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DISSERTATION

Tax avoidance by multinational corporations

An empirical analysis based on firm-level data

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Declaration of authorship

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Sarah Godar

Abstract

In this thesis, I use confidential firm-level data from the Microdatabase Direct Investment (MiDi database) provided by the Deutsche Bundesbank to analyze tax avoidance by German MNCs. While such data has frequently been used in tax-avoidance research, it has yet to be employed to derive macro-level estimates of tax avoidance by Germany-based MNCs. My MiDi-based research includes an estimation of the scale of profit shifting by German affiliates of foreign MNCs and related tax-revenue losses (Chapter 1), as well as an investigation of the tax-haven use and distribution of profits and economic activity of MNCs headquartered in Germany (Chapter 2). Finally, in collaboration with several co-authors, I investigate relatively new micro data on the global tax payments and activities of multinational corporations, voluntarily published by individual MNCs following the implementation of the new CbCR standard (Chapter 3).

I employ different methodological approaches depending on the quality of the data and the research focus of each chapter. In the first chapter, I employ a standard microeconometric approach to identify profit-shifting and estimate the semi-elasticities of MNCs' profits with regard to changes in tax incentive variables. I find that the profits of German affiliates are highly sensitive to foreign tax rate changes. The semielasticity is higher when at least one investor is located in a tax haven and is not significant when a company has never had a tax-haven investor. The estimated effects are used to extrapolate aggregate revenue losses, which range between EUR 1.5 and 5.8 billion in 2016.

In the second and third chapters, the research methodology is descriptive. The research focus of the second chapter is mainly on examining the allocation of the profits and economic activity of MNCs headquartered in Germany, at a time when German CbCR data was not yet accessible. Based on a sample of German parent companies and their foreign affiliates, my co-author Petr Janský and I, analyze to what extent the location of the MNCs' profits is misaligned with the location of their economic activities in terms of measured in terms of the number of employees, assets, and turnover. The descriptive methodology does not allow for the identification of profit shifting but provides some relevant insights based on a previously unexplored dataset. These include the relative stability of total misaligned profits over time and the relatively moderate overall scale of misaligned profits.

The third chapter, co-authored by Giulia Aliprandi, Tommaso Faccio and Petr Janský, relies on a relatively small but original dataset of voluntarily published company-level CbCRs. We assess the value added and limitations of qualitative and quantitative information provided in the reports also based on comparison to individual MNCs' annual financial reports and aggregate CbCR data. We find that early publishers of CbCRs do not double-count profits by including intra-company dividends and that some correct their profits for equity-accounted participation results. We further provide a tentative framework to evaluate tax risk indicators across sample MNCs and assess their potential overall tax aggressiveness even in the absence of a clear identification of profit shifting.

The results of this thesis suggest that cross-border tax avoidance by MNCs is substantial but that significant heterogeneity exists among firms. First, MNCs seem to shift less profit out of their headquarter jurisdictions than between foreign affiliates. Second, larger Germany-based affiliates are more likely to have ownership links to tax havens — and firms with ownership links to tax havens seem to engage more extensively in profit shifting. Third, MNCs that are more tax transparent avoid certain reporting problems identified in aggregate CbCR statistics and score low on indicators of tax aggressiveness.

JEL Classification H20, H25, H26, F21, F23

Keywords multinational corporations, tax avoidance, profit shifting, profit misalignment, tax havens, country-by-country reporting, effective tax rate

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Introduction

The liberalization of trade and international capital flows during the second half of the 20th century has given rise to an unprecedented increase in foreign direct investment (FDI). While internationally integrated multinational enterprises (MNEs) had already emerged at the beginning of the century, they only began to dominate international investment after 1945, when they began increasingly to challenge international arrangements of business taxation (Picciotto 1992). Under the international tax-treaty system, each country separately assesses the profits of the subsidiaries of MNEs operating within its territory. This creates the incentive for MNEs to generate more profits in low-tax countries and less in high-tax countries, thus reducing their global tax liability. They may achieve this by relocating their economic activity to low-tax countries, or by shifting profits to low-tax jurisdictions (i.e., without relocating their actual economic activity). Profit shifting is facilitated by the fact that instead of paying taxes on global profits, the taxable profits of MNEs are assessed separately by each country. This practice results in a number of inconsistencies.

International tax rules foresee that each subsidiary's profit should be determined based on the arm's length principle. This implies that MNEs should price intra-group transactions according to terms that would apply between independent parties. While establishing an arm's length price for transactions involving frequently traded goods with standardized characteristics may in fact be rather simple, it is far more difficult to do this for transactions involving tailor-made intermediate goods or services, such as providing expertise, supervision, or financing, or the right to use a brand, patent, or software. In addition to these technical difficulties, one might also argue that the arm's length principle is conceptually unsatisfactory, as it abstracts from the nature of multinational enterprise: it ignores the economic rationale that internalizing certain economic activities in a multinational structure may provide some economic advantage over acquiring goods and services from unrelated parties – which should be the main reason why MNEs exist. As a result, determining taxable profits leaves some room for interpretation, which has allowed MNEs to shift profits to low-tax countries by means of transfer mispricing, strategic location of intangible assets or international debt shifting (Beer et al. 2019). In addition, MNEs can channel

FDIs through several countries to exploit inconsistencies in international double-tax treaties to avoid withholding taxes on distributed profits (Beer et al. 2019).

Profit shifting by MNEs is estimated to significantly reduce their global tax payments. As MNEs presently account for more than 30% of global gross output (OECD 2018), profit shifting represents an important challenge for effective corporate tax collection in high-tax countries. Recent macro-level estimates suggest that, globally, USD 200 to 300 billion in corporate tax revenue may be lost annually due to profit shifting, of which approximately USD 45 to 60 billion accrues to the EU (Tørsløv et al. 2020; Álvarez-Martínez et al. 2022; García-Bernardo & Janský 2021). Profit shifting may also create competitive advantages for MNEs compared to purely domestic firms. For example, Bilicka (2019) finds a profit-ratio gap of 50% when comparing taxable profits per total assets between UK MNEs and domestic firms, leading to relatively higher tax payments for the latter. This may exacerbate the negative effects on revenue collection – either because MNEs increasingly outcompete purely domestic firms, or due to the pressure to reduce the general level of corporate taxation to mitigate this market distortion.

Tax-optimization strategies employed by MNEs are subject to increasing scrutiny by policymakers, civil society organizations, journalists, and the general public. Especially since the global financial crisis of 2007-2008 and subsequent public budget shortfalls, the tax payments of MNEs have received significant political attention and triggered unprecedented international cooperation aimed at reforming the international system of business taxation (Mason 2020). This collective effort, led by the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting (BEPS), has produced many important anti-avoidance measures, increased the transparency of tax payments by MNEs, and, most recently, led to the global minimum corporate tax agreement. This provides grounds for optimism, as the scope for extreme forms of profit shifting is narrowing.

The lack of representative data on MNEs' profits, tax payments, and economic activity has long impeded the satisfactory mapping of the phenomenon, as well as the assessment of countermeasures. Not only are MNEs not distinguished from other firms in national account systems, but most European countries only began to publish foreign affiliate statistics around 2010 (Tørsløv et al. 2020). Early available data include US foreign affiliate statistics, which, however, show only the US-related activities of MNEs alongside global FDI data. Although FDI data do exhibit the most extensive regional coverage (Janský & Palanský 2019), a notable

disadvantage is that the ultimate source and destination of FDI is difficult to identify – an issue addressed by Damgaard and Elkjaer (2017) and Damgaard et al. (2019). Recently, additional macro data on MNEs have become available, including the OECD's Activity of Multinational Enterprises (AMNE) database, which provides a breakdown of certain macroeconomic variables by foreign affiliates, domestic MNEs, and purely domestic firms – as well as aggregate country-by-country reporting (CbCR) data collected as part of the OECD/G20 Inclusive Framework on BEPS.

In contrast to macroeconomic data, firm-level data allow us to trace ownership structures across countries and analyze profit-shifting behavior while controlling for sectoral or firm-level characteristics. Private databases such as the Orbis database have facilitated research progress on corporate tax avoidance at the company level. As companies in low-tax jurisdictions and poor countries are especially underrepresented (Johansson et al. 2017; Tørsløv et al. 2020; Bratta et al. 2021), studies based on Orbis data likely underestimate the overall scale of profit shifting. Recently, two reliable but confidential firm-level sources of data on MNEs have become available to individual researchers: individual tax statements (as used in Bilicka 2019) and individual CbCR data (Fuest et al. 2022; Bratta et al. 2021). Based on these sources, researchers have arrived at a number of new insights. These include a quantification of the tax savings of MNEs compared to purely domestic firms (Bilicka 2019), the comparably small estimated revenue losses due to profit shifting by companies headquartered in Germany (Fuest et al. 2022), and heterogeneity in profit-shifting intensity depending on the location of MNEs' headquarters (Bratta et al. 2021).

Economic research faces different, sometimes conflicting expectations with regard to methodological rigor and relevance for policy making. In the empirical tax-avoidance literature, most microeconometric studies aim to unambiguously identify profit shifting (i.e., the research design must fulfill the conditions for causal inference). Research interest tends to focus on providing evidence that profit shifting exists, rather on than on estimating its global scale, which would necessarily involve strong assumptions and extrapolations given the described scarcity of data. These studies are complemented by less restrictive and descriptive approaches, which aim at establishing an overall magnitude of the phenomenon and would tend to produce upper-bound estimates, as I argue in the following.

Researchers have suggested different ways to demonstrate that some share of the global allocation of MNEs' profits can be explained by profit shifting and not by other confounding factors. A common strategy, following Hines and Rice (1994), is to establish a relationship between MNEs' profitability and tax rates across countries, including control variables at the country or firm level (see Beer et al. 2018 for a recent overview of based on the Hines-Rice approach). While earlier research relies on cross-country variation in tax rates and observable country characteristics (e.g., Clausing 2011), more-recent approaches rely on changes in MNEs' reported profitability in response to changes in tax rates (or other tax-incentive variables) to identify profit shifting, as this allows to control for time-constant unobserved confounding factors (Riedel 2018). Though cleaner in terms of identification, the latter may lead to an underestimation of profit shifting, as profit shifting at the beginning of period is ignored (García-Bernardo & Janský 2021).[1]

Some recent macro-level studies are less strict in terms of identifying profit shifting but provide important guidance for policymaking, as they establish estimates of the global scale of profit shifting and the varying extent to which countries' tax revenues might be affected by it. These include a study by Tørsløv et al. (2020), who estimate profit shifting based on the varying profitability of foreign affiliates and domestic firms in tax havens and non-havens without controlling for firm-specific or sector-specific characteristics. Other global estimates based on CbCR data (e.g., Bratta et al. 2021; García-Bernardo & Janský 2021) still rely on the Hines-Rice approach, but they estimate profit shifting based on cross-country variation in tax rates without controlling for unobserved country characteristics. These approaches are partly justified by limitations imposed by the data. For example, macro-level data do not allow to control for firm or industry characteristics, and cross-sectional data, as in the case of CbCR, make it difficult to control for unobserved country characteristics.

[1] An alternative microeconometric approach identifies profit shifting by observing that external profitability shocks, which should theoretically raise profits in all locations of an MNE, increase profits in low-tax jurisdictions but not in others (Riedel 2018). While this approach, applied by Dharmapala and Riedel (2013), does not rely on problematic identification via changes in tax incentives over time, it likely produces a lower-bound estimate of profit shifting as well, because subsidiaries operating in the same industry as their parent must be excluded from the analysis (Riedel 2018).

Hines-Rice approaches can be regarded as relatively restrictive, as they detect only the part of profit shifting that is driven by the selected tax-incentive variable. Several authors (e.g., Dowd et al. 2017; Bradbury et al. 2018) have pointed out that it is challenging to operationalize the tax-incentive variable: the statutory tax rate captures only part of the tax attractiveness of a country, as preferential rates on patent income and other tax incentives can lower effective tax rates below statutory rates. Forward-looking effective tax rates have limited global coverage and also cover only selected features of the tax system. Also, backward-looking effective tax rates have shortcomings, as they might be subject to endogeneity concerns (Dowd et al. 2017) or be downward biased – for example, by the effect of depreciation rules and loss carryover (see section 3.3 for a more detailed discussion). Lejour (2021) points out that most conduit jurisdictions have both higher statutory and effective tax rates than typical tax havens, as their most attractive tax features are low standard or bilateral withholding taxes on dividends, interest, or royalties, plus a big tax treaty network. These features are not well captured by standard corporate income tax indicators.

Other approaches capture profit shifting only indirectly, proxied by the share of profits that cannot be explained by economic models based on observable variables. These include propensity score matching of domestic and foreign-owned firms, which assumes that absent profit shifting and given equal firm characteristics, domestic and foreign-owned firms should have a similar tax burden (e.g., Finke 2013; Bilicka 2019).[2] Tørsløv et al. (2020) also fit this category, as they assume that the profitability gap between domestic and foreign-owned firms with the same value of capital and labor inputs should, absent profit shifting, be the same in tax havens and non-havens. Papers based on the misalignment approach (Cobham & Janský 2019; García-Bernardo & Janský 2021) imply that absent profit shifting, global corporate profits would align with economic activity measured in terms of employees, assets, or turnover. More precisely, the share of an MNE's global profits a country attracts should equal the share of economic activity the MNE locates in that country.

The advantage of these indirect approaches is that they do not rely on correctly operationalizing the tax-incentive variable, which reduces the risk of underestimating profit shifting. A drawback

[2] Egger et al. (2010) argue, however, that foreign firms are likely to receive preferential tax treatment from tax authorities, which might explain their lower tax payments.

is that part of the residual profits might be explained by unobserved variables and thus wrongly be attributed to profit shifting. In this sense, the misalignment approach might be considered the least restrictive approach, as it does not control for characteristics of countries, industries, or firms that might explain differences in productivity. Misaligned profits are thus usually not equated with shifted profits but can be regarded as a rough upper-bound estimate (see section 2.7 for a more detailed discussion).

Dharmapala (2019) argues that differences between micro and macro estimates might to a large extent be explained by different notions of profit shifting. He suggests that micro estimates tend to be based on a narrower concept of profit shifting – for example, because they implicitly consider the strategic location of intangible assets as a real response to tax incentives rather than as tax avoidance. Also, Bradbury et al. (2018) highlight that researchers have not reached consensus on which economic activities generate profits, which makes it difficult to objectively distinguish tax and non-tax motives for business decisions.

Thus, the variety of existing tax-avoidance studies not only reflects the variety of different, imperfect datasets on MNEs; it also reflects the different trade-offs faced when selecting one or the other methodology, and recalls deeper theoretical controversies about how value is created. As a result, no consensus has been reached about the scale of profit shifting and resulting tax-revenue losses, despite much research progress and increased data availability.

To add another piece to the puzzle of global research into MNEs, in this thesis, I use confidential firm-level data provided by the Deutsche Bundesbank to analyze tax avoidance by German MNEs. The Microdatabase Direct Investment (MiDi) database covers all Germany-based firms with balance-sheet totals of over EUR 3 million, and foreign participation above certain thresholds. As reporting is obligatory and subject to quality controls by the Deutsche Bundesbank, the data are reliable and might include parent–affiliate relationships not necessarily included in Orbis. In addition, changes in participations can be traced over time, and the data is free of access, which makes the MiDi dataset attractive for conducting research on German MNEs.

My MiDi-based research includes an estimation of the scale of profit shifting by Germany-based affiliates of foreign MNEs and related tax-revenue losses (Chapter 1) and an investigation of the tax-haven use and distribution of profits and economic activity of MNEs headquartered in

Germany (Chapter 2). Finally, in collaboration with several co-authors, I investigate relatively new micro data on the global tax payments and activities of multinational enterprises, voluntarily published by individual MNEs following the implementation of the new CbCR standard (Chapter 3). The first chapter has been accepted for publication in *FinanzArchiv* (*Public Finance Analysis*); the second was published in *Post-Communist Economies*.

