**Concept and assumptions**

Like PFM, the MNE vs comparable non-MNE profit shifting method also grounds its concept on the idea of abnormality. This is a bottom-up method, processed in two phases: first, to identify the tax-avoiding MNEs, and second, to measure the related amount of BEPS. The method identifies abnormalities in structural and economic variables of MNEs in comparison to the behaviour of similar domestic enterprises. The method exploits the information coming from a double comparison: between MNEs and non-MNEs (by propensity score matching) and within the group of MNEs (by receiver operating characteristics analysis, ROC) (Sallusti, 2021). This method estimates BEPS as the difference between profits that are declared and those that should have been declared.

The identification phase is composed of two steps. The first focuses on a “between” comparison, assessing the abnormalities of MNEs with respect to the similar non-MNEs, i.e., domestic firms, which are unable to freely manage the allocation of their production and finances geographically. The control group of domestic firms is determined through propensity score (PS) matching using variables, such as territory, economic activity, employment etc. Comparing profit-to-turnover ratio of a particular MNE with that ratio of domestic control group leads to identifying a proxy for abnormal behaviour of MNEs. Second, referred to as the “within” comparison, the receiver operating characteristics (ROC) analysis is conducted, resulting in defining the threshold of normality (calculation provided below). This threshold is set to identify tax-avoiding MNEs among the total population of MNEs. This step starts from the proxy of first step and uses indicators capturing economic and strategic behaviours of MNEs. An important advantage of this method using this second step is that it does not treat all MNEs equally in the sense of all (abnormal) MNEs are tax-avoiding. Therefore, ROC analysis also tends to adjust the suspect indicator provided by the proxy in the “between” comparison.

The subsequent measurement of the related amount of BEPS (second phase) is obtained by calculating the amount of profits identified tax-avoiding MNEs should have declared to classify them as non-tax avoiding. The method uses Earnings Before Interest and Tax (EBIT) as the variable to be adjusted.

To measure BEPS of tax avoiding MNEs, the indicator uses a vertical strategy, focusing only on the MNEs in the same country (rather than on all firms of a given MNE in all the countries the group operates, something not readily available in any statistical system). This strategy assesses BEPS by analysing incoherencies between a given MNE and other (local) MNEs with similar characteristics.

**Overcoming limitations**

Comparing MNEs and Non-MNEs is challenging because the differences between the two groups could be driven by a range of different factors beyond BEPS (e.g., productivity, economies of scale). This drawback is eased somewhat by forcing the control group into same size class. This, true, may still pose a problematic issue in smaller economies, where it might be more difficult to identify an appropriate domestic match for the subsidiaries of large multinationals (at the same time bearing in mind that the

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1. The method touches upon the concept of BEPS by OECD and is related to its indicator 4 of BEPS, namely MNE versus comparable non-MNE effective tax rate differentials (OECD, 2015). However, the method takes additional steps representing an innovation in the measurement of BEPS (Sallusti, 2021).

2. See the application of the method by Sallusti (2021) in Case study 2.
size refers to the local subsidiary itself and not the holding). Even in larger economies it might be hard to find a good match for very large MNEs. To overcome this, MNE units can be compared to either an average of the domestic firms with respect to available size or industry classes (clusters), or in cases where capacity does not allow for such comparison, comparing all MNE units to all domestic firms could be considered as the solution of last resort.

Another limitation of the method is that a proposed set of matching variables includes mainly ratios (except for the number of employees, sector and region), which could result in a poor match in terms of size. However, the issue is eased by imposing that each domestic firm in the control group is included in the same size class (additionally to the same sector and region) of the related MNE. Another way to control for the size-related comparability may be represented by including, if data permits, the size of assets as in the case in Bilicka (2019).

The method suffers, like the previous method, also from the confounding effect, where other reasons may contribute to, or lead altogether the identified BEPS activity.

Main drawback of the method from SDG reporting is that a country first needs to be defined as being prone to either outward (BEPS generating) or inward (BEPS collecting) flows of IFFs. Namely, the first step of defining a proxy is by design such that it requires this decision to be made prior to using the method. The presented method is for outward IFFs, whereas a symmetrical approach (with a different first phase) is presented in Box 1.

