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Abstract

This paper characterizes profit shifting behavior across the size distribution of multinational enterprises (MNEs) to evaluate the targeting of the recently introduced Global Minimum Tax (GMT). Using German microeconomic administrative data with no reporting gaps for tax havens, we first document reductions in tax payments after tax haven subsidiaries are added to a group and confirm their outsized productivity. As group size increases, so does the likelihood of including tax haven subsidiaries. Second, we introduce a new methodology to estimate shifted profits at the group level and find an exponential group size gradient in profits shifted to tax havens. A total of EUR 19 billion was shifted to tax havens by German MNEs in 2022. Large groups targeted by the GMT account for 95% of this amount. While this is mainly a function of their size, we also document a positive gradient in profit shifting aggressiveness relative to employment. Third, we relate revenue potential from taxing excess profits in low-tax jurisdictions to compliance costs of the GMT, using a 15% benchmark rate. For groups currently covered by the GMT, revenue gains significantly dominate costs, while extending coverage to additional groups yields only modest net gains. Our results support policy consistency of the GMT in the face of recent unilateral challenges.

JEL classification: H26, G38, F34

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1 Introduction

International tax avoidance by multinational enterprises (MNEs) is one of the most dominant issues on the tax policy agenda of many countries. On January 1, 2024, the global minimum tax (GMT) came into force and introduced a global tax floor of 15% on the corporate income tax of large internationally active firms. This reform represents one of the most profound changes to the global tax system in recent history and impacts hundreds of tax administrations and thousands of large MNEs worldwide. To alleviate undue administrative and compliance burdens, it is targeted only at multinational groups above a threshold of EUR 750 million in revenue. Below this cutoff, firms are not liable to pay the GMT; above it, they may be required to do so. To the best of our knowledge, there is no economic justification for this number. Instead, it is the result of an international negotiation process, dating back at least to the introduction of country-by-country reporting in 2016 that features the same cutoff.

While several anti-tax avoidance policies target very large groups only,[1] the desirability of such an approach is based on surprisingly little evidence. We have limited knowledge about heterogeneity in avoidance behavior in general and in size heterogeneity in particular. Is profit shifting primarily done by digital companies with U.S. headquarters? If not, how much of shifted profits does the GMT cover? How substantial is profit shifting below the cutoff—if it exists at all? What is the relationship between compliance costs and potential tax revenue? Answering these questions is important since targeting too broadly could impose unnecessary administrative and compliance costs on firms that do not engage in aggressive profit shifting—without yielding much additional tax revenue. Focusing too narrowly could overlook major profit shifters and undermine societal cohesion and trust in government by raising level playing field concerns. In this paper, we construct group-level estimates of shifted profits and relate them to group size in order to answer these questions.

We use administrative data on German MNEs (MiDi database), which includes detailed information on group structure and information for each subsidiary, as well as variables consolidated at the group level. Germany is a particularly interesting laboratory for our study, as it is a large and internationally integrated economy that is part of the first wave of GMT implementation. To verify the interpretation of a tax haven affiliate as a profit shifting technology, we document a rapid decrease in taxes paid when groups establish their first tax haven subsidiary. We also document outsized productivity ratios of these subsidiaries. We then show that less than half of below median-sized groups include a tax haven subsidiary within their group structure, while the likelihood approaches unity at the top of the size distribution. Profit shifting to tax havens is

[1] For example, the Global Minimum Tax (GMT) and Country-by-Country Reporting (CbCR) under BEPS Action 13 both apply to firms with revenues above EUR 750 million, while in the US, the Base Erosion and Anti-Abuse Tax affects corporations with at least USD 500 million in annual gross receipts. The UK digital services tax only applies to groups with more than GBP 500 million in revenues derived from digital activities.

hence not ubiquitous across all MNE groups but appears to be close to universal above the GMT threshold. Using measures of excess profitability we then develop a methodology that provides the total profits shifted by each individual MNE group in our sample. In total, we find that EUR 19 billion in profits were shifted by German MNEs to tax havens in 2022. We document an exponential pattern of profits shifted across the group-size distribution with the GMT covering less than 30% of MNE groups but 95% of all profits shifted. We also document a positive gradient of profits shifted per employee but its gradient is much weaker than that of total profits shifted. Hence, while larger groups are more aggressive profit shifters in relative terms, the bulk of the exponential gradient in profits shifted is due to absolute group size. In our last set of results, we compare compliance costs and potential revenue gains from taxing excess profits located in tax havens at 15% in back of the envelope calculations. For firms above the GMT threshold, potential revenues gained dominate costs substantially while gains from lowering the threshold are modest. Our results show that the GMT is well targeted and support policy consistency in the face of current unilateral challenges against it.

Access to comprehensive and reliable microeconomic data is vital in our setting for at least four reasons. First, we can be sure that we observe the entire international group structure at any point in our sample period. The MiDi database does not suffer from the systematic under-reporting of tax haven subsidiaries that has been established for the Orbis database (Tørsløv et al., 2023). We can, for example, use the emergence of tax haven subsidiaries for identification and provide tax haven productivity ratios based on microeconomic data. Second, we have access to comprehensive group-level variables such as consolidated turnover and employment. This allows us to sort groups according to the consolidated turnover relevant for the GMT and to establish ratios relative to group-level totals. Third, we have access to balance sheet data for each subsidiary in our dataset and can therefore control for non-tax related differences in profitability across firms. Lastly, contrary to studies on profit shifting that use the country-by-country data (Clausing, 2020a; Aliprandi et al., 2025; Fuest et al., 2022), we are able to observe firms below the policy threshold and estimate profit shifting on the whole MNE group distribution.

This paper makes three main contributions to the literature. The first is to characterize profit shifting behavior across the MNE group-size distribution along several dimensions. After documenting a decrease in tax payments when tax haven subsidiaries are established, we show that the likelihood of using this profit shifting technology, as well as the amount of profits shifted and the intensity of shifting—systematically increases with group size. These results add to a literature investigating heterogeneity in tax planning and trying to understand the determinants of profit shifting behavior (Bilicka, 2019; Gumpert et al., 2016; Davies et al., 2018; Hebous and Johannesen, 2021). A few recent papers argue that a large part of profit shifting appears to be concentrated on only a few large groups (Dyreng et al., 2023; Garcia-Bernardo et al., 2022; Wier and Erasmus, 2023). We complement and extend this evidence by quantifying aggregate profits shifted across

all parts of the distribution in Germany, including those close to relevant policy thresholds.[2] We further confirm that strong concentration at the top is not unique to the U.S., which is important given the distinctiveness of U.S. tax avoidance rules and corporate tax planning, as highlighted in several studies (Clifford, 2019; Tørsløv et al., 2023). Lastly, we not only consider aggregate profits shifted, but also shifting aggressiveness. We document a positive gradient of tax planning aggressiveness across the size distribution. However, this gradient is an order of magnitude weaker than that of total profits shifted. The concentration in profits shifted at the top is therefore a function of both aggressiveness and size but dominated by the latter.

Our second contribution is to provide an aggregate estimate of profit shifting by German MNEs of EUR 19 billion based on a new non-parametric methodology. Our unique micro-level data allows us to provide an estimate for the universe of German multinational groups while still accounting for affiliate- and group-level differences in non-tax related profitability. A comprehensive placebo analysis confirms that our estimation is not picking up non-tax related differences in profitability across group size. Studies relying on country-by-country reports can only provide an aggregate estimate for the largest MNE groups (Fuest et al., 2022, 2025; Bratta et al., 2024; Aliprandi et al., 2025; Garcia-Bernardo and Janskỳ, 2024). Studies using macro data on the other hand cannot account for any affiliate- or group level differences in profitability unrelated to taxes (Tørsløv et al., 2023; Garcia-Bernardo and Janskỳ, 2024). With this estimate, we contribute with a new approach to a literature characterized by a very wide range of estimates and still little consensus on the level of this important figure (Clausing, 2020b). Since most of the literature using microeconomic data has focused on the US, there is perhaps even less consensus for other countries with very different tax systems.[3] We confirm the outsized profitability of tax haven subsidiaries in German MNEs and our aggregate estimate falls in between the existing estimates for German MNEs by Fuest et al. (2022) & Fuest et al. (2025), and Tørsløv et al. (2023).

In our third contribution, we use our results on profit shifting across the group size-distribution to evaluate the GMT threshold by relating three dimensions: profits shifted, missing tax revenue potential, and compliance costs. Some MNEs are very complex firms with large affiliate networks (Francois and Vicard, 2023; Altshuler et al., 2023; Bilicka, 2019), while others own a single foreign supplier of intermediate goods. This raises the question of whether the GMT should focus primarily

[2]Note that the US does not currently participate in the GMT and it is unclear if it will in the foreseeable future. In relation to policies such as the GMT we therefore now more than ever need evidence representative for the hundreds of participating countries. Compared to the already in place US minimum tax (Global Intangible Low-Taxed Income) that blends the taxation of foreign income across jurisdiction, a per-country minimum tax like Pillar 2 can substantially increase revenue gains, as shown in Clausing (2020b).