I employ different methodological approaches depending on the quality of the data and the research focus of each chapter. In the first chapter, I follow a more rigorous approach with regard to the identification of profit shifting by estimating standard elasticities of MNEs' profits with regard to changes in tax incentive variables. I can show that profits of Germany-based MNEs are sensitive to changes in foreign tax policy controlling for observed and unobserved company characteristics, which can be interpreted as evidence of profit shifting. In the second and third chapters, the research methodology is descriptive. The research focus of the second chapter is mainly to examine the allocation of the profits and economic activity of MNEs headquartered in Germany at a time when German country-by-country reporting was not yet accessible and most of the profit-shifting literature at the macro level referred to foreign affiliates only, or to US MNEs. The descriptive methodology does not allow for the identification of profit shifting but provides some relevant insights based on a previously unexplored dataset. These include the relative stability of total misaligned profits over time and the relatively low overall scale of misaligned profits – a finding later confirmed by Fuest et al. (2022). Chapter 3 relies on a relatively small but original dataset of voluntarily published company-level CbCRs. While the dataset is too small to achieve a meaningful quantitative analysis, our analysis still provides important insights with regard to the quality of CbCR data and proposes a by-company assessment of tax aggressiveness.

This thesis contributes to the growing body of literature on tax avoidance by MNEs in several ways: In the first chapter, I show that the share of Germany-based foreign affiliates at least partially owned by tax-haven investors has increased continuously – from 38% in 1999 to 47% in 2017. A regression analysis further suggests that firms with ownership links to tax havens shift profit more intensively, and that accounting for this heterogeneity among firms may improve the identification of profit shifting. The estimated share of profits shifted out of Germany by foreign affiliates ranged between 7% and 27% in 2016. This is higher than the 4.3% suggested by Fuest et al. (2022), whose extrapolations are based on profit-shifting estimates for companies

headquartered in Germany. This suggests that foreign affiliates may play a more important role than headquarter companies in MNEs' tax avoidance in Germany. This view is also supported by the second chapter of this thesis, in which my co-author (Petr Janský) and I analyze a sample of MNEs headquartered in Germany. We find that these MNEs report disproportionately high profits in tax havens – which cannot sufficiently be explained by economic activity in terms of employees, tangible assets, and turnover – while making disproportionately low profits in most rich high-tax countries, developing countries, and, surprisingly, also in most relatively low-tax Eastern European countries. We find that 10%–13% of German MNEs' global profits are misaligned with economic activity, which seems modest compared to the above-mentioned macro-level studies. In addition, the profits of headquarter companies themselves seem to be broadly in line with economic activity reported in Germany, which supports the hypothesis of a headquarter bias in profit shifting (Dischinger et al. 2014).

The third chapter, co-authored with Giulia Aliprandi, Tommaso Faccio, and Petr Janský, is based on a novel dataset collected from individual MNEs' voluntary CbC reports. Our findings confirm that concerns raised with respect to data quality and interpretation are valid, and that some degree of uncertainty remains attached to tax-risk indicators based on CbCR data. While all sample companies seem to avoid double-counting dividends, only a few explicitly correct for associate and joint venture profits, which on average account for 10% of global consolidated profits. We further find that early publishers of CbCR seem, on average, to score low on typical tax-risk indicators – a result that might motivate more-detailed analysis, as more micro-level CbCR will become available in the future.

The results of this thesis suggest that cross-border tax avoidance by MNEs is substantial, but that significant heterogeneity exists between firms. First, MNEs seem to shift less profit out of their headquarter jurisdictions than between foreign affiliates. Second, larger Germany-based affiliates are more likely to have ownership links to tax havens – and firms with ownership links to tax havens seem to engage more extensively in profit shifting. Third, MNEs that are more tax transparent avoid certain reporting problems identified in aggregate CbCR statistics and score low on indicators of tax aggressiveness. The observed heterogeneity is plausible and partly in agreement with earlier findings established in the tax-avoidance literature.

Applicable limitations are discussed in detail in the individual chapters of this thesis. These include the likely underestimation of profit shifting in fixed-effects panel regressions. On the other hand, equating the misalignment of profits and arguably blunt indicators of economic activity with profit shifting might lead to overestimation. Another problem might be the inconsistent treatment of intra-company dividends in MNEs' reporting, which might concern both Deutsche Bundesbank and aggregate CbCR data. A high share of received intra-company dividends might explain part of the above-average profitability in headquarters – and also in certain jurisdictions.

The question of dividends stands a good chance of being clarified in the near future – as the guidelines for the composition of MNEs' CbC reports have been revised, and cleaner research data will thus become available in the coming years. The first issue, by contrast, points to a more fundamental challenge in the empirical analysis of profit shifting: the adequate modelling of corporate profitability. The concept of economic rents under monopolistic or oligopolistic competition, and the distribution of these rents along global value chains, can contribute to our understanding of where MNEs make profits, and why. Interesting avenues for future research might include establishing ways to account for the different positions of countries in global value chains in country-level descriptive studies, or allowing for more-granular sectoral heterogeneity in firm-level studies. As country- or firm-level fixed effects neutralize the time-invariant incentive to shift profits in panel regressions, it remains worthwhile to explore potential alternatives.

Chapter 1: Tax-haven investors and corporate profitability: evidence of profit shifting by German affiliates of multinational firms

Sarah Godar

Abstract: This paper uses confidential firm-level panel data to provide new estimates of corporate profit shifting by German affiliates of multinational enterprises. The estimated semielasticity suggests that the profits of German affiliates are highly sensitive to foreign tax rate changes. The semielasticity is higher when at least one investor is located in a tax haven and is not significant when a company has never had a tax-haven investor. Using the tax attractiveness index as an alternative operationalization of the profit-shifting incentive yields similar but less robust results. The estimated effects are used to extrapolate aggregate revenue losses, which range between EUR 1.5 and 5.8 billion in 2016. The results suggest that ownership links to tax havens are an informative indicator of whether or not a company engages in international profit shifting.

Keywords: tax avoidance, multinational firms, tax revenue, tax havens

JEL classification: H 20, H 26, F 23

1.1. Introduction

A growing body of academic literature shows that multinational enterprises (MNEs) manipulate profits to reduce their share of profits in high-tax countries and increase it in low-tax jurisdictions in order to minimize their overall global tax payments. Several studies indicate that the profit-shifting activities of MNEs also affect taxable profits in Germany. However, no consensus has thus far been reached regarding the overall scale of profit shifting by German companies and the related tax revenue losses. Despite significant improvements achieved in the past several years, representative data on multinational activities is still scarce, which is why researchers so far have collected and added up information based on different data in order to obtain an increasingly precise but still incomplete picture of MNEs' global tax avoidance strategies.

This paper provides new estimates of the scale of profit shifting by Germany-based affiliates of MNEs and resulting tax revenue losses, based on confidential company-level data from the Microdatabase Direct Investment (MiDi) data set by Deutsche Bundesbank (Blank et al. 2020). I use a Hines–Rice-type econometric approach (Hines & Rice 1994) adapted for the MiDi data by Weichenrieder (2009) in order to estimate the semielasticity of reported profits with regard to the average foreign tax rate in investor countries. I extend the approach by allowing for heterogeneous effects on firms with and without tax-haven investors. As the statutory tax rate is only one of several features of the corporate tax system determining the corporate tax burden, I also use the tax attractiveness index as an alternative operationalization of the tax incentive variable. Based on the estimated semielasticities, I extrapolate the scale of profit shifting and corporate tax revenue losses at a macro scale.

My descriptive analysis of the MiDi data reveals that the share of German companies with tax-haven investors has continuously increased since 1999 and that the relative importance of EU tax havens is fairly high and has increased over time. Despite significant corporate tax reliefs in Germany since 1999, incentives to shift profits to foreign investors persist, and especially to the world's tax havens. The econometric analysis confirms that profits reported by German affiliates are highly sensitive to the statutory tax rates in their investor companies' home countries. The estimated semielasticity of profits with regard to the foreign tax rates is stronger when at least one investor company is located in a tax haven at some point during the sample period and is not

significant when a company never had a tax-haven investor. The effects are similar but smaller and less robust when using the tax attractiveness index as an alternative tax incentive variable.

Based on the regression results, I estimate the scale of profit shifting in my sample of German affiliates to lie between 7 and 29 percent of their total reported profits, which – extrapolated to the total population of foreign affiliates – would translate into tax revenue losses between EUR 1.5 and 5.8 billion, or 2.4 to 9.3 percent of total corporate income tax revenues in 2016. These are likely to be lower-bound estimates, as they exploit only the within-country variation of the tax incentive variables over time for the identification of profit shifting.

This chapter adds in several ways to the growing body of literature on profit shifting. I extend Weichenrieder's approach and extrapolate the results to obtain the first macro-level estimates of the scale of profit shifting by German affiliates based on the MiDi data. By allowing for firm heterogeneity, I show that the profits of firms with tax-haven investors are more sensitive to changes in foreign tax incentives. In contrast, I do not find a significant effect of foreign tax rates on the profits of firms that have never had a tax-haven investor. This lends further support to the view that ownership links to tax havens constitute a suitable indicator of whether or not a firm engages in international profit shifting. I further show that using the tax attractiveness index as an alternative operationalization of the tax incentive variable produces qualitatively similar but smaller and less robust results, likely due to the shorter data availability period.

The chapter is structured as follows: Section 1.2 summarizes the literature and existing estimates of profit shifting by German companies. Section 1.3 describes the MiDi data and the sample selection and discusses potential advantages and disadvantages of using the tax attractiveness index as the tax incentive variable instead of the statutory rate. Section 1.4 provides descriptive evidence of the development of key variables and the share of companies with tax-haven investors. The econometric approach is set out in section 1.5, followed by a summary of the results and extrapolation of results to the macro scale in section 1.6 and robustness checks in section 1.7.

1.2. Profit shifting by German MNEs

Several studies have produced estimates of how much revenue is lost due to profit shifting in Germany. Approaches differ with respect to the potential of data sources and identification strategies, but also with respect to research interest. Top-down approaches analyse the gap between corporate profits derived from the national accounts and the corporate tax base or payments from the national tax statistics (Bach, 2013). Alternatively, inconsistencies in the distribution of profits and foreign affiliates' activity across countries may also be explored using international investment positions and national accounts (Tørsløv et al., 2020). The most common approach in economic literature is to compare MNEs' profits in low- and high-tax jurisdictions based on firm-level data and derive semielasticities of profits with respect to changes in foreign tax rates or tax rate differentials. Few researchers in this strand of literature have extrapolated the amount of profit shifting associated with their estimates. Although this extrapolation from firm-level data to country-level aggregates is subject to many uncertainties, it can help bridge the gap between the micro- and macro-level estimates and make them comparable. The following section provides an overview of existing estimates.

1.2.1. Existing estimates of tax revenue losses due to profit shifting

Table 1 provides an overview of estimates of corporate tax revenue losses in Germany. Some authors provide the share of shifted profits in absolute numbers, others as a percentage of their sample's total profits or both. Similarly, the related revenue losses are either reported in absolute values or as a share of total corporate tax revenues. Where possible, I added transformed results in italics to improve comparability.

The upper bound of estimates for Germany is the corporate tax gap of EUR 90 billion established by Bach (2013) for 2008. It refers to the discrepancy between corporate profits as derived from the national accounts and the actual corporate tax base derived from the national tax revenue statistics. This discrepancy may have various explanations, such as profit shifting but also conceptual divergences in national accounts and financial or tax accounting, which are hard to disentangle due to a lack of data on the tax contribution of unincorporated enterprises and the lack of bottom-up data on entrepreneurial activity. A more common approach to identifying profit shifting exploits inconsistencies between the location of multinationals' declared profits

and their economic activities across countries. This can be done on the basis of macro as well as micro data. For example, Cobham and Janský (2019) find that the share of German affiliates of U.S. MNEs in the total group's profits is too low with respect to their share in the group's activities in terms of assets, employment, and turnover; and they derive an approximate amount of revenues lost due to profit shifting (USD 7.1 billion for 2012; 15 percent of CIT revenues). However, a country's below-average share of a group's profits may also be explained by other (unobserved) country-specific factors besides profit shifting. One way to control for this is to compare the profitability of local and foreign-owned firms by country. Tørsløv et al. (2020) find that in relation to their wage cost, foreign-owned firms make significantly less profit than local firms in most of the countries, while the opposite is true for companies based in tax havens. The authors thus suggest that tax avoidance can only explain a country's below-world-average profitability if multinationals' profitability deviates from that of local firms. They estimate that approximately USD 55 billion in profits were shifted out of Germany by foreign affiliates in 2015, resulting in a revenue loss of 28 percent of corporate income tax.

Another study that compares multinational firms with local firms – but at a micro level – is by Finke (2013). With a propensity-score-matching approach, she demonstrates that in 2007 multinational enterprises paid significantly lower taxes than similar domestic firms and derives aggregate revenue losses of EUR 10.2 billion, or 19 percent of corporate income taxes. Most econometric approaches are driven by the wish to isolate a tax effect from other country-specific or firm-specific factors and an unexplained residual. A common research design is to estimate the (semi)elasticity of pretax income of multinationals' affiliates to a tax incentive variable. As noted by Dharmapala (2014), the most influential approach is the Hines–Rice approach (following Hines and Rice, 1994), which regresses the observed pretax income of multinationals' affiliates on measures of their capital and labor inputs, a measure of a tax incentive (such as the tax rate difference between the parent and the affiliate or between affiliates), and country-level or affiliate-level controls. As in the previously mentioned studies, the idea is that in the absence of tax planning, capital and labor inputs should be able to explain the variation in the affiliates' taxable profits. However, additional control variables at country or firm level can explain differences in the profits across countries or firms. In addition, fixed effects control for unobserved heterogeneity across countries or firms. The tax incentive variable should capture

the degree to which profits are actually sensitive to changes in foreign tax rates or changes in tax differentials between countries. Variations of this approach are used in Huizinga and Laeven (2008), Weichenrieder (2009), Clausing (2016), and Fuest et al. (2020). Huizinga and Laeven (2008) estimate that about 13.6 percent of their sample's profits are shifted out of Germany. But as they do not extrapolate their results to the macro level, these results translate into comparably low revenue losses of USD 1.2 billion in 1999. Clausing (2016), in contrast, derives significantly higher estimates of revenue losses (USD 17.2 billion in 2012); however, this figure is extrapolated from a sample of U.S. firms that might not be representative of all German MNEs. The most recent estimate is by Fuest et al. (2022), who rely on country-by-country reports filed by German MNEs. They find that the annual amount of profit shifting by German parent companies out of Germany was EUR 10.7 billion for the years 2016 and 2017 combined (EUR 5.35 billion per year), or 4.3 percent of their profits reported in Germany. By extrapolating these results to the full population of parent companies and German affiliates of foreign MNEs, they obtain an estimate of EUR 19.1 billion shifted out of Germany per year, which results in a relatively moderate annual revenue loss of EUR 5.7 billion, or approximately 9 percent of corporate tax revenues.[3] While the authors use probably the best available data on multinational activity, it does not include the activities of Germany-based foreign affiliates. As parent companies might have a lower propensity to shift profits out of their headquarters (Dischinger et al., 2014; Godar and Janský, 2020), extrapolating from this data is likely to underestimate the overall level of profit shifting in Germany.

[3] The average corporate tax revenue in 2016 and 2017 was EUR 63.95 billion according to OECD (2020b).

Table 1: Estimates of corporate tax revenue losses for Germany

Author	Data	Sample	Year	Shifted profits	Revenue loss	% of total CIT revenue*
Huizinga & Laeven 2008	Micro; AMADEUS database	European parent companies and foreign affiliates	1999	*13.6% of sample profits* **USD 2.1 bn**	**USD 1.2 bn** (of sample profits; not extrapolated to macro scale)	*3.4*
Bach 2013	*Macro; national accounts, national tax statistics*	*total German business sector*	*2008*	not estimated	**EUR 90 bn** *(tax gap)*	
Finke 2013	Micro; DAFNE database	German parent companies and German affiliates	2007	not estimated	**EUR 10.2 bn**	*19*
Clausing 2016	Micro; aggregated at country-level; BEA	U.S. parents and their Germany-based foreign affiliates	2012	not estimated	**USD 17.2 bn**	**28**
Cobham & Janský 2019	Micro; aggregated at country-level; BEA	U.S. parents and their Germany-based foreign affiliates	2012	**USD 25.8 bn, 154%**	**USD 7.1 bn**	*15*
Tørsløv et al. 2020	Macro	Germany-based foreign affiliates (total)	2015	**USD 55 bn**	**Calculated with ETR 11%: USD 6 bn**	**28**
Fuest et al. 2022	Micro; country-by-country reports	Big German parent companies	2016–2017	**Extrapolation incl. affiliates: EUR 19.1 bn**	**EUR 5.7 bn**	*9*

*Notes: A problem with this relative measure is that the total corporate income tax (CIT) revenues as reported by the OECD revenue statistics (OECD 2020b) do not include tax revenues from partnerships which are taxed under the personal income tax. Those make up a considerable share of business taxation in Germany. For this reason, using corporate income tax revenues as a reference might make the relative importance of profit shifting seem overly dramatic. Nevertheless, it is commonly used in international literature and facilitates a comparison of estimates across individual years. See Bach (2013) for a more comprehensive overview of revenues from business taxation in Germany.

