1. International tax avoidance by MNEs

Observing discrepancies in aggregated statistics (such as BoP) provides a starting point for estimating profit shifting by MNEs. As Case study 1 describes, profit shifting will not lead to distortions in aggregate account balances, but it will affect their components (Hebous et al., 2021). Analysis of aggregate data can offer valuable insight into profit shifting, as showed by Case study 2 on extractive industries in Zambia. Similarly, using statistics on FDI (or their ratio to GDP) can provide signs of profit shifting (see case studies Error! Reference source not found. and Error! Reference source not found.) or help estimate IFFs (see UNCTAD, 2015; Janský and Palanský, 2019). FATS macro data have been used by Tørslov et al. (2020) to compare profitability levels of MNE units in different jurisdictions. However, these macro approaches may not capture all IFFs or separate them sufficiently from other flows to provide an accurate measure.

With significant recent development in methodologies to measure MNE profit shifting, two methods to estimate international tax avoidance by MNEs are presented. First, a method analysing the global distribution of MNEs’ profits and their corresponding corporate taxes. And second, a method comparing MNEs to similar domestic companies using microdata to determine aggressive tax avoiding behaviour and estimate IFFs.

**Case study 1. How does profit shifting reflect on the balance of payments?**

Hebous et al. (2021) studied how tax strategies of MNEs shifting profits to jurisdictions with lower tax rates reflect on international flows. Using a panel of 81 countries for a period from 1990 to 2018, they find that the current account balance is not affected by statutory corporate tax rate, yet higher tax rates are associated with lower trade balances and higher income balances. Transfer mispricing flows (F3) affect import and export statistics; debt shifting (F4) and assets and intellectual property shifting (F5) affect international flows of interests, royalties and licence fees. Thus, profit shifting affects various components of the BoP.

Examples of how (1) transfer price manipulation and (2) profit shifting via intragroup lending impact the BoP are presented in figures below. The authors note that transfer price manipulation can affect bilateral current account balances, but not the aggregate level (except indirectly through changes in tax liabilities). With debt shifting, on the other hand, no impact is observed in the trade balance, yet credits and debits do occur in the income account.

**Graphical representation of BoP impact of**

**(1) transfer price manipulation**
Fischer (2020) analysed the financial account of Zambia’s BoP to analyse anomalies of outflows. The study found anomalies such as a sharp rise in net acquisition of debt instruments by resident non-financial other sectors on the other investment account. The study identified massive outflows of private wealth over the past fifteen years, reaching peaks of almost 20 per cent of GDP in 2012, 15 per cent in 2015, and over 7 per cent in 2017.

In-depth analysis revealed that the debt assets anomalies are an accounting discrepancy that is mostly likely explained by unreported profit shifting by large mining companies in Zambia. Interviewing experts of monetary and other government authorities can be useful to understand the sources of anomalies. The discrepancy was also visible between national data and data reported on assets held by Zambian residents by BIS. Mining companies, as non-financial firms,
are not obliged to report to the central bank. Technically, however, it should have been reported in the category of errors and omissions, although this would have of course raised alarm bells given the magnitude of these flows.

**Selected other investment categories and portfolio liabilities, Zambia, 1997-2019 (current US$ millions)**

Source: Fischer (2020)

**Concept and assumptions**

The method looks at the distribution of profits of an MNE among its units globally and relates it to the corresponding corporate (effective) tax rates and underlying economic activity of a particular unit. It assumes that an MNE unit is likely to shift profits out of the country if another unit’s tax regime induces a lower tax rate. Following empirical literature on corporate profit shifting, the method tests a regression model, linking MNE unit’s profits as dependent variable, with its economic activity identified through employment and assets; general conditions of a country which it operates in, such as population size and GDP per capita; and tax rate differences between rates faced by the MNE unit in a country and rates faced by units in other countries (Garcia-Bernardo and Janský, 2021; Fuest et al., 2021; Bratta et al., 2021).

The method assumes that any systematic deviation from predicted profitability of the unit based on its economic activity and circumstances of the host country, is a sign of potential profit shifting. This is evaluated through semi-elasticity of profits to tax rates. Identified deviations are further quantified to propose a measure of IFFs from profit shifting (flows F3-F5).