[3]Very few studies on profit shifting have complete data on the foreign operations of MNEs. This seems to be restricted to studies in the US, with for instance Dowd et al. (2017), or Clausing (2020b) who use both country-by-country reports and data from the Bureau of Economic Analysis (BEA) which is subject to some aggregation. Studies using country-by-country reporting data are limited to study firms above the GMT threshold. The problem of coverage in other micro-level datasets used for many estimates is severe as pointed out in Fuest et al. (2022). For instance, the Orbis database, which is often used, lacks any information for 75% of the countries where large German MNEs have subsidiaries (Fuest et al., 2022).

on the former group of firms—at least for revenue and efficiency reasons—while leaving smaller firms untouched to avoid increasing dead-weight loss through unnecessary administrative or consulting costs (Bustos et al. 2022; Clausing 2023). Smaller firms could likely engage in aggressive profit shifting even if their collective revenue impact is less noticeable (Wollan, 2019). Concerns for societal cohesion and trust in government could make such behavior relevant. Indeed, this threshold could lead to responses where tax competition continues below the threshold (Haufler and Kato, 2024). Our results confirm that profit shifting takes place across the group size distribution but increases exponentially at the top; with 95% of all profits shifted attributable to groups above the threshold. Recent literature has evaluated revenue and broader implications of the GMT (Janeba and Schjelderup, 2023; Baraké et al., 2022; Gómez-Cram and Olbert, 2023; Gaul et al., 2022; Bachas et al., 2025), while other studies explore the incentives for countries to adopt unilateral responses (Janeba and Schjelderup, 2023; Devereux, 2023; Johannesen, 2022; Clausing, 2020b). A small number of papers further consider the legal aspects and optimality of policy characteristics such as the minimum rate (Hebous and Keen, 2023; Becker and Englisch, 2021). To our knowledge, no prior work evaluates which firms should be targeted within the policy.[4] We contribute to this gap by showing that excess profits subject to potential top-up taxation increase exponentially above the GMT threshold, with limited amounts below it. While this does not constitute a direct estimate of revenue gains—since it abstracts from taxes currently paid in those jurisdictions—it serves to evaluate the magnitude of excess profits that would fall under top-up taxation. By comparing potential revenue gains to firm-level compliance costs, we also add to a small literature on the compliance costs of tax filing (Benzarti, 2020; Hauck and Wallossek, 2024; Jacob and Todtenhaupt, 2023). Much of this literature is focused on individuals and none are focused on the compliance implications of a global tax policy. While our estimate of the cost function is a first pass based on the little information available, this is, to the best of our knowledge, the first attempt to quantify this important consequence of the policy. We document increasing compliance costs with group size but these costs are dwarfed by potential tax revenue gained above the GMT threshold. Overall, our results suggest that the GMT is a relatively well targeted policy. Some revenue potential exists below the threshold—we estimate a total of EUR 44 million potential taxes gained on low taxed excess profit if the next decile below the cutoff were included. But lowering the threshold to cover this decile would also generate EUR 27 million in costs for firms according to our estimate. Potential welfare gains are therefore modest. Keeping in mind the uncertainties associated with our cost estimate, such modest gains are unlikely to justify the additional administrative burden

[4] A specific body of literature has examined the impact of the Country-by-Country Reporting (CbCR) standard on firms' profit-shifting activities, using the EUR 750 million revenue threshold, see for example Doeleman and Langenmayr (2024), Hugger (2024), Nessa et al. (2022), De Simone and Olbert (2022) and Joshi (2020). That said, these studies apply this threshold in regression discontinuity designs, often assuming—but not questioning—whether profit shifting differs on either side of the threshold and whether the threshold itself is appropriately set. Additionally, CbCR is conceptually distinct from the Global Minimum Tax (GMT), as it primarily increases audit risk rather than imposing an actual minimum tax on multinational groups.

that would come from adjusting the threshold right after the implementation of the GMT.

The paper is structured as follows. Section 2 briefly describes the global minimum tax and what we know about the origins of the EUR 750 Million cutoff. Section 3 introduces the MiDi database and its advantages in providing group and subsidiary data with no reporting gaps for tax havens. We then show how the appearance of tax haven subsidiaries correlates with lower taxes paid and are highly profitable (section 4) and how likely these subsidiaries are across group size bins (section 5). Section 6 introduces our profit shifting estimate and shows its relation to group size. Section 7 relates potential taxes gained to compliance costs before section 8 concludes.

2 The Global Minimum Tax

In 2021, 137 member countries of the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting (BEPS) agreed to reform international tax regulations in an attempt to halt profit shifting of large companies. The first wave of implementation began in 2024, with jurisdictions in the EU, the UK, Japan, and Canada leading the adoption. A central component of this reform is a Global Minimum Tax (GMT) on corporate profits to ensure that large multinational enterprises with global consolidated revenues exceeding EUR 750 million in at least two of the past four years pay at least a 15% tax rate on their profits, regardless of where they operate. This threshold on large MNEs is a carryover from the Country-by-Country Reporting (CbCR) standards implemented in 2016 and reflects a pragmatic but somewhat arbitrary cutoff.[5] According to the 2021 OECD aggregate CbCR 427 German MNE groups are in scope of the GMT. Using the turnover information in our data, 478 groups are potentially in scope.

The reform aims to curb tax avoidance, reduce harmful tax competition between countries, and create a more equitable global tax system. The GMT functions through three key mechanisms: the Qualified Domestic Minimum Tax (QDMT), the Income Inclusion Rule (IIR), and the Undertaxed Profits Rule (UTPR). These rules collectively prevent companies from shifting profits to low-tax jurisdictions by imposing a top-up tax on earnings taxed below the minimum rate. If a company's home country does not enforce the minimum tax, other jurisdictions where it operates can claim the additional tax revenue. These mechanisms should generate additional tax revenues for tax administrations and limit profit shifting by firms, especially for advanced economies where most ultimate parent entities are headquartered. Mechanical revenue estimates for Germany have been estimated to reach EUR 13.1 billion, according to Baraké et al. (2022).[6]

[5]The CbCR is a transparency measure introduced by the OECD's Base Erosion and Profit Shifting (BEPS) framework in 2016. It requires large MNEs to report key financial information—such as revenues, profits, taxes paid, and economic activity—separately for each jurisdiction in which they operate.

[6]In practice, those numbers are likely to be lower due to substance-based carve-outs and other exemptions, as well as behavioral responses of MNEs. Baraké et al. (2022) estimates that revenue gains for Germany could reach EUR 13.1 billion without carve-outs, or EUR 7.8 billion with 10% carve-outs for payroll and 8% for tangible assets. Allowing for behavioral response, Ferrari et al. (2022) measure the effect of a 15% multilateral residence-based minimum tax

Although the GMT is expected to generate additional tax revenue, it also comes with increased administrative burdens for both governments and businesses. At the business level, firms subject to the rules must file a 28-page GloBE information return and provide data on the corporate structure, constituent entities and all information necessary for the computation of the ETR, the top-up tax rate as well as the allocation of the taxes according to the GloBE rules. Gaul et al. (2022) conducted a survey in collaboration with the Federation of German Industries (BDI) which highlights the significant cost implications for affected companies: they found that the average one-time cost of implementing compliant reporting amounted to EUR 1.6 million per company, with recurring annual costs of EUR 0.4 million.[7] At the tax administration level, additional resources are necessary to process this new information and ensure compliance with the GloBE rules. Tax authorities must develop new systems for data collection, validation, and enforcement, requiring investments in personnel, IT infrastructure, and regulatory oversight. In section 7 we take into account the compliance cost of firms based on Gaul et al. (2022), but abstract from modeling costs for tax administrations for lack of cost estimates.

3 Data

The administrative Microdatabase Direct Investment (MiDi) of the German central bank collects detailed data on German foreign direct investment (FDI). Subject to a modest reporting threshold of a balance sheet total of EUR 3 million, it includes financial and ownership information on the universe of foreign affiliates owned by German parent companies. It also includes downstream investment out of Germany by firms ultimately held from abroad.[8] For each foreign affiliate owned through Germany, we can observe the identity and ownership share of the German parent company, as well as the identity and share of a potential immediate owner if the affiliate is not directly owned by the German parent. The data include general firm characteristics such as industry, as well as detailed historical economic variables in our sample period from 2002 to 2022. Relevant for our analysis, these include data on employment, turnover, and post-tax corporate profits.

We use information on post-tax profits to calculate pre-tax corporate profits for subsidiary i in year t and country c as: $\Pi_{it} = \Pi_{it}^{post}/(1 - \tau_{ct})$. Here, τ_{ct} denotes the effective tax rate of country c taken from the OECD and the CBT Tax Database by Oxford University Centre for Business

and find an increase of corporate revenue by slightly more than 1% for Germany.

[7] The survey, which included firms with annual revenues ranging from under EUR 2 billion to over EUR 20 billion, was sent to all German companies in scope of the GMT, and had 27 respondents. It was conducted in 2022, when most firms still had not conducted detailed cost estimations for the GMT, thus the numbers are likely lower bound for the true compliance cost.

[8] The German reporting party is obligated to report on any foreign holdings with a modest balance sheet total of more than EUR 3 million. Both German MNEs and foreign MNEs that organize their ownership structures through a German firm are required to report. When we provide event study results, we use these data. For the distributional results, we focus on German firms.

Taxation and, in rare cases where no effective tax rate is available, the statutory tax rate taken from the USAID Collecting Taxes Database.[9] Data on employment at the subsidiary level allow us to construct profitability ratios as profits per employee: $\pi_{it} = \Pi_{it}/emp_{it}$. The difference between pre- and post-tax profits counts taxes paid at the subsidiary level. We scale this variable with subsidiary level turnover to construct a tax-to-turnover ratio (TTR), and obtain a measure of taxes paid relative to economic activity of subsidiary i: $TTR_{it} = (\Pi_{it} - \Pi_{it}^{post})/turn_{it}$. Beyond detailed data on the affiliate, MiDi includes consolidated data for the entire group of which we use the consolidated turnover measure, the relevant size variable for the GMT cutoff, as well as a measure of consolidated employment.

4 The Role of Tax Haven Subsidiaries for Profit Shifting

Having access to the full foreign network of multinational enterprises allows us to reliably document the emergence of tax haven subsidiaries as a potential profit shifting technology.[10] In this section, we test if such events coincide with lower subsequent tax payments in the non-haven subsidiaries from which we expect profits to be shifted and confirm their above average productivity on paper.[11] Both pieces of evidence suggest the use of new tax planning strategies and motivates the interpretation of tax haven affiliates within a group as an extensive margin indicator of profit shifting. It does not preclude the use of tax haven affiliates for non-tax purposes but highlights their prominent role in corporate tax planning. Our variable of interest is the tax-to-turnover ratio (TTR) in the non-haven part of groups that open tax haven subsidiaries. Since establishing a new tax haven subsidiary, by definition, signifies growth of the MNE group (see Egger et al. (2014a) for a treatment of MNE growth), we construct a control group composed of firms that expand by adding subsidiaries in non-haven jurisdictions. Our estimation compares the evolution of the TTR of pre-existing non-haven subsidiaries in both treatment and control groups. $T_g = 1$ denotes the treatment group which consists of MNEs establishing their first tax haven affiliate at event time $j = 0$ (200 groups) while the control group ($T_g = 0$, 1,068 groups) adds a non-haven affiliate. Intuitively, we compare the tax payments of a firm in France when its group establishes a subsidiary in Cyprus to a similar firm in France whose group expands by adding a subsidiary in Spain. Figure A.1 in the annex conceptually shows this identification strategy. We estimate the following event study specification:

[9] We have effective tax rate information for 46 countries from 2002 to 2016, and for 78 from 2017 onward. When post-tax profits are 0 or negative, we assume that pre-tax profits are zero and that no taxes were paid.