1.2.2 Studies based on MiDi data

Several authors have used MiDi data to investigate corporate tax avoidance (e.g., Buettner et al., 2006; Buettner and Wamser, 2013; Gumpert et al., 2015). While they do provide convincing evidence of German MNEs' profit-shifting strategies or specific channels, they are not necessarily suitable for deriving estimates of the overall level of profit shifting. Weichenrieder (2009) uses a Hines–Rice-type specification to estimate the effect of foreign tax rates on reported profitability (return on assets) by Germany-based foreign affiliates, but he does not estimate the associated level of profit shifting and revenue losses.

His findings indicate that a one-percentage-point increase in the average foreign tax rate would reduce the profitability (ROA) of German affiliates by 0.049 percentage points. With an average ROA of 5.24 percent and an average tax difference of 11.2 percentage points between Germany and the foreign investors' home countries in 2003, I would derive that, absent tax differences, the profitability of German affiliates would increase by 0.55 percentage points, or 10.5 percent.[4] This is a relatively moderate estimate, and it is valid only for the subgroup of affiliates directly held by foreign investors. The profitability ratio as a dependent variable potentially leads to lower profit-shifting estimates than does the natural logarithm of profits (Beer et al., 2019), while the assumption of a linear relationship between reported profits and tax rate might bias results downwards (Dowd et al., 2017). I update Weichenrieder's results with a more recent and longer MiDi data set and provide alternative estimates based on different sample and variable selections and an alternative operationalization of the tax incentive variable (see section 1.3.3.). I use the estimated semielasticities to derive the amount of profits shifted by German affiliates and the associated revenue losses and make the results comparable to previous estimates. I thereby contribute to closing the gap between the existing macro- and micro-level estimates.

[4] The estimated coefficient by Weichenrieder is 0.049 which I multiply by the tax difference of 11.2 percentage points to obtain the effect of 0.55 percentage points.

1.3. Data

1.3.1 Microdatabase Direct Investment

This study relies on firm-level data on inward foreign direct investment from the Microdatabase Direct Investment (MiDi) as provided by the Research Data and Service Centre of the Deutsche Bundesbank (Blank et al., 2020). As reporting is obligatory, the database covers all firms with balance-sheet totals of over EUR 3 million and above certain foreign participation thresholds.[5] Key variables include net-of-tax profits, turnover, number of employees, fixed and intangible assets, total assets, and financial liabilities for German affiliates as well as information on the location of direct or indirect foreign investor companies.

I adjust the sample to take account of changes in reporting requirements implemented in 2002.[6] In 2007 the reporting requirements changed again with regard to the participation thresholds of the immediate German owner and the indirect foreign owner. As the structure of the data does not allow for a systematic adjustment of the sample to this change in reporting requirements, this gives rise to some inconsistency. However, it seems that relatively few firms were affected by this change, because the number of dropouts and new entrants in relation to firms staying in the panel between 2006 and 2007 increased only slightly in comparison with the years before and after. In addition, as the means of the key variables do not indicate any structural break in or after that year, I assume that this change in reporting requirements does not distort the estimation results. This is also confirmed by the robustness checks in section 1.7, where I include results only on directly held affiliates, which were not affected by this change in reporting requirements.

Key advantages of the utilized data are free-of-charge access and reliability resulting from the strict quality controls implemented by the Deutsche Bundesbank. As reporting is obligatory, the data includes some confidential firm-level data and parent–affiliate relationships not necessarily

[5] At least 10 percent of shares or voting rights owned by foreign investors in case of direct participation and at least 50 percent of shares or voting rights in case of indirect foreign participation (Schild & Walter, 2017).

[6] Firms with a balance sheet total of less than EUR 3 million for the years 1999–2001 were dropped as they subsequently no longer reported to MiDi. Firms with a foreign minority interest and a balance sheet total of below EUR 5 million were included only after 2002 and were thus dropped to obtain a more consistent sample.

included in Orbis. In addition, the data facilitates the tracing of changes in foreign participations over time, which to the best of my knowledge is not possible in Orbis. Nevertheless, the data does have some minor shortcomings. First, companies are not required to report pretax profits. However, the net-of-tax profits should be reported prior to profit distribution as well as the offsetting of losses carried forward, which should make them an acceptable proxy for gross profits. Second, as no wage data is reported, the effect of labor input on reported profits can only be proxied by the number of employees.

1.3.2 Sample

Following Weichenrieder (2009), I exclude companies that were unprofitable on average over the sample period, companies from the nonprofit sector, and unincorporated companies. I also exclude banking and insurance companies and holding companies as well as government-sector companies. The data contains information on affiliates whose immediate owner is a foreign company, i.e., direct affiliates, and affiliates whose immediate owner is a German company owned by a foreign company, i.e., indirect affiliates. It also includes mixed cases, which I rank among indirect affiliates. Weichenrieder (2009) excludes indirect affiliates from the regression, because he finds indication that, contrary to the reporting requirements, some of them report profits after distributions to an upper-tier enterprise. This might explain the much lower average profitability of indirect affiliates found in the sample and would justify their exclusion. However, anecdotal evidence suggests that profit-shifting schemes tend to involve many different members of the corporate group in complex ownership networks. Multinational enterprises have an interest in not making their profit-shifting activities fully transparent. For this very reason, I presume that profits are not necessarily shifted to the immediate owner but follow more complicated routes. I might thus forgo relevant information by excluding indirect affiliates. In order to deal with the suspected misreporting by indirect affiliates, I construct two auxiliary dummy variables indicating when an affiliate switches from a direct ownership relationship to an indirect one and vice versa. I assume that the indirect affiliates' tendency to misreport is constant over time and should therefore not affect my estimation results. A measurable effect on reported

profits should only occur if an affiliate changes ownership status during the sample period and subsequently changes its way of reporting.[7]

The final sample includes on average 5,452 affiliates with an average ROA of 4.9 percent, an average number of employees of 261, and an average turnover of EUR 126 million (Table 2).

Table 2: Final sample

Year	N	Mean ROA_w, %	Mean net profits_w, millions EUR	Mean no. of employees	Mean turnover, millions EUR	Mean assets, millions EUR	Mean liability ratio_w, %
1999–2017	5,452	4.9	1.6	261	126	23	48.3

Source: Research Data and Service Centre (RDSC) of the Deutsche Bundesbank, Microdatabase Direct investment (MiDi), 1999–2015, own calculations. Notes. ROA_w, profits_w, and liability ratio_w were winsorized at the 5th and 95th percentiles.

The top five investor countries are the Netherlands, Luxembourg, Switzerland, the United States, and France. Approximately 20 percent of companies report at least one investor company from the Netherlands, followed by Luxembourg and Switzerland with 12 percent of affiliates reporting investors from these countries. 11 percent of companies report investors from the United States, and 8 percent from France.

1.3.3 Measuring tax attractiveness

Following Weichenrieder (2009), I use the statutory corporate tax rates by KPMG (2020) as a proxy of tax attractiveness. Low statutory corporate tax rates constitute a profit-shifting incentive for MNEs even if in some countries other features of the tax system might be of similar importance. Most countries have lowered their statutory corporate tax rates over the sample period, which indicates that these rates still constitute an important instrument of tax competition (see section 1.4.1).

The use of statutory tax rates as a tax incentive variable for the identification of profit shifting presents several potential shortcomings. First, capital allowances, loss treatment, and special tax

[7] In the robustness checks section, I report results for direct affiliates only as a matter of consistency with Weichenrieder's results and also to exclude potential distortions due to the change in reporting requirements.

regimes such as patent boxes or other R&D incentives narrow the corporate tax base and thus also affect the corporate tax burden. Some studies therefore use backward-looking average effective tax rates (AETRs) derived from companies' actual tax payments in relation to their profits (Clausing, 2016; Dowd et al., 2017; Fuest et al., 2021). AETRs might reflect the corporate tax burden more accurately, but they also come with disadvantages. First, AETRs are sensitive to the economic cycle and thus reflect more than changes in tax law. Using them as a tax incentive might thus add white noise to the regression. Second, as corporate profits enter into the calculation of AETRs, they might not be exogenous to the dependent variable. In my case, the data do not allow me to produce AETR estimates, as they do not include profits or tax payments of foreign investor companies; so I use statutory tax rates only. Beer et al. (2019), suggest that using statutory rates rather than effective tax rates might lead to smaller profit-shifting estimates; however, their empirical evidence does not necessarily confirm this hypothesis.

In order to capture additional features of corporate tax systems, I apply the tax attractiveness index – a relatively new measure established by the Institute for Taxation and Accounting at LMU Munich (Schanz et al., 2017). It is available for the 2007–2018 period and covers 100 countries, including many tax havens. In addition to corporate tax rates, the index combines information on a broad range of tax provisions, including anti-avoidance rules, CFC rules, depreciation allowances, EU membership, group taxation regimes, holding-tax climate, loss carryback, loss carryforward, patent-box regimes, personal income tax rates, R&D incentives, taxation of capital gains, taxation of dividends received, thin capitalization rules, transfer pricing rules, treaty networks, withholding tax rates for dividends, withholding tax rates for interest, and withholding tax rates for royalties.

The index combines numerical and categorial variables normalized to range from 0 to 1, where 0 stands for the least and 1 for the most attractive. For example, the statutory corporate tax rate component is calculated as the difference between the maximum tax rate of all countries and the tax rate of each country and then normalized to range between 0 and 1. To evaluate the generosity of depreciation allowances, Schanz et al. (Ibid.) calculate the pretax present value of the depreciation allowances granted for one unit of expense on commercial property. In contrast, loss carryforward and R&D incentives are operationalized as categorial variables. A country is assigned a value of 0 if loss carryforward is granted for up to five years, a value of 0.5 for up to

20 years, and a value of 1 for more than 20 years. With regard to R&D tax incentives, a country will be rated 0 if it has no R&D incentives in place and 0.5 if it provides some R&D incentives. A value of 1 is assigned if the country belongs to the top quartile of countries with the most attractive R&D provisions (see Schanz et al. 2017 for more details).

At first glance, some indicators, such as withholding taxes in the investor country, might not seem relevant for profit shifting from a German affiliate to a foreign investor company. However, if we take the example of the Netherlands, which is used as a conduit jurisdiction for channeling profits to other tax havens, the zero withholding tax on royalties is a relevant indicator of incentive to shift profits through the Netherlands (Lejour et al., 2022). An interesting feature of the index is that some of the tax provisions (e.g., corporate income tax rate, R&D incentives) are assessed in relation to other countries' provisions, implying that a country is more attractive if its corporate tax rate is lower than that of other countries or if R&D incentives are more generous than in other countries. Accordingly, variation in a country's index value may occur even if the country does not change its tax laws but just because other countries do, which is a suitable manner of operationalizing the effects of international tax competition.

1.4. Descriptive evidence

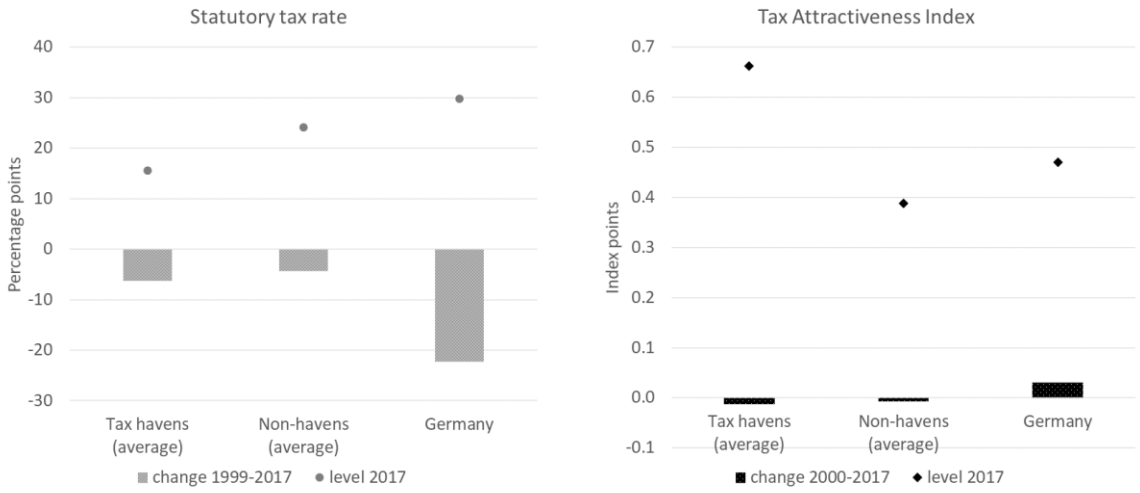
1.4.1 Persistent profit shifting incentives

Despite lowering its tax rate substantially since 1999, Germany still has a high statutory tax rate of approximately 30 percent, compared to the 2017 worldwide average of 22.4 percent (nonhaven average: 24 percent; tax-haven average: 16 percent). By contrast, Germany's score in the tax attractiveness index, where a higher score implies higher tax attractiveness, is above the worldwide nonhaven average due to generous depreciation rules, loss treatment, taxation of capital gains, and a group relief regime for domestic groups. Since the launch of the index in 2007, Germany has increased its score by 0.03, largely due to the declining statutory tax rate and the increasingly more generous depreciation rules (Figure 1). Despite corporate tax reductions, both indicators also show that incentives to shift profit to tax havens still persist.

The average tax difference of the affiliates included in this sample with regard to their foreign investors is 7.7 percentage points in 2017, which corresponds to the above-mentioned global tax

difference between Germany and the rest of the world. For the subgroup of affiliates with tax-haven links, the average tax difference is 8.1 – only slightly higher. This is because most affiliates also have nonhaven investors and because the most important tax-haven investors for German affiliates are European tax havens with moderate statutory rates rather than zero-tax jurisdictions.

Figure 1: Corporate tax rate and tax attractiveness 1999–2017



Source: KPMG (2020); Institute for Taxation and Accounting at LMU Munich (2020), own calculations

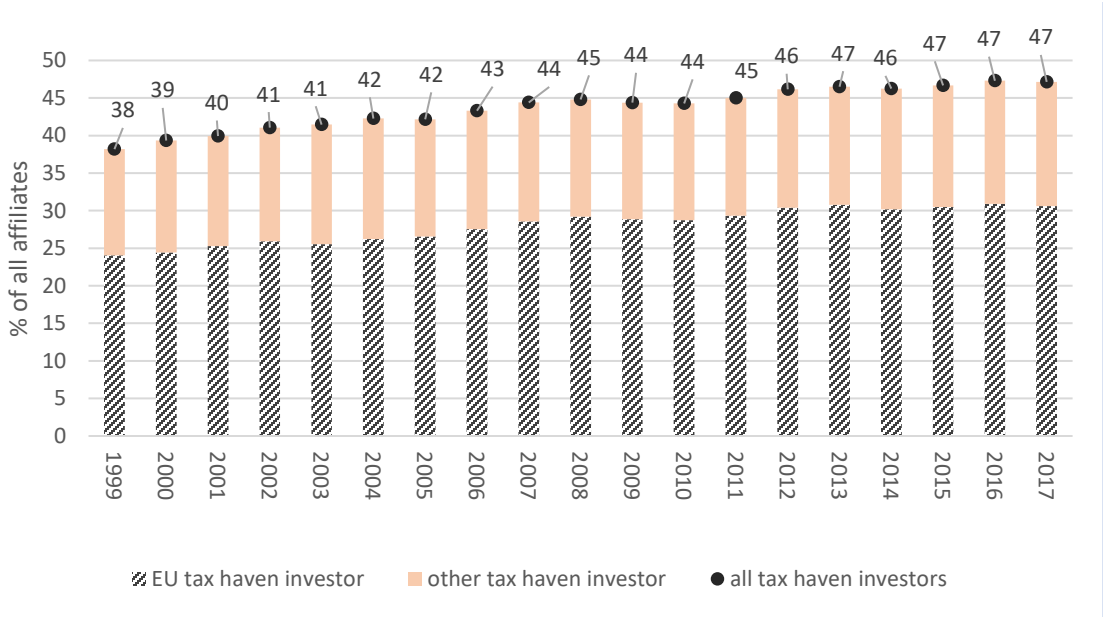
In 2017 tax attractiveness, there is no difference between Germany and the average tax attractiveness in the sample's affiliates' investor countries. For the subgroup of affiliates with taxhaven links the average difference between Germany and their main foreign investor countries is 0.07. Note that the tax attractiveness of the Netherlands, Luxembourg, and Switzerland, which seem to be the most important tax havens for German affiliates, has declined since 1999 by 0.01, 0.07, and 0.03 respectively, despite some fluctuations. As we will see, this might limit the identification of profit shifting to these jurisdictions when using the tax attractiveness index as a proxy for the profit-shifting incentive.

