.254	0.716
Brazil	53	1.781	1.368	1.425	0.949	0.937	1.312	0.967	1.302	1.374	1.268	0.277
Bulgaria	865	2.249	2.546	2.817	2.209	2.176	2.565	2.386	2.424	1.653	2.336	0.327
Canada	27	1.568	2.493	1.721	2.254	1.909	1.182	0.994	1.167	1.721	1.668	0.505
Canary Islands (Spain)	143	1.487	1.503	1.337	1.295	1.302	1.596	1.580	1.620	2.116	1.537	0.251
Cayman Islands	113	7.720	7.989	8.831	8.718	9.497	8.853	8.835	9.026	8.482	8.661	0.536
Ceuta (Spain)	14	1.506	1.321	1.344	1.340	1.312	1.375	2.747	0.761		1.463	0.564
Chile	33			1.687	0.514	1.459	1.122	2.002	1.619	0.925	1.333	0.509
China	2						1.236	0.650			0.943	0.414
Colombia	12			1.038	0.790	1.012	2.148	1.516	1.579	1.124	1.315	0.463
Croatia	478	1.215	1.046	1.294	1.175	1.224	1.217	1.261	1.196	1.228	1.206	0.069
Czech Republic	2,246	1.064	1.164	0.993	1.014	1.035	0.992	1.037	1.050	1.134	1.054	0.060
Côte d'Ivoire	35	9.458	13.080	13.349	9.142	7.958	9.304	9.097	2.251	1.822	8.384	4.041
Denmark	2019					1.668	1.639	1.578	1.649	1.794	1.666	0.079
Dominica	1								1.638		1.638	
Ecuador	4								1.116	1.083	1.099	0.023
Egypt	3				1.415	1.403	1.534				1.451	0.072
El Salvador	4								0.904	1.314	1.109	0.290
Estonia	383	1.205	1.137	1.109	1.163	1.397	1.712	1.460	1.404	1.412	1.333	0.197
Fiji	6	2.474	2.777	2.843	1.520			0.598		1.329	1.923	0.911
Finland	1,056	1.462	1.444	1.503	1.455	1.692	1.178	1.195	1.168	1.439	1.393	0.177
France	14,764	1.502	1.466	1.495	1.356	1.276	1.307	1.312	1.246	1.200	1.351	0.112
Gabon	6	1.054	1.124	0.715	0.881	1.806	1.625				1.201	0.427