The method tends to underestimate the amount of profit shifting. It assumes that MNE activity would remain the same also in absence of (tax) incentives for profit shifting. As noted by Reynolds and Weir (2016), this would imply that subsidiaries in the case of South Africa (see Case study 3) would not reduce investments when faced with a higher effective tax rate - an assumption which is unlikely to hold.

Determining the tax rate that MNE units face in a particular country may not be straightforward. Certain incomes may face different tax rates, e.g., patent box regimes offering lower rates on certain income, specific tax-reducing arrangements with governments for certain activities, such as research and
development (R&D) (Fuest et al., 2021); there may also be other, non-tax incentives to shift profits, such as the fear of expropriation (Reynolds and Wier, 2016). Moreover, tax differentials between domestic MNE unit and another MNE unit may not fully capture incentive to shift profits. Finally, tax sensitivity of profits may vary across different tax regimes, e.g., between high and low-tax jurisdictions, or depending on the size of the MNE (Wier and Reynolds, 2018; Fuest et al., 2021).

**Overcoming limitations**

Some of the above limitations can be mitigated with the following:

1. **Use effective (average) tax rate.** The effective (average) tax rate provides a more comprehensive representation of country’s corporate income taxation (Bratta et al., 2021) and is thus better suited for the analysis than statutory tax rate. The latter is deemed an inaccurate measure for the actual tax burden in a country by some studies, as Fuest et al. (2021), pointing out with an example of Luxembourg and Malta, whose statutory tax rates are nominally high (above 25 per cent), although the countries have been consistently labelled as tax havens. Statutory tax rate, however, is usually the data available by countries and hence used in various research, whereas effective tax rate may require further calculation as proposed in the section below.

2. **Use quadratic tax variable specification.** To account for uneven tax-sensitivity across various tax jurisdictions, alternative non-linear specifications of tax variable have been applied: quadratic by Fuest et al. (2021); cubic by Bratta et al. (2021), or, in cases of extreme non-linearity, logarithmic model as applied in Garcia-Bernardo and Janský (2021). We suggest adding a squared tax variable to the specification of the model, i.e., using quadratic specification. In cases when such specification would turn out inappropriate, or insufficient, listed alternatives in literature could be applied.

3. **Use quartiles of consolidated revenues to form subsamples.** To address potentially varying tax sensitivity depending on the size of MNE existing research applied various approaches, such as estimating the model on each of the sub-samples based on MNE’s consolidated revenues and estimations compared and combined for the profit shifting estimates (Fuest et al., 2021), or applying weighted regression (Wier and Reynolds, 2018; see Case study 3). Data availability and sample size will determine the application of these mitigations. When applicable, we propose to break sample into four sub-samples based on the quartiles of total consolidate revenues (see Case study 4).

4. **Use tools to confirm and interpret results.** Two tools serving as proxies for the role of the unit within MNE are proposed: (1) Location of the unit which relates to tax system, labour costs, etc. to identify the role of the unit in the tax strategy of the MNE. (2) Economic activity of a unit to assess to a certain degree the technological nature and role of each unit within the MNE’s production chain. These tools can be based on aggregated data (e.g., analysing profits per employee, outward FDI, effective average tax rates, or intra-firm revenues across non-havens and tax havens as in Fuest et al., 2021, or Fortier-Labonté and Schaffter, 2019 – see also Error! Reference source not found.), or firm level data. Comparing results from regression analysis to a
comparable unit or MNE (or a control group), on a case-by-case basis, can help validate the results. As such process is inevitably resource intensive, it lends itself perfectly to LCU tasks. International collaboration of LCUs (where established) or experts of MNE data would support application of the method; LCUs are already engaged in the mapping of global MNE structures and roles of MNE units.

Source data

This method requires data on MNEs and their units, including variables such as profits before taxes, effective tax rates, number of employees, value of tangible assets and similar. These data can be found in OECD’s CbCR data.

Important limitation lies in data availability and coverage. In an ideal scenario, MNE-unit microdata and covering entire web of units within all MNEs in any way related to a country of interest, would be available. This, however, is usually not the case; statistical authorities mostly have data on domestic MNEs (headquartered in a country of interest) with information on their units in other countries, and data on foreign-owned (headquartered) MNE units in the domestic economy, but not their units abroad. National authorities of participating countries to CbCR can access\(^1\) CbCR microdata, i.e., at the level of each individual MNE unit (see Fuest et al., 2021 in Case study 4 for Germany; or Bratta et al., 2021 in Case study 5 for Italy).