1.4.2 The rising share of companies with links to tax havens

The share of affiliates with ownership links to tax havens has increased throughout the sample period from 38 percent in 1999 to 47 percent in 2017 (Figure 2). The relative importance of the

EU tax havens (Netherlands, Luxembourg, Ireland, Cyprus, and Malta) has increased slightly over time. In 1999, approximately 63 percent of all tax-haven links were with EU tax havens. This share increased to 66 percent in 2013 and since then has decreased to 65 percent in 2017. The definition of tax haven is based on Gravelle's list (Gravelle, 2015)[8] plus the Netherlands, which is a key conduit jurisdiction for investments in Germany (Bernardo-García et al., 2017; Hebous and Weichenrieder, 2014) and besides has been found to offer preferential tax treatment to multinational companies (EC, 2015).

Figure 2: Share of affiliates with tax haven investors



Source: Research Data and Service Centre (RDSC) of the Deutsche Bundesbank, Microdatabase Direct investment (MiDi), 1999–2017, own calculations

My descriptive evidence further suggests that bigger affiliates have a higher probability of reporting a tax-haven investor at some point during the sample period. While affiliates with 500 or fewer employees report a tax-haven investor with a probability of 43 percent, affiliates with

[8] Andorra, Anguilla, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Belize, Bermuda, Cayman Islands, Cook Islands, Costa Rica, Cyprus, Dominica, Gibraltar, Grenada, Guernsey, Hong Kong, Ireland, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, Luxembourg, Macao, Maldives, Malta, Marshall Islands, Mauritius, Monaco, Montserrat, Nauru, Netherlands Antilles, Niue, Panama, Saint Lucia, Saint Vincent and the Grenadines, Samoa, San Marino, Seychelles, Singapore, St. Kitts and Nevis, Switzerland, Tonga, Turks and Caicos Islands, Vanuatu, British Virgin Islands, U.S. Virgin Islands

over 500 employees report a tax-haven investor with a probability of 63 percent. This is in agreement with findings by other authors (e.g., Wier and Hayley, 2018; Bilicka et al., 2020), who suggest that large MNEs are more likely to engage in profit shifting due to the high fixed cost of setting up an international tax optimization strategy.

1.4.3 Tax haven links and profitability

To conduct my analysis I split the sample into two subgroups: companies that report a tax-haven investor at some point during the sample period, and companies that do not. I would argue that having ownership links to tax havens might increase the probability that a company is involved in an international tax optimization scheme. A company remains in the group of companies with tax-haven links even if it does not report a tax-haven investor in all periods, as it might also generally differ in tax morale or in knowledge of tax optimization strategies.

When comparing companies with and without ownership links to tax havens (Table 3), I find that their average level of net profits is similar despite companies with ownership links to tax havens generally being larger in terms of employees and assets. Accordingly, profitability in terms of the ROA of companies with links to tax havens is lower, at 4.5 percent as opposed to 5.3 of the other companies. Affiliates with tax-haven links are thus larger on average in terms of employees and assets, but less profitable. On average, their liability ratio is slightly higher: 48.3 percent in contrast to 47.7 percent. A higher liability ratio might indicate higher financing costs in terms of interest payments and have a dampening effect on profits. This might also be due to intracompany debt-shifting – an important channel of profit shifting (Beer et al., 2019).

Table 3: Key variables by affiliate sub-groups

1999–2017	Mean ROA (winsorized) in %	Mean net profits (winsorized), EUR	Mean number of employees	Mean tangible and intangible assets, EUR	Liability ratio
no tax haven investor	5.32	1.54 bn	205	16.6	47.7
with tax haven investor	4.53	1.58 bn	310	27.9	48.3

Source: Research Data and Service Centre (RDSC) of the Deutsche Bundesbank, Microdatabase Direct investment (MiDi), 1999–2017; own calculations

1.5. Econometric approach

I use a Hines–Rice-type econometric approach to test whether part of the below-average profitability of affiliates with tax-haven links can be explained by profit-shifting activities. I regress the observed income of multinationals' affiliates on measures of their capital and labor inputs, a measure of a tax incentive, and affiliate-level controls. In a first step, I use statutory tax rates as the tax incentive variable. Due to the described shortcomings of the statutory tax rate, I also test an alternative identification strategy and estimate corporate profits' sensitivity to the tax attractiveness index as an alternative explanatory variable, and compare the results.

1.5.1. A Hines–Rice adjusted specification

For my analysis, I start with a Hines–Rice adjusted specification:

$$ln\pi_{it} = \beta_1 \tau_{it} + \beta_2 lnL_{it} + \beta_3 lnK_{it} + \gamma X_{it} + u_i + \delta_t + \varepsilon_{it} \qquad (1)$$

where π_{it} are the affiliate's total profits measured as the net-of-tax profits after interest payments (but before dividends) and τ_{it} is the average tax rate in the home countries of foreign investors weighted by the share of participation of each investor company. L_{it} and K_{it} are the number of employees and non-financial assets of the German affiliate, X_{it} are affiliate-level controls (ln turnover, liability ratio, and a dummy indicating a switch of ownership type (i.e. direct/indirect), μ_i are affiliate fixed effects, and δ_t are time fixed effects. I add a small constant before logarithmizing the profits to avoid losing observations with zero profits.

Following Weichenrieder, I also estimate the regression both with and without the liability ratio. Including it implies keeping financing decisions constant, which might neutralize an important channel of profit shifting (Beer et al., 2020). In contrast to studies using an international dataset, it is not necessary to insert the tax differential with respect to the domestic tax rates, as the domestic statutory tax rate is the same for all affiliates in the sample and thus captured in δ_t. I expect a positive coefficient of the tax variable, as a decrease of foreign tax rates should c. p. result in lower profits of the German affiliate since part of the profits are shifted to the jurisdiction lowering the tax rate. Log profits and liability ratio are winsorized at the 5th and 95th percentiles to exclude the effect of outliers; however, I also provide regressions with non-winsorized variables as a robustness check. As an alternative to the foreign tax rates, I also use the average

Tax Attractiveness Index of the home countries of foreign investors as an explanatory variable. As a higher index value indicates higher tax attractiveness, I expect the sign of the coefficient to be negative because increasing tax attractiveness of the investor countries should c.p. result in lower profits reported in Germany.

As the dependent variable, I use the natural logarithm of the affiliate's total profits as in most Hines–Rice-type studies. Weichenrieder, on the other hand, uses the return on assets ROA_{it}. The advantage of the former is that deriving revenue estimates is more straight-forward since the estimated semi-elasticities refer to total profits. In addition, the ROA also includes assets and liabilities which also serve as explanatory variables and might thus raise endogeneity concerns.

As pointed out by Beer et al. (2020), using the profitability ratio as a dependent variable "may capture real responses to the tax rate in the denominator, confounding tax-minimization responses with real ones". However, a disadvantage is that by using the natural logarithm of profits, I exclude all observations with negative profits – and would have excluded all observations with zero profits if I had not added the small constant. For this reason, and also to facilitate comparison with Weichenrieder's results, I repeat the estimations using the ROA as a dependent variable, which includes all available observations. Doing this both for affiliates with and without negative profits further allows me to examine to what extent the exclusion of loss-making firms might bias the estimates.

In all regressions, standard errors are clustered at the affiliate level and country level with the latter referring to the most important investor country of each company. For robustness, I add estimates with standard errors clustered at the level of the affiliate's industry. This reduces the sample substantially, as the statistical classification of economic activities has changed during the sample period and I can only include affiliates for which I can define a consistent industry classification over time. In the robustness checks section, I also report results for clustering standard errors both at the affiliate level and the level of the investor company or – where available – at the ultimate beneficial owner level.

1.5.2 Estimation with a tax haven dummy and interaction effect

I repeat the analysis for sub-groups of investor countries (tax havens and non-havens). The existence of ownership links to tax havens might be an indication that a given company has set

up an aggressive tax-planning scheme or at least has a higher incentive to shift profits to investor countries. Dowd et al. (2017) have shown that profit shifting is more likely to occur between high-tax and low-tax countries rather than between two high-tax countries with only minor differences in tax rates. As the average tax difference between Germany and foreign investor countries is higher for the sub-group of affiliates with tax haven investors, allowing for heterogeneous effects on the two groups is also a simple way of incorporating this insight. The preferred specification thus includes an interaction effect ($\beta_4 \tau_{it} * D_{it}$) of the tax rate variable and a dummy variable identifying companies that have a tax haven investor or have had it at some point during the sample period:

$$ln\pi_{it} = \beta_1 \tau_{it} + \beta_2 lnL_{it} + \beta_3 lnK_{it} + \beta_4 \tau_{it} * D_{it} + \gamma X_{it} + u_i + \delta_t + \varepsilon_{it} \quad (2)$$

Due to the affiliate fixed effects, the tax haven dummy is omitted in the estimation process. Including the interaction effect is preferable to estimation by sub-groups as those subsidiaries without a tax haven affiliate contribute to a better identification of δ_t.

1.6. Results

1.6.1 Statutory tax rates and domestic profits

As expected, the coefficient of the average statutory foreign tax rate is positive and significant (Table 4, regression 1). The coefficient shows that the decline of foreign tax rates by 1 percentage point is associated with a decline of an affiliate's profit by 3.9 percent. The remaining variables also show the expected signs: increases in the number of an affiliate's employees, turnover, and assets have a positive effect on its reported after-tax profits. Including the liability ratio as explanatory variable reduces the effect of the tax rate to 0.034. As expected, the coefficient of the liability ratio is negative. The dummy variables capturing whether an investment relation switches from direct to indirect or vice versa confirm that affiliates report significantly lower profits on average after switching from a direct foreign investor to an indirect investment relationship and report higher profits after switching from an indirect to a direct investment relationship. As pointed out by Weichenrieder (2009), indirect affiliates might mistakenly report

profits after distribution to their upper-tier German parent. The large significant coefficients suggest that a control of this potential change-in-reporting effect on profits is warranted.

In regressions 3 and 4, I include the interaction term of the tax rate with a dummy variable indicating whether the affiliate has or has had a tax-haven investor at some point during the sample period. The dummy itself is absorbed by the fixed effects, but the coefficient of the interaction term is positive and significant at the 5-percent level. The coefficient of 0.056 implies that a tax reduction in the investor country by 1 percentage point would *c.p.* lower reported profits of the affiliate by 5.6 percent if the affiliate has a tax-haven ownership links. The coefficient of the tax rate alone is not significant anymore, implying that a change in foreign tax rates would not influence reported profits if the affiliate has never had a tax-haven investor. This would confirm the view that profit shifting does not occur between high-tax countries with only minor differences in tax rates and that having ownership links to tax havens makes a company more likely to engage in profit shifting. Furthermore, clustering standard errors at industry level confirms the significant effect of the interaction term, which is even higher for the subsample with consistent industry classifications over time (regression 5).

Using the natural logarithm of profits as dependent variable implies excluding all negative-profit observations. I thus run additional regressions with the return on assets as a dependent variable, which also makes my estimates comparable to Weichenrieder's (2009). Regressions 6 to 9 broadly confirm the previous results: the average foreign tax rate has a positive and significant effect on profitability. A one-percentage-point decrease in the tax rate c.p. leads to a reduction of reported profitability by 0.03 percentage points. With an average profitability of 4.9 percent, this would correspond to a reduction of 0.6 percent. This is slightly lower than Weichenrieder's estimate of 0.049, which would correspond to a reduction of profitability by 0.9 percent in his sample in response to a one-percentage-point change in the average tax rate. The interaction term is also positive and significant. The coefficient is 0.047, which confirms that the reported profit of firms with tax-haven links is more sensitive to foreign tax rate changes. Both coefficients are smaller when I include the liability ratio as a dependent variable (regressions 7 and 9). When I exclude all negative-profit observations (regression 10), I find that the coefficient of the interaction term is slightly higher but the difference is only 0.0006, so the potential bias of excluding loss-making firms seems nearly negligible. In line with findings by Beer et al. (2020),

while the effect of the tax rate is smaller when I use the ROA as a dependent variable, this does not seem to be caused by the inclusion of loss-making companies.

1.6.2 Tax attractiveness index and domestic profits

When I include the tax attractiveness index as the key explanatory variable instead of the statutory tax rate, the number of observations is reduced by approximately 37 percent, as the index covers a shorter period of time, viz., from 2007 to 2017, and includes fewer countries. I do not find a significant effect on reported profits either in the baseline regression 11 or in regression 12 including the interaction term. However, the signs of both coefficients are negative, as expected. Employees and assets are not significant either, but have the expected signs. Besides turnover, the coefficients of the dummy variables indicating a switch from direct to indirect foreign ownership and vice versa are the only variables with significant effects.

When I exclude indirectly held affiliates to avoid potentially confounding effects of changes in the ownership structure and related changes in reporting behavior, as suggested by Weichenrieder (2009), I find a significant effect of the tax attractiveness index of the main investor country on reported profits at the 1% level (regression 13). The average of the tax attractiveness index of all investor countries of an affiliate is not significant; only the index of the country where the main investor is located is significant. The coefficient is 2.2, implying that an increase in foreign tax attractiveness leads to a decrease in reported profits by German affiliates. As the index takes a value between 0 and 1, interpretation of the coefficient referring to a one-unit change in the explanatory variable is an unrealistic example. Assuming instead that the index of the investor country rises by 0.01, the reported profits by German affiliates would change by approximately exp(-2.2 * 0.01) – 1 = -0.022 or -2.2 percent. Again, the effect is smaller when I include the liability ratio, thereby holding financing decisions constant (regression 14).

The interaction term is not significant but negative, as expected (regressions 15 and 16). When I split the sample into subsamples of affiliates with and without tax-haven links, I find a significant effect of the tax attractiveness index on the reported profits of the first group (regressions 17 and 18) and no significant effect on the profits of the second group (regressions 19 and 20).

Table 4: Regression output – statutory tax rates

DEPENDENT VARIABLE: LN(PROFITS)						**DEPENDENT VARIABLE: ROA**				
REGRESSION NO.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
REGRESSION TYPE	standard	standard	interaction	Interaction	industry clusters	standard	standard	interaction	interaction	only positive profits
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
TAX RATE	0.039***	0.035***	0.001	-0.001	-0.001	0.026***	0.018**	-0.007	-0.008	-0.003
	(0.008)	(0.007)	(0.017)	(0.016)	(0.019)	(0.006)	(0.007)	(0.009)	(0.0102)	(0.013)
INTERACTION TERM			0.056*	0.052*	0.061**			0.047**	0.038*	0.048*
			(0.025)	(0.023)	(0.020)			(0.015)	(0.015)	(0.020)
LN_EMPLOYEES	0.028**	0.030**	0.027**	0.029**	0.013	-0.023	-0.021	-0.024	-0.022	-0.010
	(0.010)	(0.011)	(0.010)	(0.011)	(0.019)	(0.015)	(0.017)	(0.015)	(0.017)	(0.0130)
LN_TURNOVER	0.044**	0.051***	0.044**	0.051***	0.047*	0.123***	0.134***	0.123***	.134***	0.070***
	(0.015)	(0.014)	(0.015)	(0.014)	(0.018)	(0.012)	(0.013)	(0.012)	(0.013)	(0.009)
LN_ASSETS	0.002	0.034***	0.001	0.034***	-0.002	-0.112***	-0.041**	-0.112***	-0.041*	-0.088***
	(0.011)	(0.008)	(0.011)	(0.008)	(0.012)	(0.027)	(0.020)	(0.027)	(0.020)	(0.020)
LIABILITY_RATIO		-0.056***		-0.056***			-0.112***		-0.112***	
		(0.003)		(0.003)			(0.004)		(0.004)	
SWITCH_10	-8.465***	-8.171***	-8.463***	-8.169***	-8.788***	-3.310***	-2.814***	-3.307***	-2.812***	-4.072***
	(0.400)	(0.381)	(0.400)	(0.382)	(0.766)	(0.255)	(0.231)	(0.260)	(0.235)	(0.300)
SWITCH_01	5.468***	5.435***	5.496***	5.461***	5.518***	1.603***	1.652***	1.626***	1.671***	2.110***
	(0.825)	(0.783)	(0.826)	(0.784)	(0.774)	(0.338)	(0.287)	(0.337)	(0.289)	(0.451)
N	89,897	89,897	89,897	89,897	71,553	102,249	102,249	102,249	102,249	89,897

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. All regressions include robust standard errors clustered at affiliate and country level with the exception of regression (5) where standard errors are clustered at affiliate and industry level. Small constants were added before logarithmizing to avoid losing zero observations. Liability ratio and log profits were winsorized at the 5th and 95th percentiles to avoid the effect of outliers. Switch_10 is a dummy indicating when a company switches from direct to indirect foreign ownership, switch_01 indicates when the company switches from indirect to direct foreign ownership. Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, KPMG (2020), own calculation.