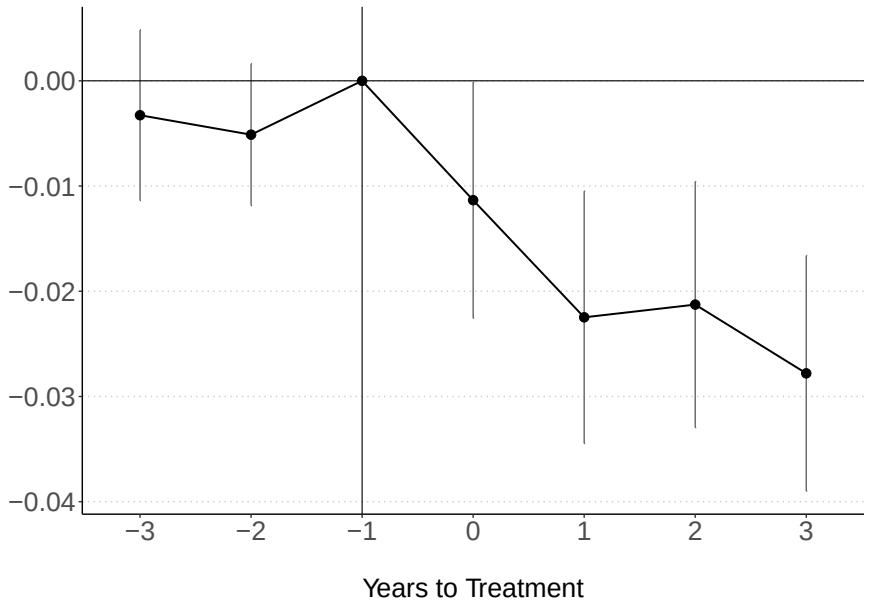
[10] As a point of comparison, Tørsløv et al. (2023) document that the global Orbis database only covers 17% of MNE profits in 2012 motivating their macroeconomic approach. More recent work on more recent tranches of Orbis shows representativeness of aggregated values with macroeconomic variable (Kalemli-Özcan et al., 2024) but the patchy coverage of tax haven subsidiaries remains unresolved. In contrast, the Midi data is comprehensive with the exception of firms below the modest reporting threshold of a balance sheet total of EUR three million. The reporting party is located in Germany and no data provided by the authorities of a tax haven is required.

[11] See Table A.1 for the list of tax havens. This is the union of lists provided in Gravelle (2015) and Johannesen and Zucman (2014).

$$TTR_{it} = \sum_{j=-4,\neq -1}^{j=4} \beta^j D_{gt}^j \cdot T_g + \alpha_i + \delta_{ct} + \epsilon_{it} \tag{1}$$

Here, TTR_{icgt} is the tax-to-turnover ratio of a non-haven subsidiary i in country c and part of group g in year t. D_{it}^j takes value 1 j periods from the year t in which group g gets a new subsidiary. Our coefficients of interest β^j show the development of TTR_{itcg} for non-haven subsidiaries of which the group opened a tax haven subsidiary ($T_g = treated$). The fixed effects structure is made up of subsidiary fixed effects α_i, event time fixed effects load on the control group ($T_g = control$, non-interacted dummies omitted for readability), and dynamic host country-time trends δ_{ct} to capture country specific developments. Endpoints are binned at the limits of the effects window following Schmidheiny and Siegloch (2023).

Figure 1: Tax haven subsidiaries correlate with lower TTR



Notes: This figure shows the results of the event study testing reactions of the tax-to-turnover ratio (TTR) to the emergence of tax haven subsidiaries. Our baseline estimation compares the TTR of the ex ante existing non-haven subsidiary of groups that open a tax haven subsidiary to those of groups that open a non-haven subsidiary. Standard errors are clustered at the subsidiary level and 95% confidence bands plotted. At t=0, the number of treated groups is 200, and the number of control groups is 1068. Standard errors are clustered at the subsidiary level and 95% confidence bands plotted.

Figure 1 shows the results of this event study for groups that are establishing their second international subsidiary, comparing groups that locate this subsidiary in a tax haven to those that do not. We plot the β^j coefficients with 95% confidence bands. These coefficients are not statistically different from 0 until the first year after the establishment of the new subsidiary.

Then, the TTR of the pre-existing non-haven subsidiaries declines by up to 0.028.[12] Against a baseline TTR of 0.08—meaning 8% of turnover is paid in taxes—2.8 percentage points represent a substantial 35% decrease. Standard sample robustness tests do not change the results.

If companies shift profits to tax-haven subsidiaries, these subsidiaries become more profitable on paper (Dharmapala, 2020). Using CbCr data for the US, Clausing (2020a) shows that total profits per employee at the country level are between 2.8 and 12 times higher in tax havens than in typical foreign countries. In work using macroeconomic data, Tørsløv et al. (2023) confirm such excess profitability using the wage bill. In our data, averaging the profitability ratio ($\pi_{it} = \Pi_{it}/emp_{it}$) by country confirms very high profitability ratios in tax havens. Figure 2 plots two versions of this calculation for all countries with at least 30 German subsidiaries in our data. In the top panel, we plot the average firm-level profitability ratio by country. Dark shading indicates if a country is classified as a tax haven. See Table A.1 for the full list of tax havens. Calculating the ratio within firm we find that an employee of an average German firm in Malta appears to generate more than three times the profits of an employee of the average firm in France. Aggregating profits and employees within each country before taking the ratio leads to an even starker picture. Here, the Maltese employee produces EUR 1.3 million in profits against the roughly EUR 50.000 of her French counterpart. This latter approach is more in line with the aggregate approach used by Clausing (2020a) and Tørsløv et al. (2023).[13] The difference between panel (a) and panel (b) of Figure 2 hints at the existence of a few large subsidiaries that dominate the aggregate picture of profits in tax havens. In both cases, however, the outsized role of tax havens is apparent. Confirming this established result of excess profitability of German firms in tax havens is also a useful sanity check for our data before we turn to group level estimates.

These two results are consistent with tax haven subsidiaries being a relevant profit shifting technology for MNEs. The entry of a tax haven subsidiary into a non-haven group significantly lowers average tax payments of those non-haven subsidiaries, with little observable delay. These tax haven subsidiaries exhibit outsized productivity ratios. We therefore interpret the propensity to include a tax haven subsidiary as an extensive margin measure of profit shifting.[14] While this aggregate result is not controversial in the field of international corporate taxation (Riedel, 2018; Davies et al., 2018; Hebous and Johannesen, 2021), we now turn to the question of how the use of this profit-shifting technology varies across the group size distribution.

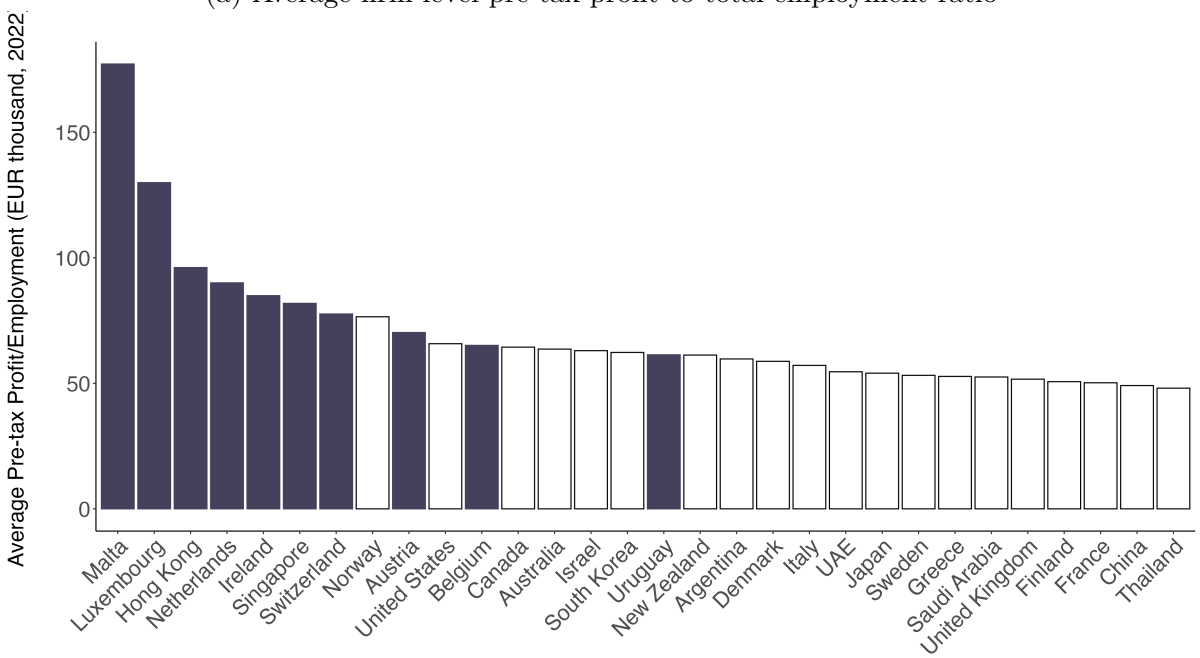
[12] In appendix Figure A.3 we confirm this pattern for groups whose first tax haven subsidiary appears within the group as the 3rd to 6th subsidiary using the same identification strategy. Note that the treatment group declines as we increase the number of subsidiaries: There are not many groups that set up a 6th subsidiary without already having a tax haven subsidiary in their pre-existing structure.

[13] Clausing (2020a) uses 2017 CbCr data and report total profit of those jurisdictions relative to total employment, which is directly comparable to our Figure 2 (b). Out of the top 20 US MNE profit countries, she finds that profits per worker averages USD 488,000 in 11 havens, compared to USD 22,900 in non-haven countries. Tørsløv et al. (2023) use the ratio of pre-tax profits to the wage bill, not to the number of employees, as a profitability measure.