CbCR reporting is required for MNE groups with more than €750 million of consolidated group revenue. Therefore, the dataset is limited in coverage, but studies have shown that the largest MNEs account for the bulk of profit shifting flows (see Wier and Reynolds, 2018; see Case study 3).

There may be some “double counting” of items in CbCR microdata, i.e., with reference to stateless entities (not resident anywhere for tax purposes) when reporting revenue and profit as “stateless” in both, the transparent unit and in the jurisdiction in which units operate (OECD, 2020a). However, as Fuest at al. (2021) show, along with additional guidance to the actual reporting by OECD (e.g., also on intracompany dividends), this problem is only of minor relevance.

National statistical authorities can access detailed data on MNE units active in the country (see Case study 3 for analysis based on firm-level tax returns from national Tax authority) from business statistics or tax data, etc., and these can be analysed in combination with CbCR microdata. Some legal settings exist also for the exchange of economic data among national statistical authorities, e.g., within the European Statistical System, to gain access to data on MNE units abroad beyond the CbCR threshold. Additional global data sources can also be used, as appropriate, such as OECD’s databases (ADIMA, AMNE and Tax Database), GGR, EuroGroups register or similar.

The method requires data on conditions of countries in which MNEs operate, such as population size, GDP per capita and tax rate. Several global data bases of international organisations provide data on population and GDP by country (such as UN Data or UNCTAD Statistical Database). KPMG’s Corporate

\(^1\) Conditions for access and automatic exchange of information, such as bilateral or multilateral tax treaties or tax information exchange agreements, are outlined in OECD (2019).
Calculation

The method estimates profit shifting in two steps: first, determine the presence of profit shifting via a semi-elasticity of profits on taxes, and second, measure the size of profit shifting flows.

1. Determining the presence of profit shifting

Following Fuest et al. (2021), the empirical model is specified as:

\[
\log(y_{i,c,t}) = \alpha_i + \beta_1 T_{i,c,t} + \beta_2 T_{i,c,t}^2 + \gamma' Firm_{i,c,t} + \delta' Country_{c,t} + \theta_t + \epsilon_{i,c,t} \quad \text{Equation (26)}
\]

where:

- \(y_{i,c,t}\) ... sum of profits before taxes of MNE unit’s \(i\) in country \(c\)
- \(T_{i,c,t}\) ... tax variable of MNE unit’s \(i\) in country \(c\)
- \(Firm_{i,c,t}\) ... vector including variables describing unit’s \(i\) activities in country \(c\)
- \(Country_{c,t}\) ... vector including variables describing conditions in country \(c\)
- Subscript \(t\) denotes time

For dependent variable, \(y_{i,c,t}\), we propose to use the logarithm of sum of profits before taxes of MNE unit’s \(i\) in country \(c\) to estimate the size of profits shifted.

From the above equation, the tax variable \(T_{i,c,t}\) is of our interest. This tax variable is defined as the difference between tax rate faced by MNE \(m\)’s unit \(i\) in country \(c\), \(\tau_{i,c,t}\), and the unweighted average of tax rates applied to the units of the same MNE \(m\) in all the countries apart from \(c\), \(\bar{\tau}_{m-i,-c,t}\). Therefore, \(T_{i,c,t} = \tau_{i,c,t} - \bar{\tau}_{m-i,-c,t}\). As mentioned, we propose using the effective average tax rate instead of statutory tax rate. If effective tax rates by different countries cannot be obtained from global data sources, such as OECD's Tax Database, at country level, they need to be calculated for a particular unit.