Table 5: Regression output – Tax Attractiveness Index

DEPENDENT VARIABLE: LN(PROFITS)	FULL SAMPLE		DIRECTLY HELD AFFILIATES ONLY				BY SUB-GROUPS			
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	standard	interaction	standard	Standard	interaction	interaction	with tax haven links	with tax haven links	without tax haven links	without tax haven links
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
TAX INDEX	-0.664	0.558	-2.204**	-1.805**	-1.81	-1.727	-2.382**	-2.356**	-1.867	-1.817
	(0.809)	(1.271)	(0.673)	(0.055)	(1.366)	(1.414)	(0.758)	(0.717)	(1.329)	(1.361)
INTERACTION TERM		-1.497			-0.528	-0.578				
		(1.589)			(1.604)	(1.620)				
LN(EMPLOYEES)	0.021	0.021	-0.018	-0.017	-0.018	-0.017	-0.040*	-0.034+	0.006	0.002
	(0.022)	(0.022)	(0.017)	(0.017)	(0.017)	(0.016)	(0.019)	(0.020)	(0.027)	(0.028)
LN(TURNOVER)	0.043**	0.043**	0.047***	0.048**	0.047***	0.049**	0.063**	0.063**	0.028	0.032+
	(0.013)	(0.013)	(0.016)	(0.016)	(0.016)	(0.016)	(0.023)	(0.022)	(0.018)	(0.018)
LN(ASSETS)	0.011	0.011	0.021+	0.035**	0.021*	0.034**	0.009	0.026+	0.032+	0.042*
	(0.018)	(0.018)	(0.011)	(0.012)	(0.011)	(0.0120)	(0.013)	(0.015)	(0.018)	(0.019)
LIABILITY RATIO				-0.025***		-0.025***		-0.027**		-0.023***
				(0.005)		(0.005)		(0.008)		(0.003)
SWITCH_10	-8.466***	-8.460***								
	(0.462)	(0.462)								
SWITCH_01	7.822***	7.821***								
	(0.853)	(0.852)								
N	56753	56,753	34,741	34,636	34,741	34,741	16,598	16,598	18,143	18,143

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. The variable Tax index refers to the Tax Attractiveness Index of the main investor country of an affiliate. Switch_10 is a dummy indicating when a company switches from direct to indirect foreign ownership, switch_01 indicates when the company switches from indirect to direct foreign ownership. All regressions include robust standard errors clustered at affiliate and country level with the exception of (11) and (12). Small constants were added before logarithmizing to avoid losing zero observations. Liability ratio and log profits were winsorized at the 5th and 95th percentiles to avoid the effect of outliers. Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, Institute for Tax and Accounting at LMU Munich (2020), own calculations

1.6.3 Extrapolation of results

The estimated coefficients can be used to calculate how much profits would be reported by German affiliates absent differences in tax rates (or tax attractiveness) between investor countries and Germany. I thus compute the average tax difference between Germany and the countries of foreign investors for each sample or subsample and multiply it by the estimated coefficient of the tax rate variable to obtain the share of shifted profits for each sample. I set the share of shifted profits of the subsample with tax-haven links in relation with the total profits of the sample in order to make the results comparable.

Table 6: Extrapolation of estimation results

ESTIMATION WITH STATUTORY TAX RATES							
Regression	sample	estimated coefficient	average tax difference	effect of eliminating tax differences	total profits 2017, EUR	shifted profits, EUR	in % of the whole sample's profits
(1)	full	0.039	8.6	0.34	40.0 bn	13.41 bn	33.5%
(3)	with tax haven links	0.056	9.1	0.51	22.5 bn	11.47 bn	28.7%
(4)	with tax haven links	0.052	9.1	0.47	22.5 bn	10.64 bn	26.6%
ESTIMATION WITH TAX ATTRACTIVENESS INDEX							
	sample	estimated coefficient	Average tax index difference	Effect of eliminating tax differences	total profits 2017, EUR	shifted profits, EUR	in % of the whole sample's profits
(13)	directly held affiliates	-2.2	-0.007	0.016	29.3 bn	0.46 bn	1.6%
(17)	directly held affiliates with tax haven links	-2.38	-0.07	0.181	16.2 bn	2.93 bn	7.3%
(18)	directly held affiliates with tax haven links	-2.36	-0.07	0.180	16.2 bn	2.91 bn	7.3%

Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, KPMG (2020), Institute for Tax and Accounting at LMU Munich (2020), own calculations.

The difference between the German statutory tax rate and the average tax rates in the countries of the affiliates' investors is 8.6 percentage points on average for the full sample. Absent this tax difference, the profits reported by affiliates with tax-haven links would increase by 33.5 percent, or EUR 13.41 billion. However, as the coefficient of the tax rate variable becomes insignificant once I insert the interaction term (regressions 3 to 5), I conclude that extrapolating from the average coefficient estimated for the whole sample would be misleading. Instead, the coefficient of the interaction term that is higher but valid only for the subsample of affiliates with tax-haven links seems more accurate. The difference between the German statutory rate and the average tax rate in the countries of the investors of this subgroup is 9.1. Accordingly, the share of shifted profits is 51 percent of the subsample's profits, or 29 percent of the total sample's profit. As there are arguments both for and against including the liability ratio as explanatory variable, I also calculate results based on regression 4, which leads to a slightly lower profit-shifting estimate of 27 percent.

Extrapolation based on the tax attractiveness index leads to much lower profit-shifting estimates. Based on regression 13, I would obtain profit-shifting estimates of about EUR 0.46 billion, or 1.6 percent of the sample's total prof its. Here, the estimated coefficient of 2.2 is multiplied by the difference between the German tax index and the tax index of the affiliates' main investor country, which is 0.007. The difference of 0.007 implies that on average there is little incentive for Germany-based affiliates to shift profits to their investor countries, which is why the extrapolated share of shifted profits would turn out unrealistically small. By contrast, the incentive for affiliates with tax-haven links is ten times stronger. As a result, the coefficient from regression 18, which is only slightly higher, translates into a much higher and more realistic estimate of shifted profits: EU 2.9 billion, or 7.3 percent of the total sample's profits (regression 17). Including the liability ratio has a negligible effect on the outcome (regression 18).

As I find no significant effect of the tax attractiveness index on the profits of the subgroup of affiliates that have never had a tax-haven investor, I again conclude that using the average effect based on the full sample would produce misleading results. Taking into account the heterogeneous effects on firms with and without tax-haven investors, I thus obtain profit-shifting estimates of 27 to 29 percent of reported profits when identification is based on changes in

foreign statutory tax rates. By contrast, I obtain a lower profit-shifting estimate of approximately 7 percent based on the tax attractiveness index.

What might explain the difference in outcomes? The tax attractiveness index spans a shorter sample period and includes fewer investor countries, which reduces the total number of observations by approximately 37 percent – and may produce less robust results. The regressions using the tax attractiveness index yield significant results only for the subsample of directly held affiliates, whose shifted profits are less important than the total sample's profits. As a fixed-effects panel estimation does not exploit cross-sectional differences between affiliates but is limited to within-affiliate variation over time, it only identifies profit shifting caused by changes in profit-shifting incentives over time. This generally leads to an underestimation of the total prevailing level of profit shifting, which might be exacerbated in the case of the shorter sample period of 2007–2017 for which the index is available. For example, according to the index, Ireland, Luxembourg, the Netherlands, and Switzerland improved their tax attractiveness only in some subperiods and experienced an overall decline in relative tax attractiveness between 2007 and 2017. This implies that the fixed-effects approach captures profit shifting to these jurisdictions only to a limited extent. As a result, the estimated extent of profit shifting based on the tax attractiveness index is probably too low.

In addition, some components of the tax attractiveness index are not very granular and may fail to capture some variation in the tax provisions of a country. For example, a country can only improve its assigned value for R&D tax incentives from 0.5 to 1 if it enters the top quartile of countries with the most attractive provisions. Otherwise, incremental improvements will be disregarded. Similarly, the values assigned for loss carryforward only change if the thresholds of 5 or 20 years are crossed. The additional explanatory power of the tax attractiveness index compared to the statutory rate may thus be lower than expected when it comes to variation over time.

1.6.4 Revenue estimates

Extrapolating the results from firm-level data to the macro level is subject to strong simplifying assumptions, as my sample is not necessarily representative of the entire population of Germany-based foreign affiliates. I obtain information on these from the OECD AMNE Database (OECD,

2020a), which provides aggregate data on the inward activity of multinationals in Germany. According to the OECD, total foreign affiliates' profits amounted to approximately EUR 149 billion in 2016. Comparing my sample with the population reveals that the companies in the MiDi sample are larger than the population of foreign affiliates in terms of the average number of employees and turnover.[9] This is not surprising, as a balance-sheet total of over EUR 3 million is one of the Bundesbank's reporting obligation criteria. In addition, the share of companies with tax-haven investors seems to be smaller in the population than in my sample (38.2 compared to 47 percent). This might be due to the correlation of size and tax-haven links observed in section 4. Another possible explanation is that the MiDi data also includes information on minority participations while the OECD only counts majority participations. Profits, however, can also be shifted to tax-haven companies holding a minority share. As it is better to err on the side of caution, I assume that my estimation results hold only for the 38.2 percent of German affiliates that have a tax-haven investor according to the OECD data. Unfortunately, as the aggregate data do not allow me to identify the aggregate profits of this subgroup, I assume that they account for a proportional share of aggregate profits of 38.2 percent, i.e., a total amount of EUR 56.6 billion in 2016 according to the OECD (2020a).[10]

According to my estimates based on the statutory tax rates, the companies with tax-haven links shift 51 percent of their profits, which translates to EUR 28.9 billion at a macro scale (Table 7). An assumed effective tax rate of 22 percent (which is the mean of estimates by García-Bernardo et al. 2020) would then imply revenue losses of EUR 5.8 billion, or 9.3 percent of total corporate tax revenues, which amounted to EUR 56.6 billion in 2016 (OECD, 2020b). Based on the tax attractiveness index, I estimated that direct affiliates with tax-haven investors shift approximately 18 percent of their profits. This translates to 13 percent of profits for the entire subsample of affiliates with tax-haven investors (including indirectly held affiliates) and EUR 7.4 billion of aggregate shifted profits. The resulting tax revenue loss would be EUR 1.5 billion, or 2.4 percent of total corporate tax revenues in 2016.

[9] The average number of employees in the population is 100 and average turnover is EUR 45 million in 2016, compared to the sample average of 261 employees and EUR 126 million of turnover in 1999-2017.
[10] This might be too conservative, as large companies, which are also more likely to have a tax haven investor, might also account for a disproportionate share of aggregate profits. However, in my sample, average profits per company were surprisingly similar for the two sub-groups (Table 3).

Table 7: Extrapolation of results to the macro scale

Regression	Share of shifted profits according to sub-sample	Aggregate profits of affiliates with tax haven owners in EUR billions	Total shifted profits in EUR billions	Tax revenue loss in EUR billions	Share of corporate tax revenue
(3)	51%	56.6	28.9	5.8	9.3
(17)	13%	56.6	7.4	1.5	2.4

Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, OECD (2020a), OECD (2020b), own calculations.

These estimates are low compared to existing literature and might constitute an underestimation due to the methodological issues explained above. Differences in the identification strategy are likely to make my estimates more conservative than those by Clausing (2016), Cobham and Janský (2019), and Tørsløv et al. (2020): Most notably, the fixed-effects panel estimation allows me to control for unobserved heterogeneity between firms, which tends to lower the share of a firm's below-average profits attributed to profit shifting. The fixed-effects approach is also more restrictive in dealing with unobserved heterogeneity than the propensity score matching applied by Finke (2013).

Despite being more conservative than several estimates from earlier studies, my results still suggest that Fuest et al. (2020) underestimate the total amount of profit shifting by German companies, as they assume that German affiliates shifted approximately EUR 5 billion annually in 2016 and 2017. They infer the amount of profit shifting by Germany-based foreign affiliates from the behavior of the German headquarters, which, according to the authors, only shift 4.3 percent of their profits. My results thus lend support to the hypothesis that global tax optimization by MNEs affects the profits of foreign affiliates more than the profits of headquarter companies (Dischinger et al., 2014; Godar and Janský, 2020).

1.7. Robustness checks

In order to check the robustness of my results, I repeat the tax rate regressions for directly held affiliates only, as these were not affected by the change in reporting requirements in 2007. This sample is also more consistent with Weichenrieder's estimations, which only include direct affiliates. The results confirm a positive and significant effect of the average statutory tax rate in investor countries, which disappears when I include the interaction effect of the tax rate and the tax-haven links (regressions 21 and 22 in the Appendix).

In addition, I report results for nonwinsorized profits both with the tax rate and with the tax attractiveness index in regressions 23, 24, 29, and 30. Winsorizing the logarithmized profits to avoid the effect of outliers does not seem to affect the results to any great extent. The coefficients of the statutory tax rate and the interaction term are still significant, and their size hardly changes without winsorizing. The same holds true for the effect of the tax attractiveness index in the total and the subsample of affiliates with tax-haven links.

Furthermore, I am able to show that the effects of the statutory tax rate on reported profits and the interaction term are robust with respect to changes to the start and end points of the sample period from 1999–2017 to 2000–2016 (regressions 25 and 26) and to clustering standard errors at the affiliate level and the level of the investor company or ultimate beneficial owner, if available (regressions 27 and 28). For the latter, I use the ID of the foreign investor company as an additional clustering variable, replaced by the ID of the ultimate beneficial owner when available. The effect of the tax attractiveness index is also robust to clustering standard errors at affiliate and industry levels (regressions 31 and 32) instead of affiliate and country levels, or to clustering at affiliate level and the level of the foreign investor company or ultimate owner (regression 33).

1.8. Conclusion

Several researchers have provided evidence of profit-shifting activities by German MNEs and have estimated related tax revenue losses ranging from 3 to 28 percent of corporate income tax revenue. Data sources include the BEA data for U.S. multinationals, international firm-level data from private data providers, current-account data, and most recently also country-by-country

reports by German parent companies. While confidential MiDi data has been used by numerous authors to provide evidence of profit shifting by German MNEs using various channels, it has not, to the best of my knowledge, been used to estimate the extent of profit shifting and tax revenue losses. With this study, I aim to fill in this gap.

Analyzing a sample of German affiliates of multinational enterprises from the the MiDi database, I find that the share of companies with tax-haven investors has increased significantly since 1999 and that the reported profits of affiliates with tax-haven investors are more sensitive to changes in foreign tax rates. For the econometric identification of profit shifting, I build on the Hines–Rice approach and the MiDi-specific adaptation by Weichenrieder (2009). In contrast to Weichenrieder, I use the natural logarithm of profits as a dependent variable instead of a profitability ratio, and I use a bigger sample including also indirectly held affiliates. As an extension, I include an interaction term of the foreign tax rate with a dummy variable indicating that an affiliate has reported a tax-haven investor at some point in the sample period.