**Source data**

This method uses microdata available to NSOs (SBS) in a country and as such provides the possibility of linking with national accounts. These data are likely to be more complete relative to the CbCR data which have a threshold for inclusion of entities. The source data include firm-level data containing economic and structural variables (e.g., value added, research and development (R&D) spending, share of salaries to total costs, etc. – see also Case study 2). The NSO’s structural business statistics and other relevant sources with firm-level data can be used. Research showed that in some cases data from administrative data on taxable profits directly from the tax returns may be better suited than financial accounts (accounting profits). Foreign multinational subsidiaries seem to be reporting positive profits in their accounts, while at the same time reporting zero taxable profits on their tax returns. This would bias downwards the estimates of profit shifting obtained using accounting data (Bilicka, 2019). These microdata are further integrated with statistics on these firms’ international trade by products and trading partners (country of origin/destination), and position of national firms within MNEs (sourced from, preferably, national Groups Register3), where relevant. FATS, if available, can provide a useful additional data source. Moreover, LCU, if established in the NSO, can help with the integration of various data sources.

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3 In absence of national register with business groups structures, alternative registers can be used, if available. One example is the EuroGroups Register (European Commission, 2020b).
Calculation
The method is described in Sallusti (2021) for the case of Italian MNEs (see also Case study 2). Main phases of the application of MNE vs comparable non-MNE profit shifting method by NSOs are listed below.

**Phase zero** is the identification of either inward or outward IFFs nature of your country. Inspection of tax practices and other macroeconomic variables is used to process this classification of the country. Using OECD’s dashboard approach of BEPS indicators (OECD, 2015) an example of quantifying MNEs impacts on Canadian tax base is presented (and can be applied in this phase) by Fortier-Labonté and Schaffter (2019) – see Case study 1.

**Case study 1. Indicators of profit shifting by multinational enterprises operating in Canada**

Indicators of profit shifting by MNEs in Canada have been studied by Fortier-Labonté and Schaffter (2019), whereby they apply the BEPS indicators of OECD (2015) to identify whether Canada experiences MNEs performing BEPS activities. Specifically, they look for mismatches between financial and real economic activity using macroeconomic data from Statistics Canada and the World Bank. The mismatch may indicate income not being reported, and therefore not taxed, where it was earned.

The data are from Statistics Canada’s Balance of Payments program, specifically the outward foreign direct investment statistics and the activities of Canadian majority-owned affiliates abroad. Two indicators are studied:

1. **BEPS Indicator 1A**: Mismatches between stocks of Canadian outward FDI and GDP of recipient countries for countries with favourable corporate income tax rates, revealing that a high level of Canadian outward FDI was directed to countries with favourable corporate tax rates.

   ![Relative size of Canadian outward FDI and of GDP for ten countries with highest stocks of Canadian FDI, 2016](image)

   **Source:** Fortier-Labonté and Schaffter (2019), based on Statistics Canada (NDM table 36-10-0008-01) and the World Development Indicators.

2. **BEPS Indicator 1B**: Mismatches between assets, employment and sales for countries with favourable corporate tax rates. Results showed that in 2016, in countries with favourable corporate tax rates, foreign subsidiaries reported having 23 employees per billion dollars of assets. For the other countries, foreign subsidiaries reported having 270 employees per billion of assets. These results suggest that investment in countries with favourable corporate tax rates by the subsidiaries of MNEs operating in Canada is not driven by real economic factors.

Overall, using these indicators, Canada can be interpreted as an outward IFFs country.
1. **Identification phase**

The identification phase is processed in two steps: the between and within comparison. They are presented in turn.

**Between comparison** of the identification phase first applies the PS to define, for each MNE, the most efficient control group of domestic firms. Characterization is based on variables including territory, economic activity, employment, indicators of internationalization, structure of costs and revenues (see Case study 2).

Next, clustering between MNEs with “normal” and “abnormal” behaviour in comparison to similar non-MNEs is processed based on a proxy for each MNE-control group pair:
- \( Proxy = 1 \) (suspect, or indicator of “abnormality”) if EBIT-to-turnover ratio of the given MNE is lower than the average of the control group; and
- \( Proxy = 0 \) (no suspect) if EBIT-to-turnover ratio of the given MNE is higher than (or equal to) the average of the control group.