Depending on data availability, multiple options are available. Fuest et al. (2021) calculate the effective average tax rate in country \(\tau_{i,c,t}\) as the sum of taxes MNEs pay in country \(c\) divided by the sum of profits these units report in country \(c\). To avoid the potential endogeneity problem they propose to determine the effective average tax rate for unit \(i\) in country \(c\) only based on information on taxes paid and profits reported by other MNE units in country \(c\). If data availability is limited, however, the approach by Bratta et al. (2021) may be more feasible, whereby effective tax rate is imposed to be zero if statutory tax rate is zero; for other countries for which effective tax rates are not available, they are calculated as the difference between statutory tax rate of the country and the median difference between statutory and effective tax rates observed in the (populated) dataset.

\[\text{In case where tax difference is being constantly referenced to the same “domestic” country } c, \text{ as is the case of Fuest at al. (2021) where observations are only made for German MNEs, average tax rates faced by units of the same MNE abroad can be used alone instead of differences in tax rates.}\]
Firm vector includes variables depicting unit’s economic activity: logarithms of (i) number of employees and (ii) value of tangible assets.

Vector Country includes (i) logarithm value of GDP per capita adjusted for purchasing power parity (PPP) and (ii) logarithm of population. \( \alpha_i \) refers to MNE unit’s fixed effects and \( \theta_t \) to year fixed effects (conditioned on data availability).

As the specification above is quadratic, related coefficients \( \beta_1 \) and \( \beta_2 \) constitute the semi-elasticity of profits with respect to tax rate. In their interpretation, however, we need to compute a (combined) marginal effect of a tax rate at certain effective tax rate (e.g., 10 or 25 per cent; see Fuest et al., 2021; Bratta et al., 2021), as it is no longer constant with the addition of \( \beta_2 T^2_{i,c,t} \). Negative marginal effect of 0.01, for example, would show that a 1 percentage point higher tax rate is associated with a 1 per cent lower (reported) profits. The estimated parameters of semi-elasticities of profits with respect to tax rate are the result of first step and used directly in the second step (as outlined below) to observe the measured profit shifting flows.

2. Measuring the size of profit shifting flows

To provide a dollar-measure of IFFs from MNE profit shifting (to low-tax countries), we observe how the actual profits declared in country \( c, y_{i,c,t} \), would change if a different (lower) tax rate was applied and hence tax incentive to shift profits removed (assuming other factors are accounted for in the model specification). This is processed in the following way (following Bratta et al., 2021; see Case study 5).

First, we recognize that actual, declared profits can be decomposed into part \( R \), related to real economic activity, and part \( S \), related to differences in tax rates, i.e., (tax-induced profit shifting):

\[
y_{i,c} = R_{i,c} + S_{i,c} \\
\text{Equation (27)}
\]

Second, we note that shifted profits are a part of real profits, \( R \). This part is defined through semi-elasticity from step 1 and corresponding tax variable, together marking the marginal effect of tax rate: how much do real profits change with tax rate change. Hence, we can write:

\[
y_{i,c} = R_{i,c} + \hat{\beta} T_{i,c} * R_{i,c} \\
\text{Equation (28)}
\]

where:

\[
\hat{\beta} T_{i,c} = \beta_1 T_{i,c} + \beta_2 T^2_{i,c}.
\]

Finally, rearranging slightly to obtain \( R_{i,c} = \frac{y_{i,c}}{1 + \hat{\beta} T_{i,c}} \) and inserting into \( S_{i,c} = y_{i,c} - R_{i,c} \) we obtain the final equation to measure the size of profit shifting:

\[
S_{i,c,t} = \frac{y_{i,c,t} * \hat{\beta} T_{i,c,t}}{1 + \hat{\beta} T_{i,c,t}} \\
\text{Equation (29)}
\]

where \( T_{i,c,t} \) is defined as the difference of effective tax rate of country \( c \) and the unweighted average effective tax rate applied to other units than unit \( i \) of MNE \((m-i)\) in other countries \((-c)\). Note, however, that with non-linear semi-elasticity, the value of marginal effect will depend on the actual values and not
just the difference, i.e., even though the difference between 5 and 10 is the same as between 20 and 25, the corresponding marginal effects would not be the same. Hence:

$$\hat{\beta}_{T_{i,c}} = (\beta_1 \cdot \tau_{i,c} + \beta_2 \cdot \tau_{i,c}^2) - (\beta_1 \cdot \bar{\tau}_{m-i,-c} + \beta_2 \cdot \bar{\tau}_{m-i,-c})$$  \hspace{1cm} \text{Equation (30)}$$

Results will be calculated for each MNE and per country where the MNE’s unit is present (and in time $t$, depending on data availability). A negative value of $S_{i,c,t}$ indicates that profits are being shifted out of a country, with reverse holding for positive values of $S_{i,c,t}$, meaning profits are being shifted into a country.\(^3\)