I show that while the effect of the foreign tax rate on reported profits is stronger for firms with tax-haven investors, it is not significant for affiliates that never had a tax-haven investor. I achieve qualitatively similar results when using the relatively new tax attractiveness index as an alternative operationalization of the tax-incentive variable, though the effects are smaller and less robust. This may be due to the shorter period of time covered by the index and the relative decrease of tax attractiveness of important European tax havens in several subperiods, which make it technically difficult to identify profit shifting in these jurisdictions using the chosen fixed-effects approach.

The preferred specification yields an estimated semielasticity of 5.6 for the subgroup of affiliates with tax-haven links, based on which I estimate that 29 percent of the sample's total profits are shifted out of Germany. Extrapolating the result to the whole population of foreign affiliates in Germany, this translates into an aggregate annual revenue loss of EUR 5.8 billion, or 9.3 percent of corporate income tax revenues in 2016. Results based on changes in the tax attractiveness index suggest a lower scale of profit shifting: 7.3 percent of the total sample's profits, which – extrapolated to the macro scale – translates into an aggregate tax revenue loss of EUR 1.5 billion annually, or 2.4 percent of total corporate tax revenues.

The broad range of estimates illustrates the sensitivity of results to methodological choices. Regardless, the results suggest that German affiliates of MNEs engage in profit shifting involving nonnegligible public revenue losses and that the existence of ownership links to tax havens seems to constitute a good indicator of whether a company engages in international profit shifting or not. Compared to recent studies on profit shifting by German companies, my results confirm the view that foreign affiliates play a more important role in MNEs' tax optimization strategies than the headquarter companies.

Chapter 2: Corporate profit misalignment: evidence from German headquarter companies and their foreign affiliates

Sarah Godar & Petr Janský[11]

Abstract

Despite numerous data challenges, economists have established that the multinational enterprises' reported profits are not well aligned with their economic activity across countries. However, uncertainties remain about the extent and patterns of this misalignment. We fill in this gap for Germany-based multinational enterprises and their foreign affiliates. We use the data collected by the Deutsche Bundesbank, which include confidential data on foreign direct investments and a combination of confidential and publicly available balance sheet data. We find that the world's tax havens attract a considerably higher share of German multinational enterprises' profit than economic activity, while in Eastern European countries, most developing countries and some big European countries reported profits are much lower than economic activity would suggest. We also find that the most important tax haven is the Netherlands, followed by other EU tax havens of Cyprus, Ireland, Luxembourg and Malta.

Keywords: multinational enterprises; profit misalignment; tax havens; Germany

JEL classification: F21; F23; H25

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2.1. Introduction

Under its recent Base Erosion and Profit Shifting proposals, the Organisation for Economic Co-operation and Development requires all large multinational enterprises to report aggregate data on the global allocation of income, profit, taxes paid and economic activity among tax jurisdictions in which it operates (Country-by-Country Reporting). This measure was motivated by the lack of quality data on the activities of multinational enterprises which has troubled tax authorities worldwide. But not only tax authorities, also researchers have been troubled by the lack of representative data on the activities of multinational enterprises. Good data are available for U.S.-based multinational enterprises because the Bureau of Economic Analysis collects and publishes data on parent (or headquarter) firms and affiliates. Research on European multinational enterprises mostly relies on data by private data providers such as the Bureau van Dijk's Amadeus and Orbis databases. Orbis, despite being the most comprehensive data source, covers only a nonrepresentative share of the global profits of multinational groups (Tørsløv et al., 2018). The publication of the foreign affiliate statistics has improved the public data availability for Europe significantly but they do not include information on the profits and activities of domestic parent companies. Domestic parent companies are, however, estimated to account for about 21% of global output or 60% of global multinational output (OECD, 2018). In the German economy, domestic multinational enterprises accounted for about 23.5% of total output in 2016.[12] This share has risen slightly from 21.5% since 2008 (OECD, 2020a).

Despite the absence of representative data, so far, researchers have analysed different pieces of available data with different methods and have again and again concluded that the multinational enterprises' reported profits are not well aligned with their economic activity across countries (e.g. Cobham & Janský, 2019; Riedel, 2018). Uncertainties remain about the extent and patterns of misalignment. In order to get closer to consensus estimates of the latter, we analyse a sample of Germany-based multinational enterprises and their foreign affiliates based on data collected by the Deutsche Bundesbank. We obtain this sample by matching partly confidential balance sheet data from the JANIS database (Becker et al., 2019) to confidential data on foreign direct investments from the MiDi database (Blank et al., 2020) using the matching IDs provided by

[12] The respective share of foreign affiliates was 19% in 2016. Domestic non-MNEs still produce the largest share of output but it has declined slightly from 58.5 in 2008 to 57.6 in 2016 (OECD, 2020a)

Deutsche Bundesbank (Schild et al., 2017). Our main sample includes on average 1236 German parent companies per year with 5047 foreign affiliates in 178 jurisdictions for the years 1999–2016.

Based on this sample, we analyse to what extent the location of the multinational enterprises' profit is aligned with the location of their economic activities. We find that the misaligned profits on average amount to 10–13% of the sample's total profits. The intensity of misalignment with regard to the location of assets and turnover has increased over time but no such trend can be observed with regard to the location of employees. The distribution of misaligned profits across countries confirms the outstanding role of EU tax havens which attract a large share of excess profits. In contrast, German multinational enterprises report much more economic activity than profits in Eastern European countries, most developing countries and some big European countries. For the German parent companies the pattern of misalignment is less clear depending on the activity measure we use.

With our results, we hope to contribute to a growing literature on global profit misalignment (e.g. Cobham & Janský, 2019; Janský, 2020a) or the potential effects of formulary apportionment of the international distribution of corporate tax base (e.g. Cobham & Loretz, 2014; Fuest et al., 2006) and profit shifting by Germany-based multinational enterprises (e.g. Finke, 2013; Gumpert et al., 2015; Weichenrieder, 2009). The relatively small misalignment of profits reported by German parent companies might also be in line with results by Dischinger et al. (2014) who found that multinational enterprises might be reluctant to shift profits out of their headquarters. We are not able to attribute the observed extent of misalignment to particular reasons. Profit shifting is only one of several possible explanations. Still, the outstanding role of the world's tax havens in our sample points into this direction and thus requires further explanation.

The paper is structured as follows: Section 2.2 discusses how our approach relates to the existing literature on profit misalignment, formulary apportionment and profit shifting. Section 2.3 describes our data and section 2.4 our methodology. Section 2.5 summarises and discusses our results including the global scale of misalignment, the development of the intensity of misalignment over time and the distribution of misaligned profits across countries. Sub-section 2.5.3 analyses the German parent companies in more detail. Section 2.6 provides some robustness checks based on an alternative sample. Section 2.7 concludes.

2.2. Related literature

A growing literature explores the inconsistencies between the location of multinational enterprises' declared profits and their economic activities across countries. This includes descriptive studies on corporate profit 'misalignment' which analyse the scale and patterns of these inconsistencies based on firm-level data (Cobham & Janský, 2019; Janský, 2020a) and studies on the potential effects of unitary taxation based on formulary apportionment of the corporate tax base (Clausing & Lahav, 2011; Cobham & Loretz, 2014; Devereux & Loretz, 2008; Fuest et al., 2006).

Analysing profit misalignment by U.S. multinational enterprises, Cobham and Janský (2019) find that profits reported by their Germany-based affiliates should be more than twice as high if they were aligned with economic activity in terms of assets, employees and turnover reported in Germany. Profit shifting might not be the only reason for this profit misalignment. A possible way to control for (unobserved) country-specific factors that might explain below-average profitability is to compare the profitability of local and foreign-owned firms by country. Based on national accounts data, Tørsløv et al. (2018) find that in relation to their wage cost, foreign-owned firms make significantly less profits than local firms in most of the countries while the opposite is true for companies based in tax havens. A similar idea is brought up by Finke (2013) who establishes a profitability gap between multinational and non-multinational companies in Germany based on propensity score matching.

The misalignment of profits and activity has also been examined in policy-oriented studies: Policy debates about potential reforms of the international system of corporate tax brought up proposals of redistributing the corporate tax base across countries with the help of formulary apportionment to ensure that multinational profits are taxed where their actual economic activity takes place. In its proposal for the Common Consolidated Corporate Tax Base (CCCTB), the European Commission's suggested a formula which would measure economic activity by equally weighting the three factors real assets, sales and employees. The employee factor is split into 50% head count and 50% payroll (European Commission, 2016). In order to estimate the distributional implications of formula apportionment in the EU, Fuest et al. (2006) analyse a sample of German multinational enterprises based on FDI data from MiDi, and corporate balance sheets from USTAN and Hoppenstedt databases. For the years 1996 to 2001, they find that

Germany would gain about 6% of its multinational tax base if profits were aligned with activity while the Netherlands, Belgium and Ireland would lose a lot. In a similar way Cobham and Loretz (2014) analyse a sample from the Orbis database.

Most econometric studies analysing the discrepancies between multinational enterprises' reported profits and activity are driven by the wish to isolate a tax effect from other country-specific or firm-specific factors and an unexplained residual. A common research design is to estimate the (semi-)elasticity of pre-tax income of multinationals' affiliates to a tax incentive variable. As noted by Dharmapala (2014), the most influential approach ('Hines-Rice approach' following Hines and Rice (1994)) is to regress the observed pre-tax income of multinationals' affiliates on measures of their capital and labour inputs, a measure of a tax incentive (such as the tax rate difference between the parent and the affiliate) and country-level (or affiliate-level) controls (see Riedel, 2018 for a comprehensive overview). 'Hines-Rice'-type studies, producing also explicit results for Germany-based companies, are for example, Huizinga and Laeven (2008) and Weichenrieder (2009).

The 'Hines-Rice' type identification of profit shifting is however limited by problems with the operationalisation of the tax incentive variable. Nominal tax rates do not necessarily reflect the true tax-attractiveness of tax havens for multinational companies and estimates of effective tax rates are available for a limited number of countries and years and not necessarily very reliable. More comprehensive measures of tax attractiveness such as the Tax Attractiveness Index (Institute for Taxation and Accounting at LMU Munich, 2020) and the Corporate Tax Haven Index (Tax Justice Network, 2019) have become available only recently. Also, many econometric identification strategies build on variation of the tax attractiveness over time and are therefore more likely to identify increases in profit shifting rather than the time-invariant share of shifted profits which then needs to be extrapolated based on strong assumptions. Other authors focus on specific channels of profit shifting, such as the use of internal debt (Buettner et al., 2009; Buettner & Wamser, 2013; Reiter et al., 2021). They provide convincing evidence of German MNEs profit-shifting strategies but are not necessarily suitable for deriving estimates of the overall level of profit shifting. For these reasons, we believe that descriptive analyses of corporate profit misalignment still are a valid contribution also to the profit-shifting literature, in the sense

that they may serve as an upper bound of profit shifting estimates despite the absence of clear identification.

Another research gap to which we hope to contribute to this study is the profit-shifting behaviour of parent companies. As pointed out by Tørsløv et al. (2018), the global Foreign Affiliate Statistics have been improved significantly and have allowed them to obtain a macro picture of foreign affiliates' reported profits and economic activities at a global scale. The recently published OECD AMNE database, on the other hand, now allows to distinguish domestic economic activities of domestic multinational and non-multinational enterprises at a macro scale for the first time. Apart from that, information on European parent companies can only be obtained from private micro databases such as Orbis and Amadeus and is far from comprehensive.

A special role of parent companies is not explicitly discussed in many studies. Huizinga and Laeven (2008) use a sample of European parent companies and their subsidiaries. For Germany-based companies, they find a below-average semi-elasticity of pre-tax profits with respect to the tax rate of 0.28. Based on this elasticity, they estimate that about 13.6% of multinational profits are shifted out of Germany. The average estimated elasticity does not change significantly whether based on affiliates alone or including also the parent companies. This result would thus not support asymmetries in the direction of profit shifting between parent and subsidiary. In contrast, Dischinger et al. (2014) find that profit-shifting activities between parent and subsidiary are not symmetric in the sense that they tend to be larger when the parent's location has a lower corporate tax rate but less important when the subsidiary's location has a lower corporate tax rate. They argue that there might be a bias in the location of profits and profitable assets in favour of the headquarter firm. They suggest as possible explanation that headquarters' managers might prefer having funds and valuable assets under direct control at their host location.

Second, they argue that companies might try to avoid taxes on the repatriation of profits, e.g. dividend withholding taxes in the source country. Also, Dharmapala and Riedel (2013) who analyse a sample of European parent companies and their foreign affiliates produce estimates of profit shifting that lie at the lower end of the range of semi-elasticities from the profit-shifting literature. Our analysis of profit misalignment by German parent companies points in the same direction.

2.3. Data

2.3.1. German parent companies and their foreign affiliates

In order to analyse the extent and patterns of profit misalignment, we use a sample of Germany-based multinational enterprises and their foreign affiliates based on data collected by the Deutsche Bundesbank. These include confidential data on foreign direct investments from the MiDi database (Blank et al., 2020)[13] and a combination of confidential and publicly available balance sheet data from the JANIS database (Becker et al., 2019).[14] The Deutsche Bundesbank provides a table of matching IDs which allows researchers to match company information from the two databases (Schild et al., 2017). Like Fuest et al. (2006), we obtain the sample by matching balance sheet data of Germany-based multinational enterprises to data on their foreign affiliates from the MiDi database.[15] While Fuest et al. used balance sheet data from the USTAN database, we use the JANIS database which is a new and more comprehensive version of USTAN.

The JANIS database includes annual balance sheet information of Germany-based nonfinancial enterprises. Part of the information is collected by domestic credit institutions which report the annual financial statements of enterprises to the Deutsche Bundesbank as part of the Bundesbank's credit assessment system. Domestic credit institutions likely report enterprises with a relatively high creditworthiness which is thus not representative of the total population of enterprises. However, the JANIS database also includes financial statements from public sources which improve its representativeness with respect to the USTAN database. The inclusion of confidential data and the quality controls executed by the Deutsche Bundesbank make the dataset attractive for research on Germany-based companies.

[13] Blank, S., Lipponer, A., Schild, C.-J., & Scholz, D. (2020). Microdatabase Direct Investment – a Full Survey of German Inward and Outward Investment. German Economic Review, forthcoming (available online ahead of print).
https://www.degruyter.com/view/journals/ger/ahead-of-print/article-10.1515-ger-2019-0123/article-10.1515-ger-2019-0123.xml?rskey=Ru9aJv&result=10&tab_body=fullHtml-75008

[14] Becker, T., Biewen, E., Schultz, S. and Weisbecker, M. (2019). Individual financial statements of non-financial firms (JANIS) 1997-2017, Data Report 2019-10 – Metadata Version 2. Deutsche Bundesbank Research Data and Service Centre.

[15] Likewise, other authors have combined MiDi and USTAN data to study different aspects of MNEs' behaviour (e.g. Becker, Ekholm et al. 2013, Jäckle/Wamser 2010).

The MiDi database collects firm-level data on inward and outward foreign investments. On the outbound side, German companies report key statistics on their foreign investment enterprises. Reporting is obligatory for firms with a balance sheet total of more than 3 million EUR and above certain foreign participation thresholds so that the data covers the population above these thresholds. The MiDi does not include balance sheet information on the German parent companies which is why we match it to the JANIS sample.

Our data covers a significantly lower share of firms than the Orbis database. The advantages of our data are free-of-charge access and reliability due to strict quality controls by the Deutsche Bundesbank. Our data includes some confidential firm-level data that are not necessarily included in Orbis as well as parent-affiliate relationships that might not be included in Orbis as the reporting of foreign affiliates is obligatory in the MiDi database. In contrast to the FATS, our data cover also German parent companies. The main contribution of our paper is thus, on the one hand, to validate results of other researchers based on a different piece of data. On the other hand, we specifically examine the pattern of misalignment between German parent companies and their foreign affiliates. Estimates of profit misalignment based only on foreign affiliates might underestimate the scale of the phenomenon. At the same time, patterns of misalignment might differ between parent companies and foreign affiliates (Dischinger et al., 2014).

Our variables of interest include profits, number of employees, assets, and turnover as a proxy for sales. Our choice of variables is limited by the availability of variables in the MiDi dataset. In order to measure economic activity, we use the variable 'number of employees' as compensation of employees is not available for the foreign affiliates. We use tangible and intangible assets to proxy capital input. Unfortunately, tangible and intangible assets of the foreign affiliates are not reported separately. Our preferred pre-tax profit variable from the JANIS database is the 'result from ordinary activities' which does not have an equivalent in the MiDi database. The latter only includes profits after taxes but prior to profit distribution, and offsetting of losses carried forward. We gross up the after-tax profit with the foreign tax rate in order to make them more comparable to the German parent's pre-tax profits. As in Fuest et al. (2006) we use the statutory tax rates which we obtain from KPMG (2020a).