Germany	4,494	1.643	1.722	1.596	1.572	1.518	1.423	1.381	1.417	1.303	1.508	0.137
Ghana	14	1.419	2.107	1.238	1.995	2.780	1.347	1.409	1.502	1.512	1.701	0.499
Greece	2	0.504		0.160							0.332	0.243
Guadeloupe (France)	3			1.677	1.405	0.781					1.288	0.459
Hong Kong	12	0.196	0.181	0.193	0.123	0.265	0.503	0.960	1.229	1.347	0.555	0.490
Hungary	1,577	1.087	1.171	0.967	0.974	1.018	1.006	1.049	1.068	2.118	1.162	0.364
Iceland	19	1.654		1.214	1.307		1.066	0.944	1.286	1.844	1.331	0.317
India	1,391	1.382	1.324	1.329	1.309	1.070	1.036	1.214	1.076	1.373	1.235	0.139
Indonesia	65	1.616	1.373	1.738	1.640	1.745	1.544	2.119	2.004	1.416	1.688	0.248
Ireland	1,365	1.718	1.715	1.623	1.705	1.544	1.715	1.541	1.516	1.172	1.583	0.175
Isle of Man (United Kingdom)	2						2.436	2.856			2.646	0.297
Israel	43	1.654	1.821	1.507	1.696	1.574	1.681	1.393	1.571	1.559	1.606	0.123
Italy	12,177	1.526	1.489	1.406	1.442	1.393	1.335	1.301	1.247	1.598	1.415	0.112
Jamaica	4					2.495	1.599		0.806	0.838	1.434	0.796
Japan	264	2.196	1.021	2.236	1.300	1.458	0.859	1.131	1.453	1.414	1.452	0.479
Jersey (United Kingdom)	7	0.636			1.813	1.103	1.044	1.559	0.853	1.363	1.196	0.409
Jordan	19	1.938			1.938	1.938	1.938	1.938	1.938	1.938	1.938	0.000
Kenya	51	5.221	1.316	1.497	1.704	1.549	1.602	1.412	1.840	1.709	1.983	1.225
Latvia	35	0.856				0.697	1.186	0.959	1.065	1.194	0.993	0.195
Luxembourg	580	1.751	1.742	1.644	1.712	1.511	1.523	1.549	1.640	1.505	1.620	0.101
Macedonia (FYR)	67				1.306	1.101	1.817	2.297	2.137	1.910	1.762	0.468
Malaysia	211	1.586	1.572	1.673	1.787	1.574	1.535	1.603	1.686	1.625	1.627	0.077
Malta	24	1.272	1.220	1.894	1.799	2.255	2.139	1.912	1.132	1.565	1.687	0.410
Martinique (France)	3		0.712	1.091						0.425	0.742	0.334
Mexico	6			0.949	0.714	1.333	1.470	1.582		2.056	1.351	0.476
Montenegro	35	7.790	1.313		1.364	5.652	1.890	2.398	1.488	2.965	3.108	2.369
Morocco	587	1.191	1.906	1.738	1.561	1.551	1.465	1.413	1.392	1.273	1.499	0.222
Netherlands	1,540	1.108	1.197	1.296	1.446	1.557	1.518	1.543	1.637	1.803	1.456	0.220
New Zealand	1,270	1.903	1.827	1.812	1.660	1.653	1.665	1.612	1.537	1.551	1.691	0.128
Nigeria	57	1.826	1.668	1.575	1.807	1.238	1.529	1.255	1.443	1.519	1.540	0.210
Norway	4,621	1.779	1.744	1.858	1.688	1.637	1.646	1.640	1.623	1.689	1.701	0.079
Oman	15	5.955	4.452	12.854	14.609	5.348	1.991	0.798	0.671	0.519	5.244	5.248
Pakistan	113	1.202	1.143	1.289	1.063	0.976	1.179	1.377	1.433	1.483	1.238	0.171
Peru	10					1.598		1.899	2.199	1.316	1.753	0.381