Therefore, building on equation (29), each flow of profits is determined either as an outward or inward IFF as per:

$$\text{OutwardIFF}_{i,c,t} = \min(0, S_{i,c,t})$$  \hspace{1cm} \text{Equation (31)}$$

$$\text{InwardIFF}_{i,c,t} = \max(0, S_{i,c,t})$$  \hspace{1cm} \text{Equation (32)}$$

Underestimation of the results stemming from data coverage (e.g., excluding firms below a certain threshold, such as the €750 million in CbCR, or potentially not accounting for foreign-owned MNE units in domestic country) can be mitigated by scaling up of obtained results. Examples are found in Clausing (2016) for United States or Fuest et al. (2021; see also Case study 4) for Germany. This, however, may be more problematic in countries with a variety of combinations and effects of MNEs’ presence, roles and related profit shifting. In the absence of specific national circumstances and data availability, the suggested method for pilot testing (still potentially subject to national enhancements) uses the following to determine IFFs at national level:

$$\text{OutwardIFF}_t = \sum_{i,c} \text{OutwardIFF}_{i,c,t}$$  \hspace{1cm} \text{Equation (33)}$$

$$\text{InwardIFF}_t = \sum_{i,c} \text{InwardIFF}_{i,c,t}$$  \hspace{1cm} \text{Equation (34)}$$

\textit{Case study 3. Estimating profit shifting in South Africa using firm-level tax returns}

Reynolds and Wier (2016) use firm tax returns from Tax authority in South Africa for the period from 2009 to 2014 to analyse variables, including labour costs, fixed capital, accounting profits and taxable profits. The analysis includes MNE units in South Africa with sales of over 1 million South African Rand (ZAR) that are at least 70 per cent owned by a foreign parent. All other MNE units are excluded due to data limitations, including cases where South African unit is the parent of the MNE. With about 2 000 MNE units, only a small number compared to nearly one million firms in South Africa, these subsidiaries are markedly larger than the average South African firm. The observed average parent tax rate is similar to domestic corporate tax rate. The authors estimate the following specification:

$$\log(\text{taxable income}_{it}) = \alpha_{net} + \beta_1 \log(\text{fixed capital}_{it}) + \beta_2 \log(\text{labour expenses}_{it}) + \beta_3 \cdot \text{parent tax rate}_{it} + \epsilon_i$$  \hspace{1cm} (1)$$

\(^3\) Underlying assumption is the »correct« results from the first step, i.e., the marginal effect is negative. If this, however, cannot be proven econometrically, the model specification is unsuitable for the country at hand and will not produce reliable IFFs estimates. In such cases, in-depth knowledge is required to either reformulate the model in step 1, or apply other approaches (see step 4 in overcoming limitations of this method above).
The semi-elasticity of taxable income with respect to the parent tax rate is estimated to be 1.7, meaning that a 10 percentage points lower parent tax rate is associated with a 17 per cent lower taxable income in the South African unit of that MNE. Accordingly, they estimate the loss of MNE units profits due to profit shifting at 7 per cent of these units’ income, or 1 per cent of the total corporate tax base in South Africa.

In another study, Wier and Reynolds (2018) investigate the link between firm size and profit shifting. They find that the major portion of profit shifting takes place with the largest of MNEs, with the majority of firms shifting only very limited amount of profits. By not considering heterogeneities in profit shifting across firms of different sizes may lead to significant underestimation of profit shifting. Accordingly, the authors account for differences in size by dividing the sample into ten groups according to wage bills and run regressions within each of these groups. They show that in larger MNE units, the estimated impact on profitability is significantly larger and also statistically significant. Alternative way to account for the size of firms is to apply a weighted regression using wage bill as the weight.

Results are significantly larger when properly accounting for firm size. Authors also note that combining high profits with aggressive tax avoidance implies that the largest 10 per cent of foreign-owned firms account for as much as 98 per cent of all profits shifted. As these findings are not unique to South Africa, authors note the findings can help in explaining the gap between micro and macro estimates of profit shifting often observed in studies.