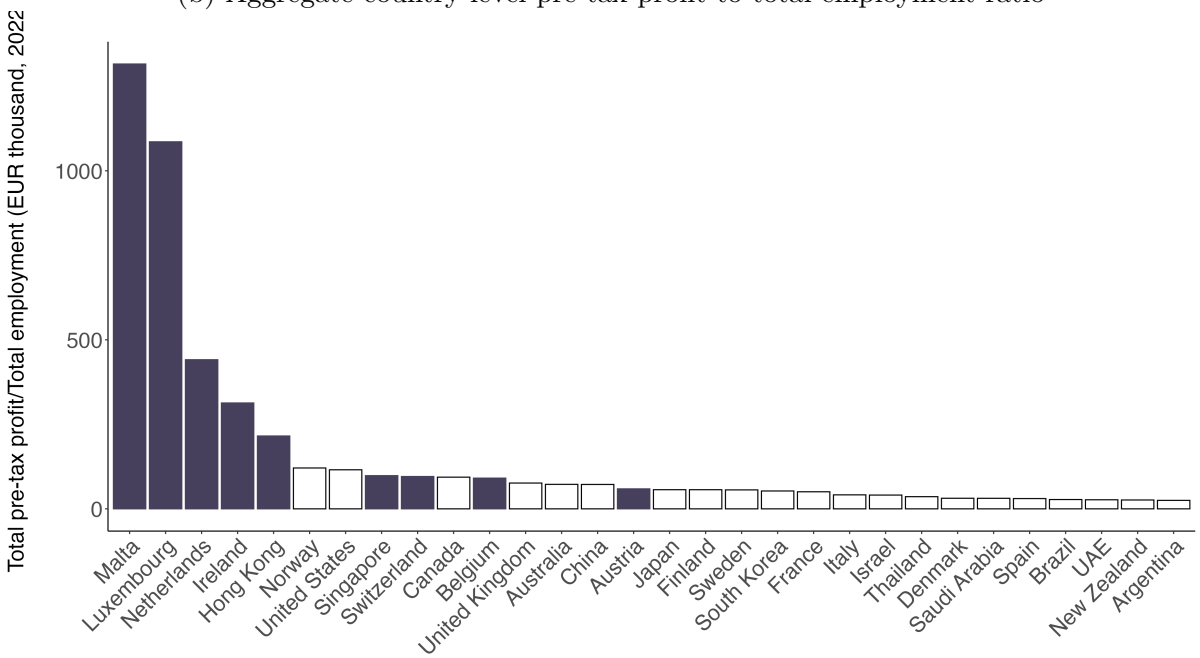
[14] Gumpert et al. (2016) show that the probability of having a tax haven affiliate is increasing in the average foreign non-haven tax rate of German manufacturing MNEs. This result supports our interpretation.

Figure 2: Profitability differences across countries

(a) Average firm-level pre-tax profit to total employment ratio



(b) Aggregate country-level pre-tax profit to total employment ratio

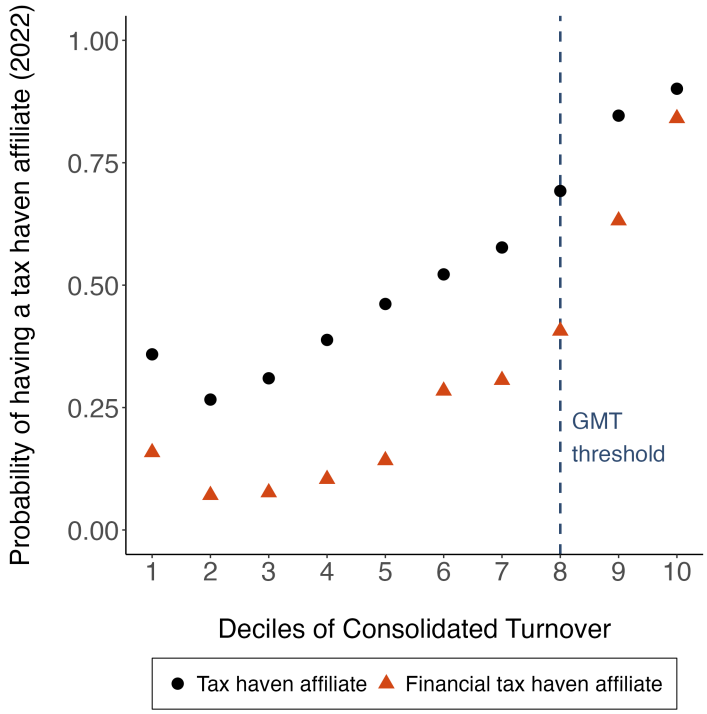


Notes: These figures plot the top 30 profitability ratios by countries in 2022. Panel (a) plots the average firm-level pre-tax profit to total employment ratio. Panel (b) first aggregates pre-tax profit and employment for the entire country before taking the ratio. Countries that we classify as tax havens are shaded in dark blue.

5 The Likelihood of Tax Haven Subsidiaries across Group Size

In this section, we characterize the propensity of MNE groups to include a tax haven affiliate within their network across the group-size distribution. Since we are interested in where the GMT threshold falls, we define group size using consolidated turnover. We have access to consolidated turnover at the group level in the MiDi data, and, for the rest of the paper, sort groups into 10 turnover size bins to comply with data confidentiality requirements. We then compare the likelihood that a group includes tax haven subsidiaries across groups size deciles.[15] Figure 3 (circle) shows the resulting probability distribution. Three observations emerge from this figure.

Figure 3: Tax haven usage across group size



Notes: In this figure, we collect all MNE groups in our sample into 10 bins using the consolidated turnover variable. These bins are plotted on the horizontal axis. On the vertical axis, the figure plots the average probability within each bin that a group includes at least one tax haven affiliate (circle), and the average probability that a group includes at least one financial affiliate in a tax haven jurisdiction (triangle) The dashed line represents the location of the GMT threshold. The exact location of the GMT threshold is at the 74th percentile of the distribution.

First, tax haven usage is not ubiquitous for the bottom half of the distribution where more than half of MNEs have no access to this profit shifting technology. Not all MNEs are able to shift profits to tax havens. Nonetheless, it is notable that within the bottom half of the group size distribution, which primarily consists of firms with three or fewer subsidiaries, between 25% and 50% do include a tax haven subsidiary. Access to profit shifting technologies are not limited to the

[15] Privacy concerns of our data provider limits the level of disaggregation.

top of the distribution. Second, the probability to use tax haven subsidiaries increases substantially and, after the first decile, monotonically across the size distribution and begins to rise more sharply after the 7th decile, close to the GMT threshold. Around the GMT threshold roughly three quarters of MNE groups have at least one tax haven subsidiary within their networks. Third, the probability of tax haven usage approaches unity towards the top of the group size distribution. Large groups are almost guaranteed to exhibit the profit shifting technology that, as shown above, coincides with reduced tax payments and excess profitability in low tax jurisdictions. These results refer to any type of tax haven affiliate. Financial tax haven affiliates in particular are widely believed to be conducive for debt shifting as they have financial flexibility to provide intra-group loans and thereby reroute interest payments into tax havens (Møen et al., 2019; Egger et al., 2014b). Figure 3 (triangles) also shows the propensity to include a financial tax haven affiliate within the group structure across the group-size distribution. Again we observe a modest take-up at the bottom of the distribution: below median, less than a quarter of groups have a financial tax haven affiliate. However, the gradient here is even steeper above the GMT threshold. In the top decile, more than 80% of groups include such a specialized financial tax haven affiliate.

High probabilities at the top of the distribution resonate with results in Garcia-Bernardo et al. (2022) and Dyreng et al. (2023) who point out the importance of a small number of large US multinationals in international profit shifting. However, these large US firms are still orders of magnitude larger than the GMT threshold.[16] The fact that we find almost universal tax haven use already among MNEs with 'only' a few hundred million EUR in turnover is a broader result that points towards profit shifting being a more wide-spread phenomenon. In the next section, we turn to group size heterogeneity explicitly.

[16] Apple reported 394 billion USD in sales in 2022, the end of our sample period in its Form 10-K available here: https://s2.q4cdn.com/470004039/files/doc_financials/2022/q4/_10-K-2022-(As-Filed).pdf. In the same year Volkswagen group reported nearly EUR 300 billion in sales according to their annual report.

6 Shifted Profits across Group Size

Access to microeconomic data on every subsidiary of the network of German MNEs allows us to construct and interpret shifted profits at the group level. We proceed in three steps. First, we describe how we construct this measure of profits shifted by group. Second, we relate it to the group-turnover cutoff relevant for GMT liability. Third, we carry out a placebo analysis to rule out that our estimate suffers from simultaneity bias—specifically, that larger groups are both inherently more profitable, regardless of profit shifting, and more likely to establish subsidiaries in any country, including in tax havens.

Group level estimate of shifted profits: We start by calculating an average profitability ratio for two types (j) of subsidiaries (i) where $j = th$ indicates that subsidiary i is in a tax haven while $j = nh$ denotes that it is not. To ensure comparability, these averages are calculated within cells (l) of 10 group level turnover bins and 10 subsidiary level turnover bins. This ensures that our profit shifting estimate is not inflated by a mechanical relationship between productivity and group or firm size, as we show in a placebo analysis below. We start from the arithmetic mean of cell l for type j denoted as: $\bar{\pi}_l^j = \frac{\sum_{i=1}^{N} \pi_i^j}{N}$. Within each cell, the difference between these profitability ratios generates an estimate of profit shifting intensity per employee as:

$$\Delta\bar{\pi}_l = \bar{\pi}_l^{th} - \bar{\pi}_l^{nh} \tag{2}$$

$\Delta\bar{\pi}_l$ can be negative if tax haven subsidiaries are less profitable per employee than non-haven subsidiaries of similar size in groups of similar size; it will be zero if there is no difference; and positive if profit shifting from non-havens to tax havens is taking place. The one value judgment in the construction of $\Delta\bar{\pi}_l$ is a list of tax haven countries that are used to determine j. We then re-scale the productivity difference for each subsidiary i by using its total employment l_i and aggregate across all subsidiaries $i = 1, ..., N_g$ of group g such that total profits shifted for each group is:

$$PS_g = \sum_{i=1}^{N_g} \Delta\bar{\pi}_l \times l_i \tag{3}$$

This group level estimate of profits shifted loads both on within cell productivity differences and on the distribution of groups across these cells based on where they employ personnel. Intuitively, it tells us how much more (or less) productive the tax haven subsidiaries of a group are compared to a counterfactual world without tax havens. In unreported robustness tests, we compared three counterfactual productivity levels: That of all non-haven subsidiaries (our baseline), only subsidiaries of pure non-haven groups, and all non-haven subsidiaries of groups that also include tax haven subsidiaries (thus ignoring the non-haven parts of tax-haven groups). The resulting distributions are almost indistinguishable both qualitatively and quantitatively.[17]

[17] Since these robustness tests all use the same sample of firms, exporting them through Bundesbank output control

Working within 100 cells of 10 subsidiary size and 10 group size bins is crucial for our methodology. These cells ensure that we are not comparing very large firms and groups to very small firms and groups which attenuates two central assumptions when calculating profits shifted. First, we assume that counterfactual profitability within a cell is comparable no matter the country in which the German MNE subsidiary operates (see Fuest et al., 2022, for a different approach, estimating country level productivity parametrically but without cells). Second, we assume that profit shifting aggressiveness within a cell does not vary dramatically across subsidiaries (see Wier and Erasmus, 2023, for a discussion of this assumption). While both of these assumptions can appear strong if maintained across the entire distribution of firms, maintaining them within 100 cells is defensible. Crucially, as we show in a placebo estimate below, in a world without tax havens, our method does not calculate positive profits shifted.