Philippines	40	1.420	1.256	1.115	1.951	1.720	1.509	1.334	1.518	1.187	1.446	0.266
Poland	2,183	1.057	0.989	0.959	1.046	1.093	1.102	1.153	0.983	1.105	1.054	0.066
Portugal	2,146	1.558	1.382	1.789	1.483	1.793	1.550	1.275	1.270	1.544	1.516	0.191
Republic of Korea	2,538	1.180	1.239	1.206	1.490	1.674	1.611	1.615	1.687	1.632	1.481	0.213
Reunion (France)	5		1.792				2.334	1.224		2.334	1.921	0.530
Romania	1,363	1.029	1.050	1.061	0.975	1.136	1.048	0.914	1.051	1.148	1.046	0.072
Russian Federation	6					0.424	1.186	1.347	1.026	0.726	0.942	0.369
Saudi Arabia	1									1.270	1.270	
Senegal	8			0.525			1.316	1.490	1.315	1.465	1.222	0.398
Serbia	399	2.698	2.466	2.337	1.832	0.866	0.994	1.141	1.053	1.119	1.612	0.724
Singapore	14	1.582	0.496	0.638	1.142			1.627	1.191	1.306	1.140	0.434
Slovakia	1,191	1.108	1.170	1.038	1.104	1.296	1.216	1.645	1.572	1.574	1.302	0.233
Slovenia	527	0.958	1.025	1.124	1.200	1.249	1.296	1.259	1.398	1.396	1.212	0.153
South Africa	51	1.305	1.457	1.164	1.021	1.303	0.907	1.412	1.684	1.516	1.307	0.245
Spain	9,172	1.801	1.832	1.666	1.544	1.487	1.427	1.558	1.653	1.653	1.625	0.135
Sri Lanka	26	1.272	1.323	1.680	2.182	2.230	2.306	2.824	0.950	2.022	1.865	0.601
Sweden	3,307	1.530	1.719	1.776	1.973	1.207	1.432	1.643	1.649	1.739	1.630	0.220
Switzerland	1								1.512		1.512	
Taiwan	47	1.364	0.720	0.989	1.081	0.839	1.056	1.189	1.226	1.198	1.073	0.201
Tanzania	4					2.795		2.709	2.453	1.395	2.338	0.645
Thailand	268	1.624	1.308	1.425	1.410	1.241	1.385	1.386	1.290	1.341	1.379	0.110
Turkey	37	1.232	1.021	1.158	1.031	1.155	2.038	1.432	1.708	2.004	1.420	0.402
Uganda	8	2.100		1.437	1.323	1.411	1.334	1.387	2.325	2.831	1.769	0.576
Ukraine	216	1.236	1.275	1.224	0.401	1.147	1.311	1.032	1.061	0.927	1.068	0.280
United Arab Emirates	6	8.164	9.178	11.170	11.394	7.420	7.257				9.097	1.825
United Kingdom	15,921	1.676	1.673	1.563	1.366	1.364	1.397	1.296	1.304	1.285	1.436	0.159
United States	9					0.521	1.601		1.163	1.362	1.162	0.463
Uruguay	1							1.602			1.602	
Vietnam	8				1.708		1.938	2.275	1.426	0.186	1.506	0.801
Zambia	4					1.505	0.838	0.508	1.749		1.150	0.576
Zimbabwe	5	1.403	1.110		0.269	2.883	1.497				1.433	0.944

Table A3. *Profit shifting* estimates by country based on the largest profit shifters

This table reports average estimates of *Profit shifting* by country using the top 5% of the subsidiaries according to their profit-shifting estimates. These firms shift profit to 61 countries.

Country	Profit shifting	Country	Profit shifting
Cayman Islands	11.736	Denmark	2.853
Bosnia and Herzegovina	11.082	Austria	2.852
Macedonia (FYR)	11.023	Netherlands	2.851
Oman	10.293	Turkey	2.843
Ireland	10.237	Fiji	2.843
Bulgaria	9.188	Canary Islands (Spain)	2.842
United Arab Emirates	9.097	South Africa	2.841
Bermuda	9.076	Poland	2.839
Montenegro	8.416	Chile	2.837
Serbia	8.162	Sri Lanka	2.832
Japan	6.957	Uganda	2.831
Hungary	6.740	Israel	2.828
India	5.798	Philippines	2.826
Kenya	4.919	Brazil	2.811
France	3.743	Tanzania	2.795
Belgium	3.602	Peru	2.789
Czech Republic	3.079		
Italy	3.067		
United Kingdom	2.936		
Germany	2.899		
Iceland	2.896		
Zimbabwe	2.883		
Croatia	2.871		
Morocco	2.869		
Sweden	2.866		
Norway	2.862		
Estonia	2.862		
Ukraine	2.862		
Malaysia	2.861		
Finland	2.860		
Republic of Korea	2.859		
Bangladesh	2.859		
Luxembourg	2.859		
Australia	2.859		
Spain	2.858		
Indonesia	2.857		
Slovakia	2.856		
Canada	2.856		
New Zealand	2.856		
Isle of Man (United Kingdom)	2.856		
Nigeria	2.855		
Portugal	2.854		
Romania	2.854		
Thailand	2.854		
Slovenia	2.853		

Table A4. Average estimates of profit shifting by industry using *Profit shifting*