**Case study 4. Profit shifting in Germany using Country-by-Country Reporting data**

Fuest et al. (2021) analyse CbCR data for German-headquartered MNEs at the level of each MNE unit. They estimate tax-induced profit shifting using the quadratic specification (to account for non-linearity of tax sensitivity):

\[ y_{ict} = \alpha_i + \beta_1 \tau_{ct} + \beta_2 \tau_{ct}^2 + \gamma_i Firm_{ict} + \delta_i Country_{ict} + \theta_i + \epsilon_{ict} \]

The authors use two alternatives for dependent variable: statutory tax rate and effective tax rate to show that statutory tax rate is an inaccurate measure of the actual tax burden in a country. In the vector Firm, they also use the unrelated revenues. Given the granularity and richness of their dataset, they further use dummy variables to test whether tax havens (divided into European and non-European) play a key role in profit shifting by German MNEs – and show this is the case, whereby confirm the bivariate graphical analysis conducted at the beginning of their study revealing that MNE units in non-haven countries have smaller profits per employee, whereas effective average tax rates are higher in non-havens (with just above 20 per cent) than in both European and non-European tax havens (10 and 11 per cent, respectively).

Fuest et al. (2021) further test whether tax sensitivity varies depending on the size of the MNE, whereby they break down the entire sample into four sub-samples based on the quartiles of MNEs’ consolidated revenues. The findings confirm that larger MNEs shift more profits. Results of the regression model (with only a linear tax sensitivity) are presented in the following table.

**Semi-elasticities by firm size**
In the last step, the authors estimated the total of profits shifted to tax havens by large German MNEs to amount to approximately €18.3 billion for 2016 and 2017 combined, roughly 40 per cent of total profits reported by MNEs in tax havens. With this estimate, the authors also note that profits shifted by German subsidiaries of foreign MNEs are excluded, as well as the ones by domestic MNEs with revenues below the threshold €750 million to be included in CbCR. To account for those, scaling-up is processed assuming, first, that the three groups (German MNEs, domestic MNEs with revenues below threshold, and German subsidiaries of foreign MNEs) contribute to the total profits reported in the same way as they contribute to gross operating surplus (for which the distribution is available); and second, that the latter two groups shift the same share profits to tax havens as German MNEs covered in CbCR. The resulting figure is €19.1 billion on average per year.

**Case study 5. Profit shifting in Italy using Country-by-Country Reporting data**

Bratta et al. (2021) study profit shifting in the case of Italy (Italian MNEs and foreign MNEs operating in Italy) using cubic specification:

\[
\ln(\pi_{c,m}) = \beta_0 + \delta_1 \ln(K_{c,m}) + \delta_2 \ln(L_{c,m}) + \delta_3 \ln(R_{c,m}) + \beta_1 T_{c,m} + \beta_2 T_{c,m}^2 + \beta_3 T_{c,m}^3 + X_m + \Psi_c + \epsilon_{c,m}
\]

Authors study scenarios differing based on what tax rate they use (statutory corporate income tax rate or effective average tax rate) and whether they use the tax rate itself or the rate differential, i.e., the difference between the tax rate of the country where the MNE unit is located and the average rate faced by other units of the same group operating in all other countries. Based on the results of different specifications, they show how semi-elasticity and marginal effects differ: the table shows the percentage change in profit in a country due to an increase of tax rate by one percentage point, and how, in their case, cubic function performs intuitively correct (always a negative marginal effect).

**Semi-elasticities of statutory CIT rates and tax rate differential in linear, quadratic and cubic formulation**
Bratta et al. (2021) estimate profits shifted using the following formula:

\[
S_{m,c} = \frac{\pi_{m,c} \hat{\beta} f(C_{m,c})}{1 + \hat{\beta} f(C_{m,c})} = \frac{\pi_{m,c}}{1 + \hat{\beta} f(C_{m,c})} \left( \hat{\beta}_1 C_{m,c} + \hat{\beta}_2 C_{m,c}^2 + \hat{\beta}_3 C_{m,c}^3 \right)
\]

Since they use a larger data base than Fuest et al. (2021), i.e., they also take into account other MNEs in Italy, their results provide for the global level of profit shifting. Adjustments need to be made for coverage (MNEs below €750 mio and MNEs not having a unit in Italy) and the authors estimate that in 2017 a total amount of €887 billion of profits was shifted due to differences in tax rates (Bratta et al., 2021).