Using this methodology, we estimate that German owned MNEs shifted a total of EUR 19 billion (or USD 19.6 billion) into tax havens in 2022. The existing range of profit shifting estimates in the literature is very broad and methods and datasets differ widely (Riedel, 2018; Beer et al., 2020). Starting with evidence for Germany, Fuest et al. (2022) use CbCR reports to analyze the profit shifting behavior of German owned MNEs above the EUR 750 million reporting threshold. Their aggregate estimate of EUR 9 billion in 2016 and 2017 lies substantially below ours, for at least two important reasons beyond the difference in the base year. Firstly, they use a log-specification and thereby exclude all zero-profit observations. These specific observations represent some of the most aggressive profit shifters as argued by Bilicka (2019). Fuest et al. (2025) argue that ignoring these zero-profit observations leads to an underestimation of profit shifting. Second, they only have data on groups above the EUR 750 million threshold and hence can only include profit shifting by these large groups.[18]

Fuest et al. (2025) find that German owned MNEs above the 750m threshold shift EUR 11 billion to low-tax jurisdictions on average across the years 2016-2019. Again, our estimate is substantially larger, potentially reflecting differences in methodology, as well as the apparent difference in coverage of groups. One important difference in methodology relates to the semi-elasticity estimated in Fuest et al. (2025) and used to back out the aggregate profit shifting amount. Firstly, by estimating one semi-elasticity for all groups, the authors do not allow heterogeneity in sensitivity to taxes across groups. Given the level of diversity within the MNE distribution, this limitation could be significant and highlights an advantage of our fully non-parametric approach. Further, recent papers argue that the choice of functional form has substantial impact on the resulting estimate of the semi-elasticity of profits with respect to the corporate tax rate (Dowd et al., 2017). For studies using this semi-elasticity to back out the total amount of profits shifted, this shifting estimate

could reduce our flexibility of providing further results going forward. We hence refrained from it for now.

[18] Differences can also come from the fact that the estimate from Fuest et al. (2022) is based on a very different data source and uses a different, more parametric, methodology.

becomes sensitive to the choice of functional form as well. By contrast, our approach avoids such assumptions by not relying on a semi-elasticity estimate.

Both of the aforementioned estimates rely on micro-level data to estimate profits shifted. Tørsløv et al. (2023) instead rely on macro-level data to estimate the global amount of profit shifting. The authors use foreign affiliates statistics and balance of payments data to construct profitability differences between tax haven affiliates of foreign MNEs and local firms. Based on these differences they find that USD 55 billion was shifted to tax havens from Germany by MNEs in 2015. This estimate is substantially larger than ours and more difficult to compare due to two differences. First, it includes profit shifting by non-German MNEs out of Germany and does not include shifting by German MNEs out of other countries. These differences in scope could certainly explain the difference in magnitude of the estimates depending what assumptions are made about the relative aggressiveness of German versus non-German groups. Second, it reflects the fundamental difference between the macro- and microeconomic approaches we pointed out when discussing Figure 2 above. Macroeconomic data can by construction not control for firm-level differences in profitability, while our counterfactual exercise takes place only within group- and subsidiary turnover cells. Within these cells we assume comparable profit shifting aggressiveness of German MNEs. If subsidiaries within these granular 100 cells differ substantially in profit shifting aggressiveness, our method could underestimate profit shifting (Wier and Erasmus, 2023). However, since we are only comparing German MNE subsidiaries, we are willing to maintain this assumption within cell.

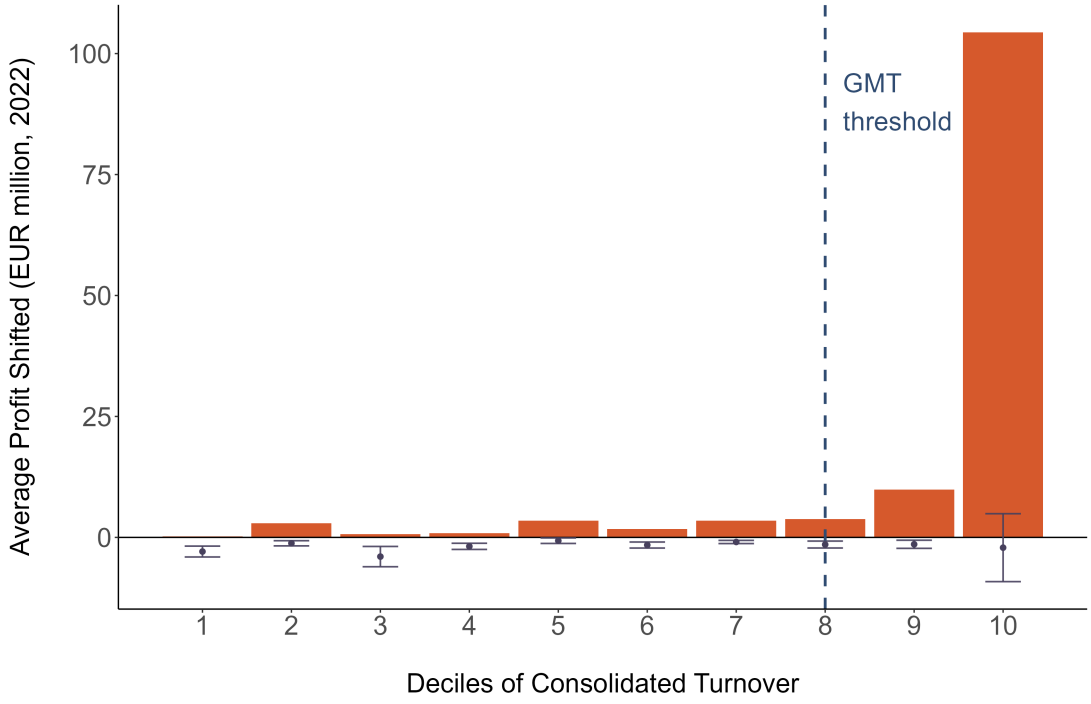
Shifted profits and group size: Turning to the distribution of profits shifted across group size, Figure 4 shows the average profits shifted across groups for the same deciles of consolidated turnover used above. This average is relatively stable for the first eight deciles of the total turnover distribution. A group in the 7th decile shifts EUR 1.7 million on average, compared to EUR 0.9 million for a group in the 4th decile. In the last three deciles, we see an exponential gradient reaching EUR 10 million in the 9th decile and more than EUR 100 million per group in the top decile. Using our microeconomic data to classify groups into GMT liable, we find that 95% of all profit shifting takes place above the GMT threshold, represented by the dashed black line.

These results show that the bulk of profit shifting is done by the very largest groups and that these are located above the GMT threshold. However, the largest groups also represent the bulk of overall profits earned, and so the size pattern in Figure 4 does not tell us whether large groups are more aggressive profit shifters compared to smaller groups.

Larger groups could be disproportionately aggressive in their tax planning strategies (Wier and Erasmus, 2023). To investigate this, we turn to a size-adjusted amount of profits shifted per group. We consider profits shifted per employee of the group in Figure 5.[19] We find a monotonous positive

[19]We only plot the top half of the distribution due to substantial noise in the smaller deciles. This noise arises from groups with very few employees inflating the ratios.

Figure 4: Profit shifted across group size



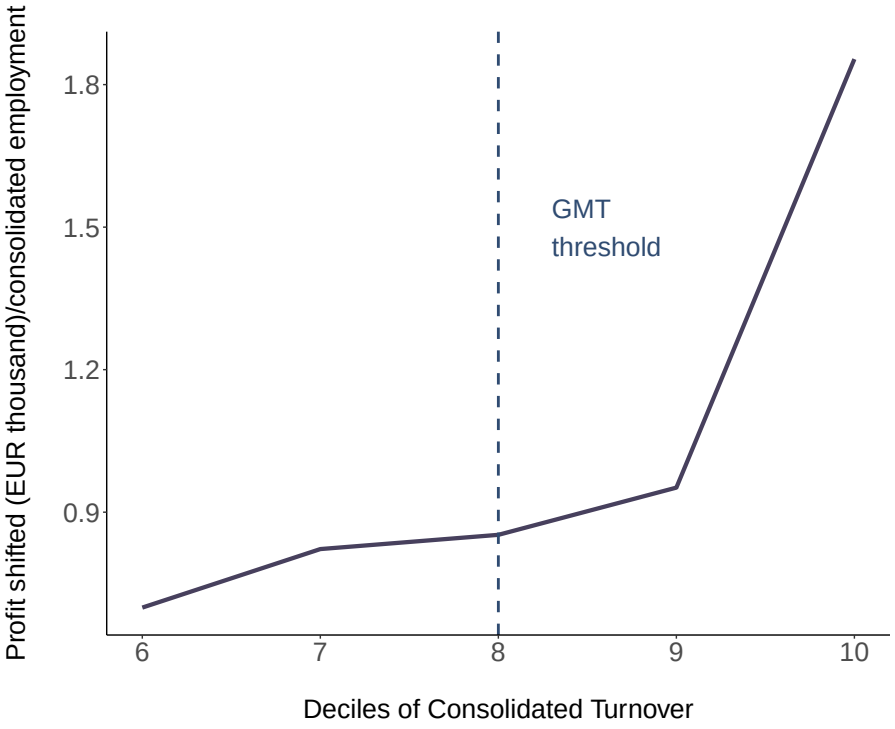
Notes: This figure plots the profit shifted gradient across group size. Consolidated turnover bins are plotted on the horizontal axis. On the vertical axis, we plot the average profits shifted per group in each decile. The dashed line shows the GMT threshold which lies close to the beginning of the 8th decile. The black dots and confidence bands show the mean and standard error of the means of the 100 placebo samples we draw in a dataset without tax haven subsidiaries.

gradient in the top half of the distribution. This suggests that larger group size is associated not only with higher total profits shifted, but also with greater profit shifting intensity.[20] Note, however, that this aggressiveness gradient is much flatter than that of profits shifted. On average, a group in the 10th decile shifts more than 10 times the profits of a group in the 9th decile. Relative to its employment, it only shifts twice as much. The bulk of the profits shifted gradient documented in Figure 4 is therefore dominated by group size. Before we turn to results on the total costs and benefits of the GMT, we introduce a placebo exercise to test the credibility of our profit shifting estimate.