Industry	Profit shifting
Mining and quarrying	2.054
Water supply; sewerage, waste management and remediation activities	1.719
Agriculture, forestry and fishing	1.642
Arts, entertainment and recreation	1.621
Human health and social work activities	1.537
Transportation and storage	1.535
Construction	1.531
Accommodation and food service activities	1.521
Manufacturing	1.498
Wholesale and retail trade; repair of motor vehicles and motorcycles	1.490
Education	1.474
Real estate activities	1.465
Administrative and support service activities	1.458
Information and communication	1.457
Professional, scientific and technical activities	1.452
Financial and insurance activities	1.424
Other service activities	1.384
Electricity, gas, steam and air conditioning supply	1.347
Public administration and defense; compulsory social security	0.878

Table A5. Average estimates of *Subsidiaries' intangibles ratio* by industry

Industry	Subsidiaries' intangibles ratio
Public administration and defense; compulsory social security	0.195
Education	0.106
Water supply; sewerage, waste management and remediation activities	0.098
Financial and insurance activities	0.097
Information and communication	0.083
Arts, entertainment and recreation	0.080
Mining and quarrying	0.074
Human health and social work activities	0.073
Other service activities	0.071
Agriculture, forestry and fishing	0.070
Administrative and support service activities	0.067
Transportation and storage	0.061
Professional, scientific and technical activities	0.057
Real estate activities	0.052
Manufacturing	0.045
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.044
Accommodation and food service activities	0.043
Construction	0.040
Electricity, gas, steam and air conditioning supply	0.034

Table A6. Alternative measures of profit shifting

The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting 2*. We define all variables in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. The lower part of the table denotes the type of fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Subsidiaries' intangibles ratio	0.251***	0.307***	0.293***	0.282***
	(0.053)	(0.097)	(0.095)	(0.092)
Subsidiaries' assets	-0.009**	0.038**	0.030	0.029
	(0.003)	(0.018)	(0.019)	(0.018)
Subsidiaries' leverage	0.007	0.015	0.007	0.003
	(0.010)	(0.011)	(0.011)	(0.010)
Subsidiaries' cost ratio	0.049***	0.092***	0.062***	0.053***
	(0.007)	(0.005)	(0.005)	(0.010)
GDP growth	-0.009***	0.007***	0.011***	
	(0.003)	(0.002)	(0.004)	
Population	-0.048***	-3.394***	-1.232*	
	(0.010)	(0.344)	(0.703)	
Voice and accountability	0.038	-0.410***	-0.410***	
	(0.043)	(0.136)	(0.141)	
Observations	54,074	49,767	49,767	49,873
Adjusted R-squared	0.006	0.444	0.449	0.477
Subsidiary effects	N	Y	Y	Y
Year effects	N	N	Y	Y
Sub.country–year effects	N	N	N	Y
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary

Table A7. Sensitivity to the type of clustering of standard errors

The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting*. We define all variables in Table 1. Estimation method is OLS. The lower part of the table denotes the type of fixed effects and clustering used in each specification. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Subsidiaries' intangibles ratio	0.292***	0.292***	0.292***	0.292***
	(0.093)	(0.073)	(0.097)	(0.086)
Subsidiaries' assets	0.033*	0.033*	0.033	0.033*
	(0.018)	(0.019)	(0.021)	(0.018)
Subsidiaries' leverage	0.003	0.003	0.003	0.003
	(0.010)	(0.009)	(0.010)	(0.010)
Subsidiaries' cost ratio	0.061***	0.061***	0.061***	0.061
	(0.005)	(0.016)	(0.006)	(0.058)
GDP growth	0.011***	0.011	0.011*	0.011
	(0.004)	(0.009)	(0.006)	(0.008)
Population	-0.997	-0.997	-0.997	-0.997
	(0.675)	(1.501)	(0.886)	(1.214)
Voice and accountability	-0.368***	-0.368	-0.368**	-0.368
	(0.133)	(0.459)	(0.151)	(0.417)
Observations	49,999	49,999	49,999	49,999
Adjusted R-squared	0.426	0.426	0.426	0.426
Subsidiary effects	Y	Y	Y	Y
Year effects	Y	Y	Y	Y
Clustered standard errors	subsidiary	Sub. country	Sub.industry	Sub.country–year