Assuming that profits were effectively taxed at the statutory rate might lead to an overestimation of foreign profits with respect to the German pre-tax profits. As a robustness check, we thus use

also backward-looking effective tax rates (ETR) by Janský (2019) and García-Bernardo et al. (2020). Using the ETR might be more appropriate for obtaining an equivalent to the pre-tax profits reported in the JANIS database as the ETR are calculated based on the accounting profit. As the ETR are lower than the statutory rates, using the ETR likely reduces the share of profits reported in Germany with respect to the results based on statutory rates. However, the ETR are available only for a limited number of countries, excluding the U.S., many tax havens and lower income countries which leads to an omission of about 1,000 affiliates in the later years of the sample. Disregarding affiliates in these countries might lead to a distortion with the direction of the distortion being unknown.

2.3.2. The sample

For our analysis, we exclude companies from banking, finance and insurance industries, as well as public administration and defense. We drop sole proprietors and 'other legal forms' which include foundations, registered associations and municipal companies. In the matching process, many observations are lost.[16] Firms tend to appear in JANIS for shorter time periods than in MiDi. In contrast to JANIS, reporting is obligatory in the MiDi so many firms are actually included since 1999, the first year of the dataset. Also, some firms with foreign direct investments are not included in JANIS. Conversely, not all firms in JANIS do necessarily have foreign affiliates. After the elimination of non-matched observations, our sample includes on average about 2,100 Germany-based companies per year with about 8,800 foreign affiliates for the years 1999–2016. We drop companies which have made losses on average over the sample period. We also drop subsidiaries in countries for which no tax rate data are available. As a consequence, we obtain different samples for the statutory and effective tax rates. Roughly 60% of all parent-year observations are from the manufacturing sector and about 30% of the service industries. This holds for both samples.

The final sample based on statutory tax rates includes on average 1,236 German parent companies per year with 5,047 foreign affiliates in 178 jurisdictions. For a rough comparison: the

[16] In the matching process we lose 1,467,683 firm-year observations which are either not included in JANIS or not included in MiDi. We obtain 122,660 matched firm-year observations.

sample's total profits in 2016 amount to about EUR 73 bn.[17] The gross operating surplus of the total German economy as obtained from the national accounts amounted to EUR 1,202 bn in the same year (European Commission, 2020). The final sample based on effective tax rates includes on average 1,230 parent companies and 4,784 affiliates in 62 countries (Table 8). If we compare the sample size for the period 2011–2015 which is the only period in which effective tax rates are available, we can see that the sample based on statutory tax rates covers much more foreign affiliates with about 1,394 parent companies and 5,824 affiliates on average. For this reason, we use the sample based on statutory rates as our main sample and report details on the sample based on ETR in the robustness checks section. Due to the confidentiality requirements by the Deutsche Bundesbank, we have to group individual country results into larger aggregates such as 'Eastern Europe' or 'rest of world' if the number of observations for each country and year is too low or if an individual firm observation dominates the aggregate value of the country.

[17] We would have preferred to compare to the gross output from the sample to gross output of domestic MNE from the AMNE database. However, we do not have access to gross output information for our sample at the moment of writing. Turnover is unfortunately not included in AMNE. Another shortcoming is that we include as MNE all firms with affiliates above an ownership threshold of 10%. The AMNE and FATS use only majority-owned affiliates as reference group. Thus, the numbers are not comparable as long as we cannot split the sample according to the ownership threshold

Table 8: Sample based on statutory tax rates

Parent companies					
	parent observations	average profits	average number of employees	average assets	average turnover
		in million EUR		in million EUR	in million EUR
1999	1249	32	1359	92	341
2000	1286	22	1157	90	363
2001	1340	26	1104	90	381
2002	928	31	1377	124	507
2003	905	29	1241	120	520
2004	962	29	1369	113	511
2005	1072	32	1206	99	497
2006	1188	31	1226	89	523
2007	1221	53	1202	89	551
2008	1265	34	1102	86	520
2009	1252	26	1091	76	492
2010	1297	53	1067	75	554
2011	1356	52	1047	79	629
2012	1380	50	1049	83	685
2013	1378	42	1035	88	672
2014	1428	46	1009	88	651
2015	1430	38	904	90	607
2016	1309	56	1088	97	701
Foreign affiliates					
	affiliate observations	average profits	average number of employees	average assets	average turnover
		in million EUR		in million EUR	in million EUR
1999	4650	4	163	12	62
2000	4952	8	180	20	71
2001	5246	4	186	23	75
2002	3475	9	267	31	114
2003	3754	8	264	24	105
2004	3893	8	245	20	102
2005	4447	8	264	24	115
2006	4813	9	255	23	114
2007	4979	10	254	21	106
2008	5202	6	260	24	94
2009	5140	5	246	22	82
2010	5323	10	256	26	106
2011	5541	13	267	28	121
2012	5690	13	275	30	125
2013	5771	11	283	30	126
2014	5979	13	284	33	135
2015	6139	14	278	36	135
2016	5857	15	288	41	144

Source: MiDi, JANIS, based on own calculations

2.4. Methodology

Our methodological approach builds on Cobham and Janský (2019). The term 'misaligned profit' describes the share of profits reported in a country that is not in line with the share of economic activity reported in the respective country. We compute each country's share in the total profits of the sample and compare it to each country's share in total economic activity measured in terms of number of employees, tangible and intangible assets, and turnover. We also use a weighted measure of activity ('CCCTB') which is weighted one-third tangible and intangible assets, one-third turnover and one-third number of employees. This is similar to the formula proposed by the European Commission (2016) for the Common Consolidated Corporate Tax Base (CCCTB). However, due to data limitations our CCCTB measure does not exactly correspond to the European Commission's proposal. For example, we cannot split the factor 'employees' between compensation costs and number of employees and we cannot distinguish between tangible and intangible assets in our data.

As in Cobham and Janský (2019), we compute the misaligned profit by country in the following way:

$$Misaligned\ profit = share\ of\ economic\ activity * global\ profits - actual\ profit \quad (3)$$

If actual profits are higher than what would be estimated based on the share of economic activity, this gives rise to 'excess' profit. If actual profits are lower than what would be estimated based on economic activity, this gives rise to 'missing profit'. In order to measure the overall scale of misalignment, we compute how much profit is in the 'wrong' place by adding up the 'excess profit' of jurisdictions where there is no concomitant economic activity.

The intensity of misalignment is an alternative way to measure misalignment (Cobham & Janský, 2019). If profits were perfectly aligned with economic activity, this would give rise to a perfect correlation of 1. A correlation of −1 would imply perfect misalignment. For our measure of the relative intensity of misalignment, we compute 1 minus the correlation of factors of economic activity with gross profits across countries and over time. In case of perfect correlation, this measure would equal zero.

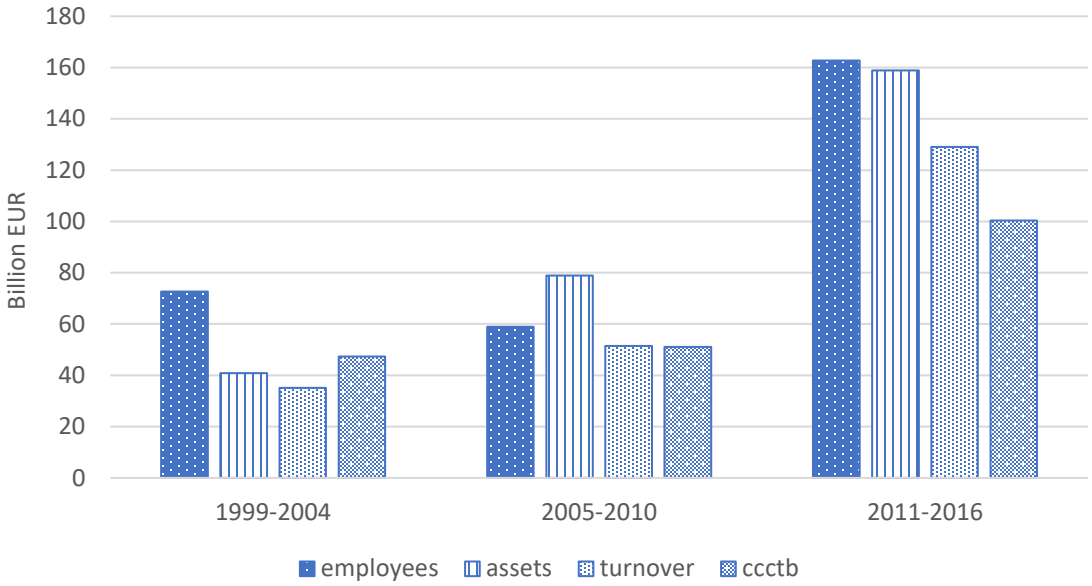
In addition to the global scale and intensity of misalignment, we also analyze the distribution of misalignment across countries. For this reason, we also report each country's missing or excess profit in absolute values and as a percentage of the total profits reported in the country. The first gives us an idea of how relevant the country's misaligned profits are in relation to the total amount of misaligned profits. The second indicates the relevance of misalignment from the point of view of the individual country.

2.5. Results

2.5.1. Global misalignment of German MNE's profits

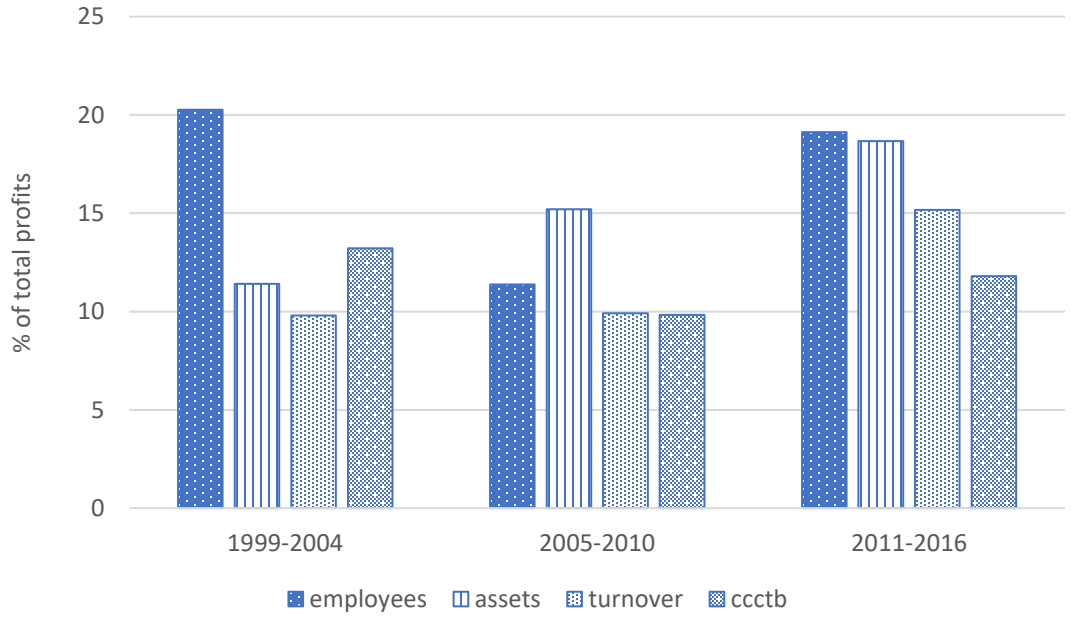
Figure 3 shows the sum of excess profits by various measures of economic activity. Those are the profits of our sample's multinational enterprises that would need to be declared in other jurisdictions in order to be aligned with economic activity. In absolute numbers, the misaligned profits have increased over the sample period from about EUR 47 bn on average in 1999–2004 to about EUR 100 bn in 2011–2015 when measured in terms of equally weighted factors of activity (CCCTB). As a percentage of the sample's total gross profits, the picture looks a bit different. When measured in terms of equally weighted factors of activity, misaligned profits amounted to about 13% on average in the period 1999–2004, decreased to about 10% in the period 2005–2010 and increased again to about 12% in 2011–2016 (Figure 4). This development is mainly driven by the strong misalignment of profits with regard to the location of employees in 1999–2004, which has not been as high in the later periods. In contrast, misalignment of profits with regard to the location of assets and turnover has either remained constant or increased on average over the periods 2005–2010 and 2011–2016.

Figure 3: Misaligned profits in absolute values, based on NCTR



Note: NCTR – nominal corporate tax rate. Source: MiDi, JANIS, KPMG, own calculations

Figure 4: Misaligned profits in %, based on NCTR

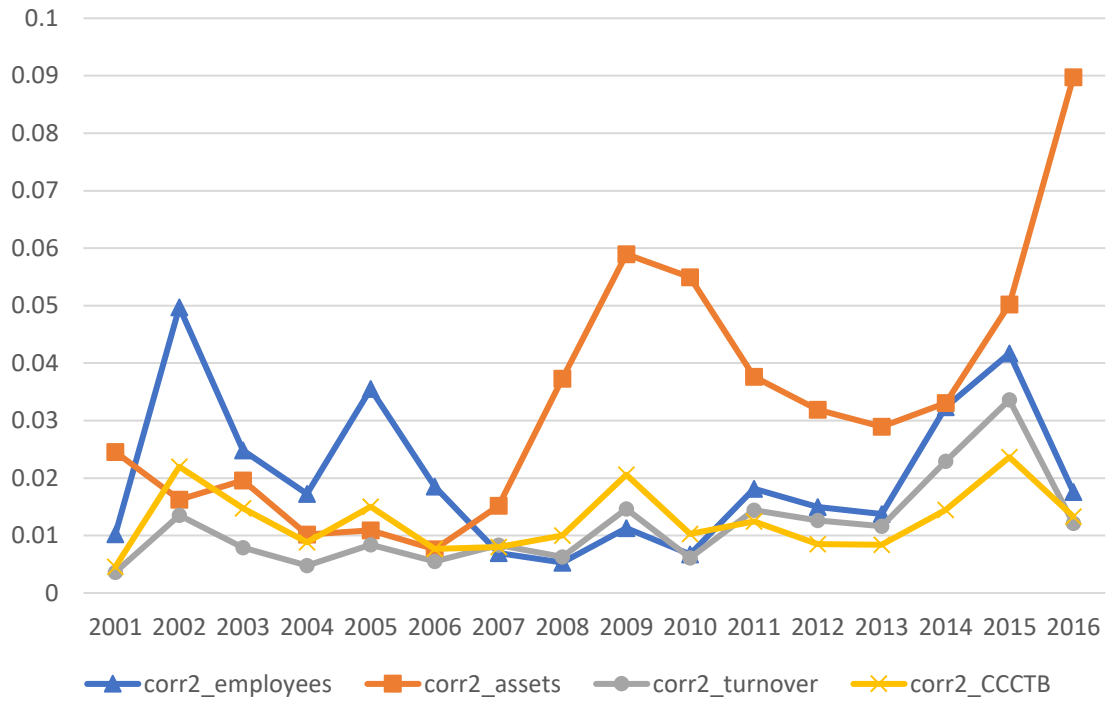


Note: NCTR – nominal corporate tax rate. Source: MiDi, JANIS, KPMG, own calculations

Figure 5 shows the relative intensity of misalignment. Remember that in case of perfect correlation, this measure would equal zero. For most years, the intensity of misalignment varies between 0 and 0.05 which is broadly in line with the scale of the intensity of misalignment measured by Cobham & Janský who analysed U.S. multinational enterprises and their foreign affiliates. When measured in terms of assets and turnover, the intensity of misalignment seems to be on an upward trend since 1999 and on a slight upward trend when measured in terms of equally weighted factors (CCCTB). However, when measured in terms of employees, an overall trend is not observable, as the misalignment has decreased until 2008 and increased again afterwards. The strong spikes of the intensity when measured in terms of employees and assets might point to weaknesses in the data. Apparently, changes in the sample or individual observations have a strong impact on our misalignment measure. The spike of misalignment between 2008 and 2010 is, however, consistent with results by Cobham and Janský and probably caused by the financial crisis. In 2009, profits dropped sharply, which we do not observe for the foreign affiliates' assets to the same extent. As a consequence for the period 2008–2010, the development of assets does not explain the drop in reported foreign profits well, which likely drives up our intensity of misalignment. In contrast in 2016, the spike in the intensity of misalignment in terms of assets is driven by a jump in average profits that is not accompanied by a similar jump in assets.