Placebo analysis to tackle simultaneity bias: Multinational groups that use tax havens can systematically differ from those that do not in ways unrelated to profit shifting. Most importantly, larger groups, being both more productive and more likely to have a subsidiary in any given

[20]Note that it's feasible that some industries are more aggressive than others and this could cause high aggressiveness at the top of the size distribution in other countries. While Germany features a large number of very large MNEs in many sectors, our data for instance does not include the very large tech and pharmaceutical companies that dominate some U.S. profit shifting estimates. It is therefore possible, that the aggressiveness gradient is even steeper in other countries.

Figure 5: Average ratio of profits shifted to consolidated employment across group size



Notes: This figure plots the average ratio of profits shifted to consolidated employees across group size. Consolidated turnover bins are plotted on the horizontal axis. On the vertical axis, we plot the aggregate ratios within each decile. The black dashed line shows the GMT threshold which lies close to the beginning of the 8th decile.

country, can introduce simultaneity bias. This bias grows with the number of countries defined as tax havens, a degree of freedom of researchers. A larger tax haven list, potentially including large OECD countries, would mean that any remaining non-haven control group would include smaller and smaller groups with less and less firms, potentially from less developed economies. We would erroneously attribute productivity differences between these sets of firms to profit shifting. Calculating productivity differences in 100 cells of subsidiary and group turnover eliminates this bias as the following placebo analysis shows. We start by eliminating all tax haven subsidiaries from the sample. Mirroring the sample share of tax havens in our original sample, we then draw a random list of countries as 'placebo' countries to test if we detect profit shifting where there should be none.[21] We then repeat our group-level profits shifted analysis using 100 such placebo samples and placebo country lists. The black dots and error bars in Figure 4 show the mean of the group-means for each decile as well as their 95% confidence bands.[22]

[21] This type of falsification exercise looking for tax haven behavior where there should be none has also been used in the literature on tax evasion (Johannesen and Zucman, 2014; Menkhoff and Miethe, 2019) and by Laffitte and Toubal (2022) in the analysis of multinational sales shifting (see Annex E.2).

[22] In annex Figure A.4, we ignore the fact that each of the 100 draws creates a mean and show the larger confidence

The results show that despite our rich microeconomic data, noise is substantial at the top with confidence bands ranging from a negative 7 to a positive EUR 3 million in decile 10. Compared to the more than 100 million profits shifted in our tax haven sample, however, these numbers are small. Most importantly, we do not see a gradient across group size in these placebo samples. This confirms that our main results are not driven by simultaneity bias when employing our method. This placebo methodology is robust to increasing or decreasing the size of our placebo country list, meaning that there is no mechanical relationship between the number of countries chosen as tax havens and the size of profit shifted estimated. Any potential error of falsely including a country in the tax haven list therefore moves our estimate closer to the placebo, a downward bias. Without employing the size cells introduced above, our placebo estimates would show profit shifting in a world without tax havens, consistent with the simultaneity bias we are addressing.

7 Potential Tax Revenue Gain and Compliance Costs

Having established both the profit shifting estimate and its gradient across the group-size distribution, we now turn to comparing potential tax revenue gains on excess profits versus compliance costs of the GMT across the group-size distribution. We start by computing, for each turnover decile, total profits shifted from the group averages plotted in Figure 4. We then assume a 15% GMT tax rate on this excess profit and plot the resulting tax revenue potential in Figure 6.[23] This comparison assumes (a) that the shifted profits were not taxed prior to GMT introduction and (b) that they are taxed at the 15% GMT minimum rate after its introduction.[24] The distribution mirrors the exponential figure seen in average profits shifted. Note that the vertical axis is cut to make visual inspection at the bottom of the distribution possible: Total revenue in the top decile is more than 10 times that of the 9th decile. Intuitively, if all excess profits of firms in the top decile had been taxed at the GMT rate in 2022, the total potential revenue gain would have been EUR 2.4 billion. This number could be a useful comparison point down the line when realized GMT tax payments can be evaluated. That said, this number is not directly comparable to typical revenue estimates from the GMT, as it does not take into account taxes paid in those jurisdictions and the associated effective tax rate.

Data on firm level compliance costs are scarce. To compare the potential tax revenue gains to the potential compliance costs of a global minimum tax, abstracting from costs of the tax administration,[25] we use the survey conducted by Gaul et al. (2022). Gaul et al. (2022) surveyed

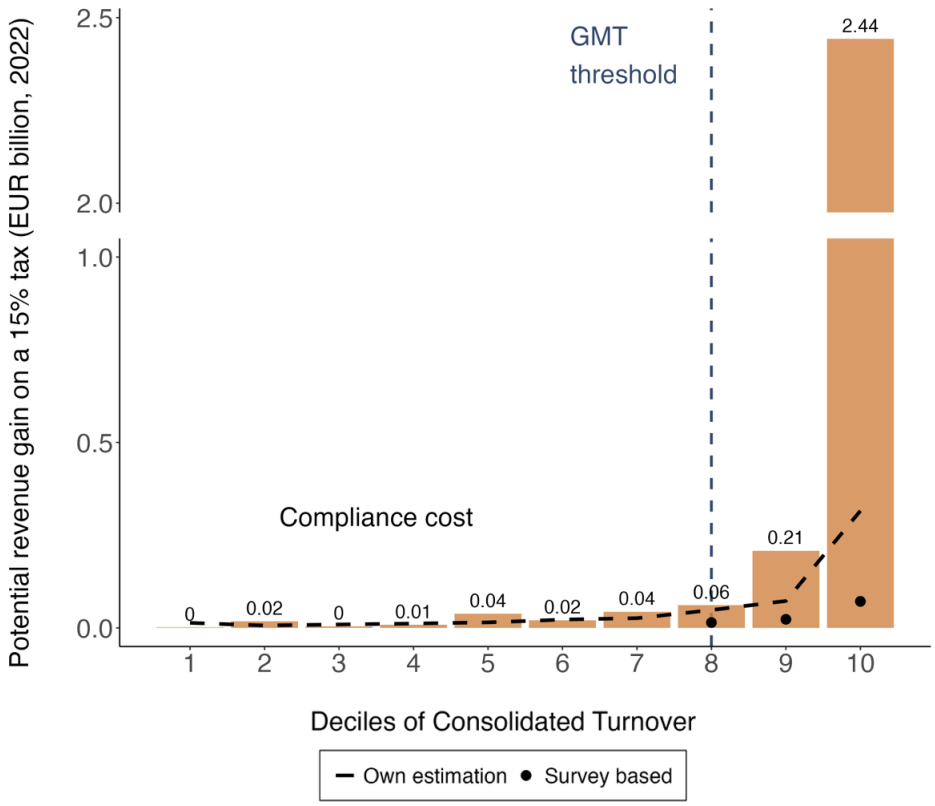
bands of the standard errors around the means not adjusted for sample size. Deciles 7, 9, and 10 remain significant.

[23] Note that these estimates are not directly comparable to those in Baraké et al. (2022) but rather to their estimate of USD 5bn based on Tørsløv et al. (2023) where the difference to our estimate is a function of the difference in profits shifted discussed above.

[24] Effective tax rates of MNEs can be lower than this due to substance based carve outs and other deductions. They can also be higher for example due to still existing CfC rules. We believe 15% is an interesting theoretical point of comparison because it is the targeted minimum tax rate.

[25] In discussions about GMT implementation in the German parliament, administrative experts differed on the

Figure 6: Aggregate Tax Revenue and Compliance Costs Across Group Size



Notes: This figure plots the potential tax revenue gain from a 15% tax on aggregated profits shifted estimated in Figure 4 across group size and the estimated aggregated compliance cost. Consolidated turnover bins are plotted on the horizontal axis. The vertical bars shows revenue from a 15% tax on aggregate profit shifted at the bin level. The dashed line plots the compliance cost that is group size dependent: each affiliate is worth around EUR 30,000 of compliance cost to the group. The black dots represent the weighted average cost per group as per the survey by Gaul et al. (2022). Figure A.5 shows the survey cost distribution based on the exact size category used in the survey. The dashed line shows the GMT threshold which lies at the 74th percentile of the distribution.

all German MNE groups above the GMT threshold to gauge expected compliance costs of the policy. They received responses from a modest number of German MNEs reporting an average expected compliance cost of EUR 0.4 million in yearly costs per group. To compare this estimate with our revenue calculations, we need to take a stance on whether we believe this cost will vary with the size of the group and if so how.

We compare two size-related approaches to estimate compliance costs. First, we use the three size categories reported in the survey by Gaul et al. (2022), which group MNEs by consolidated turnover: EUR 750 million to 7 billion, EUR 7 to 20 billion, and above EUR 20 billion. The

question if the GMT would lead to higher administrative costs or lower costs due to a potential of streamlining with now redundant regulations targeting profit shifting. The minutes are available in German here: https://www.bundestag.de/dokumente/textarchiv/2023/kw42-pa-finanzen-globale-mindestbesteuerung-971256. We do not take a stance either way here.

estimates are represented by the three black dots in Figure 6, proportional to the number of groups of the three size bands in the top three deciles.[26] This assumes identical costs per group within the bands leading to a lower bound estimates as costs are likely to increase with size within bands. Therefore, we construct an alternative size-dependent estimate based on the number of subsidiaries within each group. Starting from the average compliance cost reported in the survey, we divide this figure by the average number of subsidiaries among the surveyed firms to obtain a per-subsidiary cost estimate. This gives us a compliance cost estimate per subsidiary, which we multiply with the total number of subsidiaries per group in our sample for a group-level cost estimate. The dashed line in Figure 6 shows this cost estimate aggregated for all groups within each decile. The assumption that the cost is proportional to the number of subsidiaries implies that each additional subsidiary within a group adds the same marginal compliance cost regardless of the original size of the group. This assumes away any economies of scale in compliance effort and the estimate should therefore likely be seen as an upper bound on the compliance cost, especially at the top of the distribution. We abstract from the costs of setting up or updating a tax avoidance strategy which we interpret as sunk costs at the time of the GMT introduction.[27]

Whenever total costs exceed total revenue gains, compliance costs dominate potential gains resulting in a net loss from red tape if that decile were GMT liable. Two observations emerge from comparing our estimated potential tax revenue gains with the cost function. First, potential net losses or gains are small in the bottom of the distribution. They become systematically positive with the 7th decile where groups would owe 17 million worth of taxes more than they would incur in administrative costs. Second, at the top of the distribution the cost estimate increases substantially (to almost EUR 300 million) due to the large number of subsidiaries per group in the top deciles. However, despite this increase potential tax revenue gains still massively dominate.