**Within comparison of the identification phase**, is processed using ROC analysis to determine the extent to which status outlined by the proxy binary variable from previous step can be reliably confirmed when variables of economic performance, strategies and contextual variable are taken into account. Put differently, ROC analysis is used to define the final clustering between tax avoiding and non tax-avoiding MNEs starting from the proxy variable from previous step. To that end, first, the classifier is represented by a composite indicator built from the following set of characteristics (Sallusti, 2021): EBIT-to-turnover ratio; Value added-to-turnover ratio; R&D spending with respect to turnover; share of royalties on total costs; share of salaries on total costs; share of services on total costs; export-to-turnover ratio; import-to-total cost ratio; average differential in income taxation among (related) countries.

To account for differences in economic activities, they are treated separately in strata. For each such stratum, the composite indicator for the \( i \)-th MNEs \( \hat{I}_i \) is constructed using factor analysis on the whole set of selected characteristics, and then aggregating the first two factors\(^4\) using the relative share of explained variance as weight \( \omega_i \):

\[
\hat{I}_i = \omega_1 \left( \sum_j y_{j,1} x_{j,i} \right) + \omega_2 \left( \sum_j y_{j,2} x_{j,i} \right) 
\]

\[\text{Equation (35)}\]

\[
\text{where:} \\
\quad y_{j,1}, y_{j,2} \quad \text{... loadings of variable } j \text{ in factors 1 and 2} \\
\quad x_{j,i} \quad \text{... value of variable } j \text{ for observation } i.
\]

\(^4\) Two factors are proposed here, although this may vary given the data at hand. The share of explained variance by the factors should be at least about 80 per cent.

\(^5\) Factor analysis is based on correlation matrix of variables.
Here, $\gamma_{j,1}$ and $\gamma_{j,2}$ are the loadings of variable $j$ in factors 1 and 2, $x_{j,i}$ is the value of the $j$-th variable for the $i$-th observation, and $\omega_1$ and $\omega_2$ are weights in term of explained variance.

Next, the composite indicator calculated in Equation (35) is then used as explanatory variable in a logit model having as dependent the proxy of “suspect” ($Proxy=1$).

As a result of the ROC analysis$^6$, the threshold observation is identified (for each stratum). The value of its composite indicator can be interpreted as the threshold value ($\bar{I}$) above or below which other MNEs can be classified. Specifically, MNEs will be considered as tax avoiding if $I_i < \bar{I}$, while they will be considered as non-tax avoiding if $I_i \geq \bar{I}$.

2. Measurement of BEPS

For each MNE that was identified as tax avoiding in the previous phase, estimate of the BEPS is provided using the amount of EBIT concealed using aggressive tax avoidance$^7$.

Next, for each tax avoiding MNE, BEPS is calculated as the difference between the theoretical profits (amount of profits that they should have declared in order to be classified as non-tax avoiding) and the actually declared profits. The measurement of BEPS is carried out by increasing the EBIT-to-turnover ratio ($x_{-h}$), keeping the other variables ($x_{-h}$) unchanged so as to obtain $I_i = \bar{I}$. Applying this to equation (35), the adjusted value of EBIT-to-turnover ratio in line with the threshold shifting from tax avoiding to non-tax avoiding MNE $i$ is presented as:

$$\tilde{x}_{h,i} = \bar{I} - \left( \frac{\omega_1 \sum_{-h} \gamma_{-h,1} x_{-h,2} + \omega_2 \sum_{-h} \gamma_{-h,2} x_{-h,2}}{\omega_1 y_{h,1} + \omega_2 y_{h,2}} \right)$$  \hspace{1cm} \text{Equation (36)}

Finally, the amount of EBIT connected with BEPS, termed outward IFFs here, is calculated, for each tax avoiding MNE $i$, as:

$$OutwardIFFs_i = (\tilde{x}_{h,i} - x_{j,i}) \cdot Turnover_i$$  \hspace{1cm} \text{Equation (37)}

where

- $x_{j,i}$ … the declared value of EBIT to turnover ratio;
- $\tilde{x}_{h,i}$ … the threshold value of the EBIT to turnover ratio in order to be classified as non-tax avoiding MNE.