Table A8. Interaction terms

The table reports coefficient estimates and standard errors (in parentheses) from adding interaction terms in equation 1. Dependent variable is *Subsidiaries' earnings before taxes* and all variables are defined in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. The lower part of the table denotes the type of fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(3)	(4)	(5)	(6)	(7)
Composite tax variable	-0.613***	-0.411**	-0.322**	-0.306**	-0.278*	-0.274*
	(0.137)	(0.199)	(0.143)	(0.144)	(0.144)	(0.144)
Subsidiaries' intangibles ratio	-0.781***	-0.756***	-0.765***	-0.764***	-0.763***	-0.767***
	(0.093)	(0.093)	(0.092)	(0.092)	(0.092)	(0.092)
Composite tax variable × Subsidiaries' intangibles ratio	1.837**	1.927**	1.817**	1.846**	1.826**	1.838**
	(0.914)	(0.930)	(0.917)	(0.917)	(0.916)	(0.918)
Subsidiaries' assets	0.778***	0.763***	0.771***	0.771***	0.772***	0.771***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Subsidiaries' leverage	-0.210*	-0.200*	-0.203*	-0.203*	-0.202*	-0.203*
	(0.117)	(0.113)	(0.114)	(0.114)	(0.114)	(0.114)
Subsidiaries' cost ratio	-4.368***	-4.395***	-4.397***	-4.396***	-4.397***	-4.406***
	(0.402)	(0.399)	(0.400)	(0.400)	(0.400)	(0.400)
GDP growth			0.013***	0.013***	0.013***	0.013***
			(0.003)	(0.003)	(0.003)	(0.003)
Population			-1.883***	-1.987***	-2.122***	-1.568***
			(0.411)	(0.413)	(0.418)	(0.417)
Voice and accountability				0.146**		
				(0.071)		
Democratic conditions (Polity)					0.091***	
					(0.028)	
Government effectiveness						0.195***
						(0.047)
Observations	79,176	79,131	78,976	78,976	78,976	78,976
Adjusted R-squared	0.842	0.843	0.843	0.843	0.843	0.843
Subsidiary effects	Y	Y	Y	Y	Y	Y
Year effects	N	Y	Y	Y	Y	Y
Sub.country × year effects	N	Y	N	N	N	N
Clustered standard errors	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary	subsidiary

Table A9. Dropping low composite tax observations

This table changes our main specification of Table 4 by dropping 5% and 10% of the smallest absolute values of the Composite tax variable, respectively. The table reports coefficients and standard errors (in parentheses). The dependent variable is *Profit shifting*. We define all variables in Table 1. Estimation method is OLS with standard errors clustered by subsidiary. The lower part of the table denotes the type of fixed effects. The *, **, and *** marks denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)
Subsidiaries' intangibles ratio	0.301***	0.331***
	(0.102)	(0.108)
Subsidiaries' assets	0.038*	0.038*
	(0.020)	(0.021)
Subsidiaries' leverage	0.008	0.005
	(0.011)	(0.011)
Subsidiaries' cost ratio	0.059***	0.057***
	(0.005)	(0.006)
GDP growth	0.012***	0.014***
	(0.004)	(0.004)
Population	-1.063	-1.062
	(0.718)	(0.777)
Voice and accountability	-0.375***	-0.405***
	(0.139)	(0.146)
Observations	47,372	44,586
Adjusted R-squared	0.430	0.434
Subsidiary effects	Y	Y
Year effects	Y	Y
Clustered standard errors	subsidiary	subsidiary