All deciles above the GMT threshold have a positive ratio and while some net tax revenue could be gained by moving the threshold to the 7th decile, these would be modest at only EUR 17 million in comparison to the current coverage. With an objective of balancing firm compliance costs with government tax revenue for the marginal firm entering the scope of the GMT, the current threshold therefore appears well placed. With an objective of only maximizing total tax revenue gain, the current threshold also appears sensible with a coverage of 95% of all profits shifted. The level playing field and fairness concerns remain but are mitigated by the observation that the MNEs above the GMT threshold are also the most aggressive profit shifters relative to their size.[28]

[26] Figure A.5 shows these compliance cost estimates across the three size categories, overlaid with the actual group size distribution in our administrative data. The 8th bin contains some groups with turnover between 750m and 7bn, the 9th bin is made up exclusively of groups between 750m and 7bn while the 10th bin includes groups of all three sizes.

[27] For an estimation of these costs see Bilicka et al. (2024)

[28] Note that we also abstract from any revenue or fiscal multipliers in this section.

8 Conclusion

In this paper, we analyze heterogeneity in profit shifting behavior across the group size distribution and evaluate the EUR 750 million turnover threshold of the recently introduced Global Minimum Tax (GMT). Access to detailed administrative micro-level data on German foreign investment allows us to study MNE networks and the distribution of their real and booked activity.

We start by documenting a prompt decrease in the tax-to-turnover ratio of non-haven affiliates when a group establishes its first subsidiary in a tax haven. When looking at the amount of profits located within these tax haven affiliates, we first confirm a sizable profitability differential across countries with tax havens appearing far more profitable than other countries. These observations allow us to interpret the existence of a tax haven affiliate within a group network as an extensive margin indicator of being engaged in profit shifting. While less than half of the groups in the lower half of the group-size distribution include a tax haven affiliate, this likelihood approaches unity at the top of the distribution. This qualitative pattern is even more pronounced when we focus only on financial tax haven affiliates generally regarded as conducive of debt shifting. Hence, while many groups at the lower end of the size distribution are not engaged in profit shifting to tax havens at all, this behavior appears almost ubiquitous at the very top of the size distribution.

We introduce a methodology for constructing a measure of profits shifted at the group level. This method conceptually compares profitability levels between tax haven and non-haven affiliates within group- and firm-size bins. Plotting this measure across the group-size distribution, we find an exponential pattern with aggregate shifted profits increasing sharply in the top deciles covered by the global minimum tax. In total 95% of shifted profits are currently in scope of the GMT. While aggregate profits shifted therefore seem very concentrated at the top of the size distribution, this is not mainly driven by a positive relationship between shifting aggressiveness and size. If we consider shifted profits relative to employment as a measure of tax planning aggressiveness, we do indeed document a positive gradient at the top of the distribution. However, this gradient is much weaker than that of total profits shifted. The concentration is therefore mainly explained simply by the very large differences in size within the MNE group distribution. In placebo tests, we confirm that this measure does not pick up simultaneity bias from large groups being more likely to have affiliates in tax havens and also being more productive for reasons other than profit shifting.

In our final result, we relate the potential tax revenue gain from the global minimum tax to the compliance cost incurred by groups of different sizes. Our results suggest that the coverage of the GMT appears broadly well calibrated: it captures the bulk of profits shifted and does so for groups that avoid substantially more taxes than their potential compliance cost. By lowering the threshold slightly, some groups with lower compliance costs than avoided taxes could be included, but gains would be modest.

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Annex

Content

List of Figures

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A.1 Details on Event Studies using Tax-to-Turnover Ratio

In this annex, we test the robustness of our event study results on the development of the tax-to-turnover ratio (TTR) of pre-existing non-haven subsidiaries when a MNE establishes a new tax haven subsidiary.

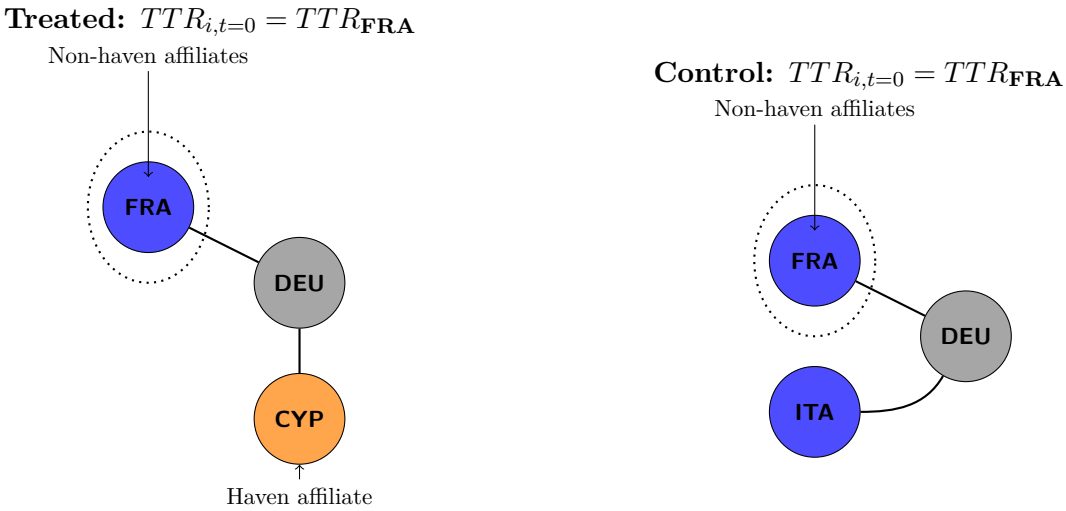
A.1.1 Visualization of the Identification Strategy

Figure A.1 conceptually shows our identification strategy. Our baseline estimate in the main text compares groups with one foreign subsidiary (in France) that creates a second subsidiary in a tax haven (in Cyprus). The control group is also made up of groups with one pre-existing non-haven subsidiary (in France) and is growing as well but it adds another non-haven subsidiary (in Spain). This ensures that we are not comparing static to growing groups but that both groups are adding more subsidiaries.

Figure A.1: Illustration of the event study identification strategy comparing groups adding a haven vs. non-haven affiliate.

Before Event:

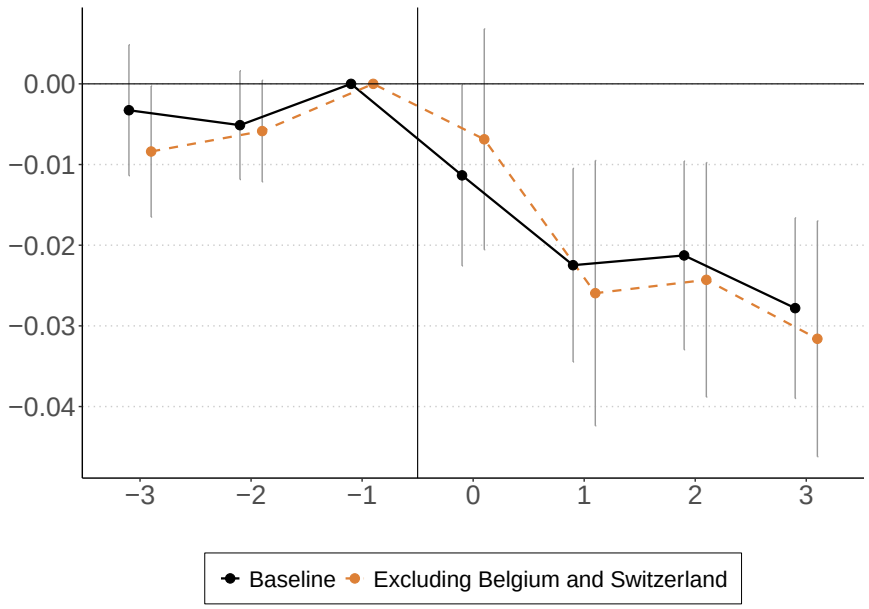
After Event: Treated group adds a tax haven affiliate, control adds a non-haven affiliate



A.1.2 Further Event Study Results at the Subsidiary Level

In Figure A.2, we compare our baseline estimate (black dots and solid lines) to a specification where Belgium and Switzerland are dropped from the sample. This is an example of a robustness test making sure that tax havens which are close to Germany and are also used for subsidiaries with economic substance do not drive our results. This shows that they are representative tax havens and do not drive the results.

Figure A.2: Tax haven subsidiaries correlate with lower TTR - Sample Robustness



Notes: This figure shows the results of the event study testing reactions of the tax-to-turnover ratio (TTR) to the emergence of tax haven subsidiaries. Our baseline estimation compares the TTR of the ex ante existing non-haven subsidiary of groups that create a tax haven subsidiary to those of groups that create a non-haven subsidiary. Standard errors are clustered at the subsidiary level and 95% confidence bands plotted. At t=0, baseline (robust) number of treated groups is 200 (143), and number of control groups is 1068 (1075). Standard errors are clustered at the subsidiary level and 95% confidence bands plotted.