At national level and for a given year, the aggregate value of IFFs is obtained by aggregating over all MNEs in a country:

$^6$ The value of parameter $h$, weight to manage the trade-off between true and false positives in ROC, is set to a neutral 0.5 (Sallusti, 2021).

$^7$ This is equal to value added if the labour cost is given. As Sallusti (2021) notes the conceptual correspondence of EBIT and value added under the condition of fixed amount of labour costs is relevant if one is willing to use the estimates in the context of the measurement of GDP and GNI in national accounts.
\[
\text{OutwardIFFs} = \sum_i \text{OutwardIFFs}_i
\]

Equation (38)

Application of the method to provide for inward IFFs is depicted in Box 1.

Box 1. Inward IFFs in MNE vs comparable non-MNE profit shifting

The procedure described above in section 2.2 of Part II is intended to identify and measure the amount of BEPS generated by tax avoiding MNEs in a given country, which in turn represents outward IFFs (see equation (37)). However, the method can also be used to account for the symmetric case, in which BEPS (outward IFFs in Country A) are collected by an MNE unit in Country B, where it represents an inward IFFs.

Following the conceptual framework proposed for the case of BEPS generation (outward IFFs), in the case of BEPS collection (inward IFFs) the assumption is that BEPS-collecting MNEs should have a level of profits higher than the “normal” level of similar non-MNEs in the same Country. Accordingly, the shape of structural, economic, and behavioural variables should be different with respect to the case of BEPS generation. In particular, the structure of revenues, instead of the structure of costs should be focused on. Other characteristics (such as the international tax framework and the participation in international markets) are the same, but they need be modified to account for the symmetric behaviour (e.g., the tax differential should in case of BEPS-collecting MNEs have an inverse relationship with the “suspect”).

To identify and measure BEPS collection (and the related inward IFFs), all the steps in the procedure are modified according to the different context of analysis. In particular:

1. The first step of the identification phase (PS matching) is modified to provide a coherent proxy of “suspect”. Indeed, it relates to a level of EBIT-to-turnover ratio for the given MNE that is higher (instead of lower) than the average of the control group. In this context, however, the definition of the control group (method, confounding variables, and constraints) is the same as in the case of BEPS generation. Similarly as in procedure described for identifying outward IFFs, also here comparison of MNE units to domestic firms can be adjusted to meet national statistical capacity, i.e., when comparable domestic firms cannot be identified, comparison can be made to an average of certain size or industry class, or, eventually, simply comparing all MNE units to all domestic firms.

2. In the second step of the identification phase (ROC analysis) the set of considered variables changes to account for structural and behavioural indicators that signal the presence of a MNE that collects eroded profits from MNEs residing in other Countries. In this case the following set of variables should be considered (take into account that variables should be positively correlated with the proxy of “suspect”, which, in case of BEPS collection, is represented by higher profits with respect to the average of the control group of non-MNEs):
   - EBIT-to-turnover ratio (reversed with respect to the case of BEPS generation)
   - Value added-to-turnover ratio (reversed with respect to the case of BEPS generation)
   - R&D spending with respect to turnover
   - share of royalties on turnover
   - share of salaries on total costs
   - share of services on turnover
   - export-to-turnover ratio
   - import-to-total cost ratio
   - average differential in income taxation among (related) countries (reversed with respect to the case of BEPS generation)

Given the change in the second step of identification, the measurement phase of BEPS-collecting MNEs (inward IFFs) is analogous as in the case of BEPS-generating MNEs (outward IFFs). Indeed, the definition of the threshold does not conceptually change. In this case, however, \( x_{j,1} \) for MNEs that are considered as collecting BEPS from other countries should be higher than \( x_{h,1} \), which is the level of the EBIT-to-turnover ratio representing the threshold. This produces the reversed sign with respect to the case of outward IFFs (BEPS generating MNEs, see equation (37)), meaning that the total level of EBIT for these MNEs has to be reduced with respect to the one they have declared. Therefore, the amount of EBIT connected with BEPS-collecting, termed inward IFFs here, is calculated, for each BEPS-colleting MNE \( i \), with a negative sign to account for the reversal:
\[ \text{InwardIFF}_{i} = - (\bar{x}_{h,i} - x_{j,i}) \times \text{Turnover}_{i} \]  \hspace{1cm} \text{Equation (39)}

At national level and for a given year, the aggregate value of inward IFFs is obtained by aggregating over all MNEs in a country:

\[ \text{InwardIFFs} = \sum_{i} \text{InwardIFF}_{i} \]  \hspace{1cm} \text{Equation (40)}

Similar as for outward IFFs, once the country is classified as inward or outward IFFs prone, its value of total IFFs will equal that category, here IFFs = InwardIFFs.

Given the concept of the method, a particular country can be prone to either outward IFFs or inward IFFs. Hence, once the country is classified accordingly, its value of total IFFs will equal that category, e.g., IFFs = OutwardIFFs for the case at hand in equation (38). Using this methodology, therefore, a breakdown of IFFs by the direction of flows cannot be achieved.

**Case study 2. Measuring profit shifting in Italy**

A PS-ROC method to measure BEPS is described in Sallusti (2021) for the case of Italian MNEs. The case uses firm-level data collected by Istat and referred to 2015. For each Italian firm (MNEs and non-MNEs), Sallusti (2021) integrates three databases:

- The archive Frame-SBS (Structural Business Statistics), which includes the information about the structure and economic variables for the whole set of 4.4 million of firms.
- The archive COE-TEC (Integrated International Trade Database), which includes the information about imports and exports (by product and origin/destination Country) for the whole set of firms.
- The archive ASIA-Groups (Italian version of European EGR), which includes the information about firms involved in domestic and foreign groups.

A final database for the analysis contains 3.6 million firms, where about 400 thousand are internationalized (export and/or import) and 61.706 belong to MNEs. Initial cleaning of the database included also removing firms with negative or zero value added or turnover, or employing less than 1 worker, as well as business units operating in industries characterized by regulated markets such as tobacco, coke and refined petroleum products, and financial intermediaries.

The method’s identification phase first looks at “between” comparison. Domestic firms were characterized by nine variables which are used for the PS matching:

- region (NUTS2)
- industry (3-digit NACE rev. 2)
- per-capita turnover
- persons employed
- share of goods and services on total costs
- export-to-turnover ratio
- import-to-total costs ratio
- share of salaries on total costs
- share of services on turnover

The matching, however, is carried out in clusters of domestic companies in control groups, comprised of 10 non-MNEs with the highest level of similarity with respect to region, industry, size class (1-2, 2-5, 5-10, 10-20, 20-50, 50-100, 100-250, 250-500, more than 500 workers).

Differences between MNEs and non-MNEs (domestic firms) exist specifically in labour productivity, but also export-to-turnover ratios and import-to-costs ratio.

**Multinational enterprises vs. non-multinational enterprises, 2015 (percentage)**
The \textit{within comparison} of the identification phase assumes the equal weights assigned to manage the trade-off between true and false positives, therefore $h=0.5$.

A “vertical” strategy has been chosen to \textbf{measure} \textbf{BEPS}. In this strategy, analysing possible incoherencies between the given MNE and others MNEs (with similar characteristics) in the same country assesses BEPS. Obvious constraint for choosing this strategy are availability and reliability of data related to foreign business units belonging to MNE in which Italian business units are involved.

Analyzing 61 191 MNEs in 2015, the PS-ROC methods reveals that tax avoiding units represent \textbf{60.1 per cent of Italian MNEs}, strongly differing by sectors: incidence of tax avoiding units ranges from 43.3 per cent in real estate activities to 78.8 per cent in informatics. Results also show that BEPS amounts to €32.3 billion, accounting for about \textbf{2 per cent of the Italian GDP} at current prices. Results also confirm that, generally speaking, tax avoiding MNEs are smaller (26.5 vs 94.2 workers on average) and less productive (€77.0 vs. €89.9 thousands) than non-tax avoiding ones. They also generate higher turnover (€26.3 vs. €17.9 million on average), value added (€8.5 vs. €2.0 million) and, particularly, EBIT (€8.2 vs. €1.4 million). Consequently, tax avoiding MNEs are characterized by lower levels of EBIT-to-turnover ratio (7.9 per cent vs. 31.2 per cent).

\textit{Source: Sallusti (2021)}