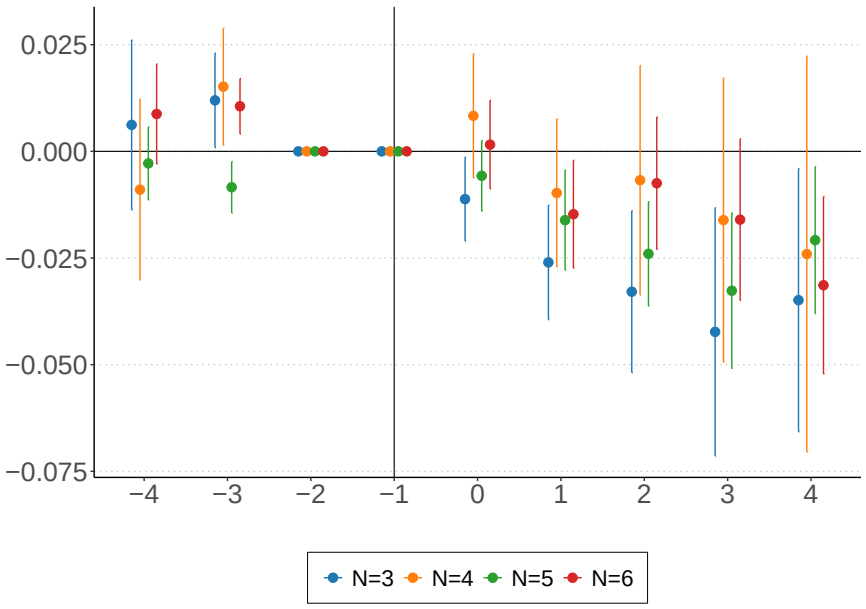
In Figure A.3, we test if the behavior of a decreasing tax-to-turnover ratio (TTR) in the pre-existing non-haven group as tax havens are added extends to larger groups. Our baseline estimate compares groups growing from one to two subsidiaries ($N = 2$), here, we look at groups that grow from their second to third ($N = 3$), third to fourth ($N = 4$), fourth to fifth ($N = 5$), and fifth to sixth ($N = 6$) subsidiary. The regression follows that used in the main text with two exceptions: First, if a group has two or more pre-existing subsidiaries, they enter the regression as separate units. Their treatment status is still defined at the group level. TTR_{it} is the tax-to-turnover ratio of

every pre-existing subsidiary divided by their turnover. Second, there are not many German MNEs that have several non-haven subsidiaries before adding their first tax haven subsidiary which limits both our treatment and control group (both need a larger and larger pre-event pure non-haven group). These groups are therefore not always on parallel trends ex ante. We pin their linear differential pre-trends based on two pre-event periods: $j = -2$ and $j = -1$ following Jakobsen et al. (2020) by leaving out two pre-period dummies and adding a linear time trend interacted with the treatment dummy. We also stop at six subsidiaries because of this sample constraint. The regressions thus take the following form:

$$TTR_{it} = \sum_{j=-4,\neq-2,\neq-1}^{j=4} \beta^j D_{gt}^j \cdot T_g + \alpha_i + \delta_{ct} + \theta t \cdot T_g + \epsilon_{it} \tag{4}$$

Figure A.3 plots the resulting β^j coefficients of the four regressions. As we move to larger and larger groups, the sample is becoming more and more selective both in the treatment and the control group hence noise increases. However, for all these specifications, coefficients are negative ex-post and with the exceptions of $N = 4$, coefficients are significant either already in year $j = 1$ or by the end of the effects window ($j = 4$). We interpret theses results as evidence that tax haven subsidiaries correlate with a lower TTR ex ante when they first appear both for small and much larger groups. All of these results only concern the extensive margin. When tax havens as a profit shifting technology are introduced for the first time, the pre-existing group starts to decrease it's tax payments relative to its turnover.

Figure A.3: Tax Haven subsidiaries correlate with lower TTR - Change in timing of first tax haven subsidiary N



Notes: This figure shows the results of the event studies testing reactions of the tax-to-turnover ratio (TTR) to the emergence of tax haven subsidiaries, when we vary the timing of the first tax haven subsidiary n. $n \in N = \{3, 4, 5, 6\}$, where n represents the number of total subsidiaries a group has ex post (after it gets its first tax haven affiliate or its next non-haven affiliate). Both control and treatment group have similar number of subsidiaries at event time 0. Our estimation compares the TTR of the ex ante existing non-haven subsidiaries of groups that create a tax haven subsidiary to those of groups that create a non-haven subsidiary. Pre-trends are pinned at -2 and -1 to deal with linear pre-trends as the sample size decreases and the sample is balanced between -2 and 2. At t=0, number of treated groups are {123, 133, 178, 172}, and number of control groups are {600, 539, 496, 388}, for n={3,4,5,6}, respectively. Standard errors are clustered at the subsidiary level and 95% confidence bands plotted.

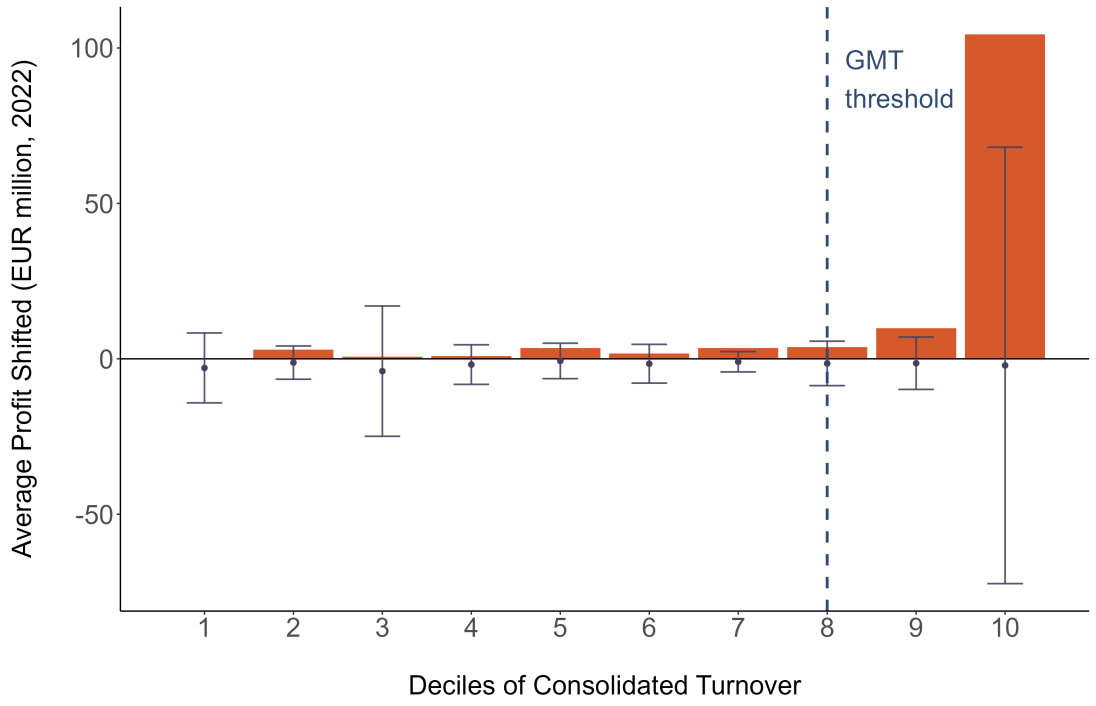
A.2 Additional Figures and Tables

Table A.1: List of tax havens

Tax Havens	**Tax Havens with economic substance**
Andorra, Anguilla, Antigua & Barbuda, Aruba, Bahamas, Bahrain, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Cyprus, Dominica, Gibraltar, Grenada, Guernsey, Hong Kong SAR, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, Macao SAR, Malaysia, Maldives, Malta, Marshall Islands, Mauritius, Monaco, Montserrat, Nauru, Niue, Panama, Samoa, San Marino, Seychelles, Sint Maarten, St. Kitts & Nevis, St. Lucia, St. Vincent & Grenadines, Tonga, Trinidad & Tobago, Turks & Caicos Islands, U.S. Virgin Islands, Vanuatu	The Netherlands, Belgium, Hong Kong, Ireland, Luxembourg, Singapore, Switzerland

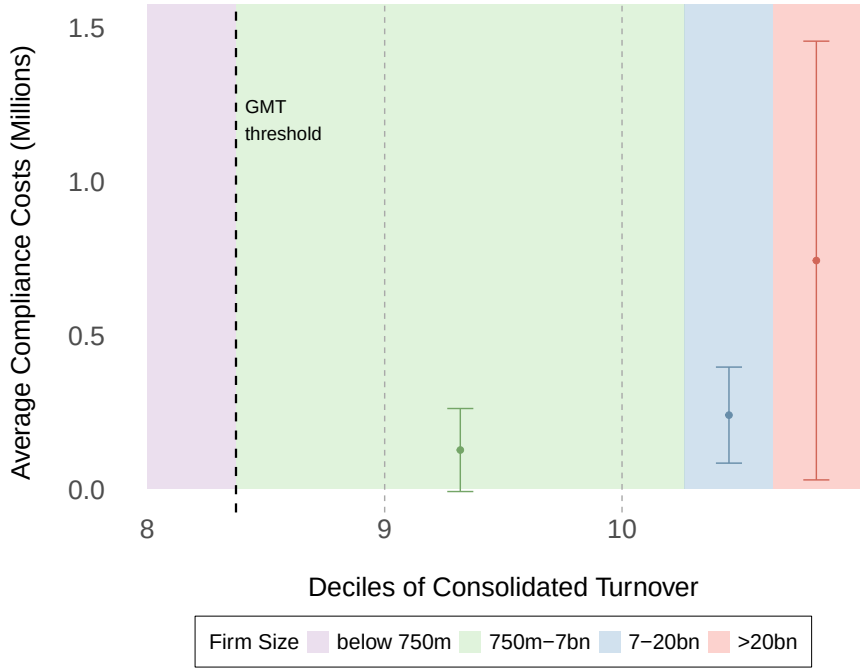
Our placebo exercise uses 100 draws of the placebo country list in a sample without tax haven subsidiaries. Within each of our 10 turnover size bins, this creates 100 means. Our main text plots the standard deviation of the means taking into account the fact that these are means and scaling the standard deviation with the square root of the sample size underlying each mean. In figure A.4, we show statistical uncertainty treating these 100 means per bin as independent observations. The resulting standard errors are therefore much larger. However, even here, the profits shifted calculated for tax haven subsidiaries when they are re-introduced into the sample (orange bars) fall outside of a 95% confidence band for the top two groups.

Figure A.4: Profit shifted across group size, Placebo using means as observations



Notes: This figure plots the profit shifted gradient across group size. Consolidated turnover bins are plotted on the horizontal axis. On the vertical axis, we plot the average profits shifted per group in each decile. The dashed line shows the GMT threshold which lies close to the beginning of the 8th decile. The black dots and confidence bands show the mean and 95% confidence bands treating the 100 placebo means as independent observations instead of means across MNE groups within each decile.

Figure A.5: Average Compliance Costs across Firm Size



Notes: This figure plots the average compliance cost to the Global Minimum Tax, based on the three moments of the survey by Gaul et al. (2022). We plot the three average and standard deviation of reported compliance cost estimates, for groups with consolidated turnover between EUR 750 million and 7 billion, between 7 and 20 billion, and above 20 billion. We overlap the group size categories with the firm size distribution based on the Midi data for 2022, which allows us to construct weighted average for the compliance costs per decile in Figure 6.