Despite these year-to-year irregularities, the broader pattern of the intensity of misalignment is in line with the upward trend observed for the 6-year averages of assets and turnover. It suggests that there is no overall trend of misalignment when measured in terms of employees but that the intensity of misalignment when measured in terms of equally weighted factors shows a slight upward trend which is masked by the 6-year-average values in Figure 4.

Figure 5: Intensity of misalignment, 2001-2016



Source: MiDi, JANIS, KPMG, own calculations

2.5.2. International distribution of misalignment

Table 9 compares the share of each country in total profits of the sample with its share in total activity. German parent companies account for about 46% of the total gross profits when calculated with the statutory tax rates. Germany's share of assets is lower than its share of profits, while its share of turnover and employees is higher than its share of profits. When we compare Germany's share of profits to its share of activity measured by equally weighting employees, assets, and turnover (CCCTB), Germany seems to belong to the missing profit countries. However, this is not robust to the use of ETR as we will see in the robustness check section. In addition, the relative weight of Germany's excess profit is not high, amounting to about 2% of its total gross profits only (Figure 7). As a consequence, we consider Germany as a mixed case.

Table 9: German MNE's global distribution of profits and economic activity, 2011-2016, based on statutory tax rates

Country	Observations	Share of profits	Share of employees	Share of assets	Share of turnover	Share of activity CCCTB
Germany	8281	45.98	47.62	38.57	54.28	46.82
United States	2796	10.42	4.65	20.38	7.99	11.01
China	2629	12.11	7.36	7.37	7.47	7.40
France	2134	1.09	1.62	1.15	2.05	1.61
United Kingdom	1979	2.51	1.79	2.96	3.41	2.72
Austria	1952	1.63	1.66	1.63	1.44	1.58
Switzerland	1470	1.69	1.09	1.90	1.65	1.55
Czech Republic	1380	1.16	2.72	2.08	1.31	2.03
Poland	1347	0.60	1.77	1.18	1.00	1.32
Italy	1294	0.47	0.76	0.85	1.25	0.95
Spain	1253	0.85	1.81	1.76	1.76	1.78
Hungary	708	1.16	1.78	1.74	1.00	1.51
India	693	0.52	2.23	0.53	0.51	1.09
Belgium	671	0.51	0.51	0.92	0.69	0.70
Singapore	567	0.47	0.37	0.35	0.73	0.49
Japan	534	1.32	2.13	2.03	2.06	2.07
Australia	518	0.66	0.33	0.51	0.50	0.44
Brazil	480	0.32	1.38	0.56	0.54	0.83
South Africa	442	0.47	0.66	0.42	0.56	0.55
Turkey	425	0.42	1.10	0.56	0.51	0.73
Slovakia	403	0.21	0.89	0.59	0.58	0.69
Denmark	340	0.18	0.16	0.26	0.19	0.20
Portugal	336	0.32	0.45	0.26	0.30	0.34
Malaysia	335	0.35	1.02	0.57	0.28	0.62
Thailand	275	0.20	0.23	0.15	0.18	0.19
Slovenia	200	0.10	0.25	0.16	0.12	0.18
Argentina	180	0.17	0.25	0.08	0.14	0.15
Indonesia	178	0.07	0.40	0.06	0.08	0.18
Chile	163	0.07	0.14	0.08	0.06	0.09
Rest of world aggregated by regions						
Eastern Europe	2109	2.12	5.38	2.54	1.98	3.30
Latin Amer.Carib.	821	0.51-	1.64	1.28	0.97	1.29
Asia	802	0.58	0.77	0.73	0.68	0.73
Middle Eastern	616	0.60	0.45	0.44	0.30	0.40
EU tax havens	608	2.11	0.32	1.05	0.34	0.57
Tax havens	569	0.57	0.21	0.06	0.24	0.17
Africa	382	0.14	1.29	0.30	0.19	0.60
RoW	3450	12.62	8.99	8.64	8.44	8.69

Source: MiDi, JANIS, KPMG, own calculations

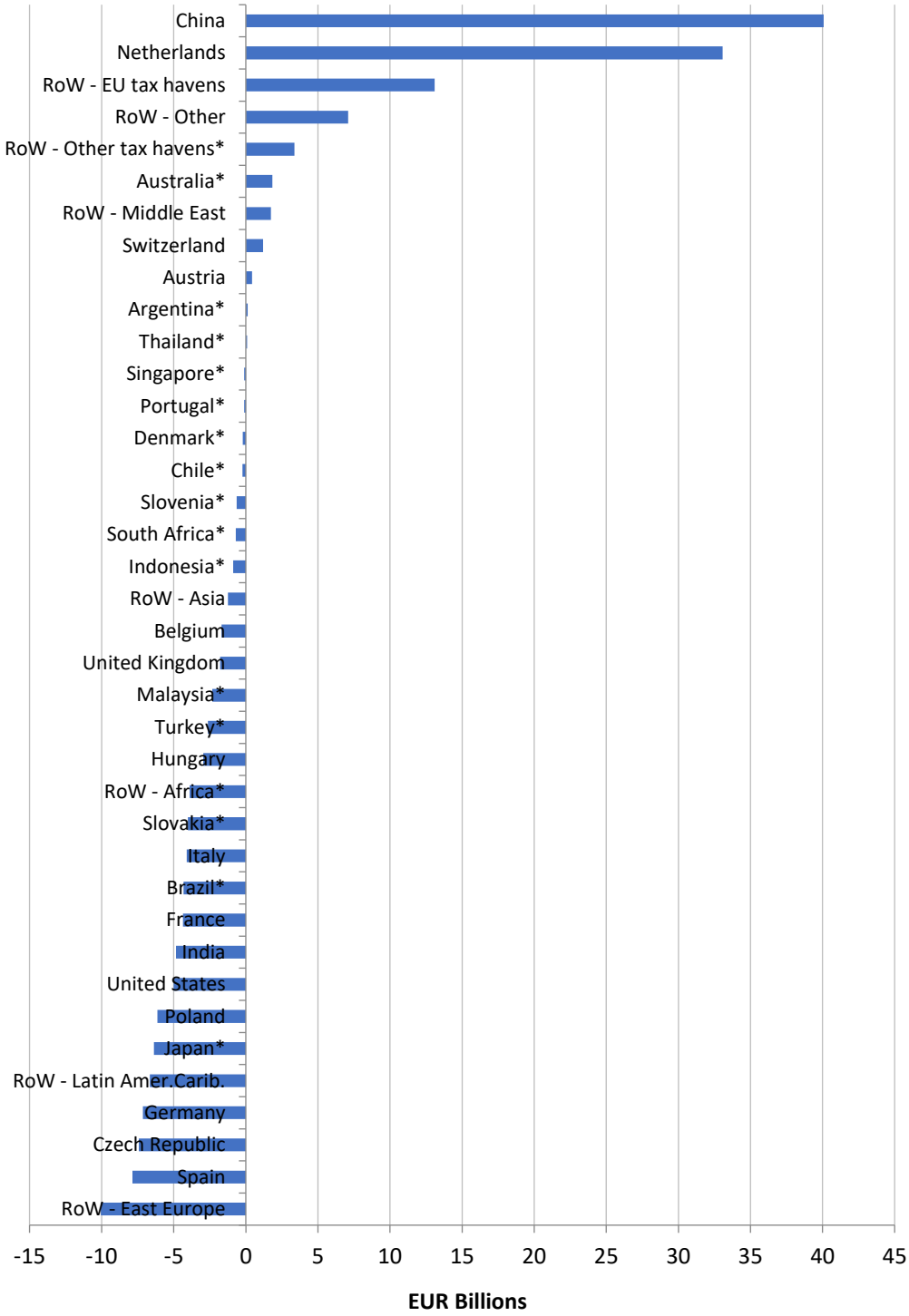
The following section presents each country's missing or excess profit in bn EUR and as a percentage of the total profits reported in the country. We highlight only those country results that are consistent based on both statutory and effective tax rates if available (for details see robustness check section).

Figures 6 and 7 illustrate the results by country both in absolute and relative numbers. The most striking cases of excess profits are China, the Netherlands and the world's tax havens. China accounts for about EUR 40 bn of excess profits or 39% of its gross profits.

This is followed by the Netherlands with about 33 bn of excess profits or 77% of its gross profits. The other EU tax havens, Luxembourg, Ireland, Cyprus and Malta account for about EUR 13 bn of excess profits or 73%. The rest of world tax havens account for about EUR 3 bn of excess profits or 70% of their gross profits. Also Norway, as a large oil exporter, is an excess profit country. In the main sample, Norway is included in 'rest of world' due to the confidentiality requirements of the Deutsche Bundesbank. Australia and the Middle East are also clearly part of the excess profit countries with about 33% and 34% of their profits being misaligned with economic activity.

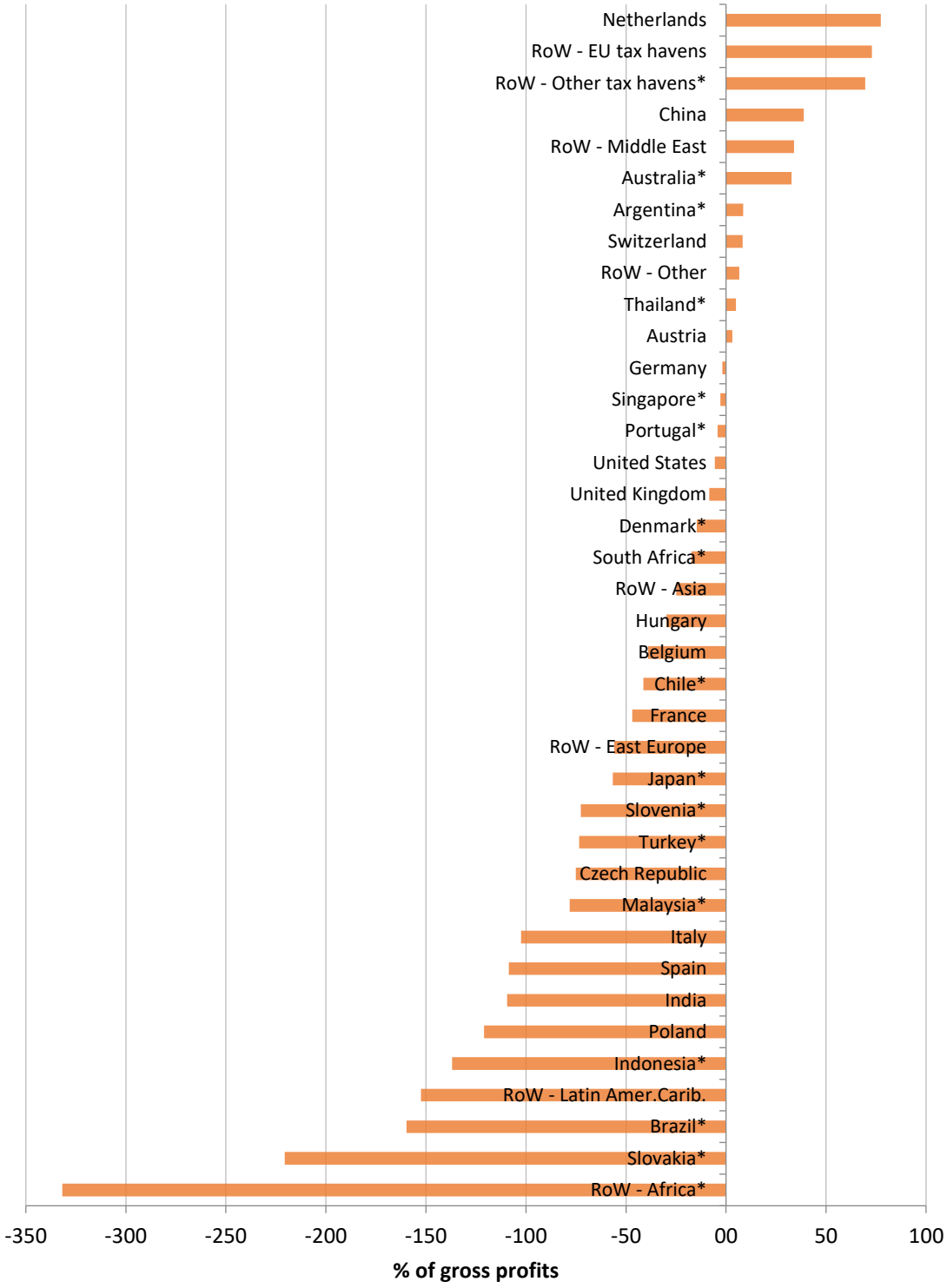
The countries which account for the largest shares of missing profits are Eastern European countries, Spain, and the aggregate of Latin American and Caribbean countries. Czech Republic's missing profits amount to about EUR 7 bn or 74%. Spain loses about EUR 8 bn or 109%. Countries from Latin America or the Caribbean which are not individually included in the graphs lose about EUR 6 bn or 152% on aggregate. In absolute numbers, Japan and Poland lose about EUR 6 bn which correspond to 57% and 121% of their profits. Likewise, France and Italy are missing profit countries with about EUR 4 bn each and shares of missing profits in their total profits of 47% and 102% respectively. When measured as a share of the total profits reported in their countries, African countries, Slovakia and Latin American countries are the top missing profit countries. African countries which are not individually included in the graphs lose about EUR 4 bn on aggregate which translate into a share of 332% of their aggregate profits (with respect to a situation where profits would be perfectly aligned with economic activity). But also Indonesia, Poland, India, Spain and Italy rank high with more than 100% of their profits misaligned. Note that for many countries the number of observations is below 100 companies per year which is why they are marked with an Asterix in the graphs.

Figure 6: Excess profits and missing profits in bn. EUR, based on NCTR, 2011-2016



Source: MiDi, JANIS, KPMG, own calculations

Figure 7: Excess profits and missing profits in % of gross profits, based on NCTR, 2011-2016



Source: MiDi, JANIS, KPMG, own calculations

Our key results regarding the international distribution of misalignment are broadly in line with the academic literature. The classification of large high-tax countries and most developing countries as missing-profit countries as well as the outstanding role of the world's tax havens as excess-profit countries are also well documented by Clausing (2016), Tørsløv et al. (2018), Cobham and Janský (2019) and others. However, our results suggest, that German MNEs have slightly different regional patterns of tax avoidance than U.S. MNEs. While the Netherlands is the number one for both German and U.S. MNEs, Bermuda and Singapore seem to be relatively less important as profit-shifting destinations for German MNEs. The predominance of EU tax havens among our excess-profit countries supports the hypothesis of geographical specialisations of tax havens as suggested by Fichtner et al. (2017) and might further stimulate the debate about the empirically controversial tax benefits of using the Netherlands as a conduit jurisdiction (Lejour et al., 2022; Weyzig, 2013).

It might be surprising that Eastern European countries are missing-profit countries according to our results. As most of them have rather low corporate tax rates, the incentive to shift profits out of Eastern Europe should not be very strong. On the contrary, they might even attract paper profits from higher-tax countries. However, our results suggest that the latter is not the case. Research by Nerudová et al. (2020) even suggests that Czech Republic, Poland, Slovakia and Hungary lose tax revenues due to profit-shifting activities of MNEs which makes our results even more plausible. Possibly, a generally low corporate tax rate is not sufficient to compete with the 'sweetheart deals' offered to individual MNEs by tax haven jurisdictions.

The classification of China as an excess-profit country and the scale of the misaligned profits in China are a bit puzzling and might require further analysis. One possible explanation is that FDI in China is often held in Joint Ventures with Chinese companies and that German ownership is often limited to minority stakes due to the strict regulation of FDI (Hanemann & Huotari, 2018). Co-ownership of the Chinese investors might limit the scope for profit shifting. In addition, for many companies the incentive to shift profits out of China might be lower than expected as reduced CIT rates apply for companies in various sectors, regions and projects (KPMG, 2020a) and for research and development (KPMG, 2020b). However, it might also be the combination of the relatively low cost of labour and capital combined with increasingly high value-added activities that contribute to the relatively higher share of profits in China. This points to a possible

weakness of our approach as we cannot control for the distribution of value added along the global value chain.

2.5.3. Are parent companies different?

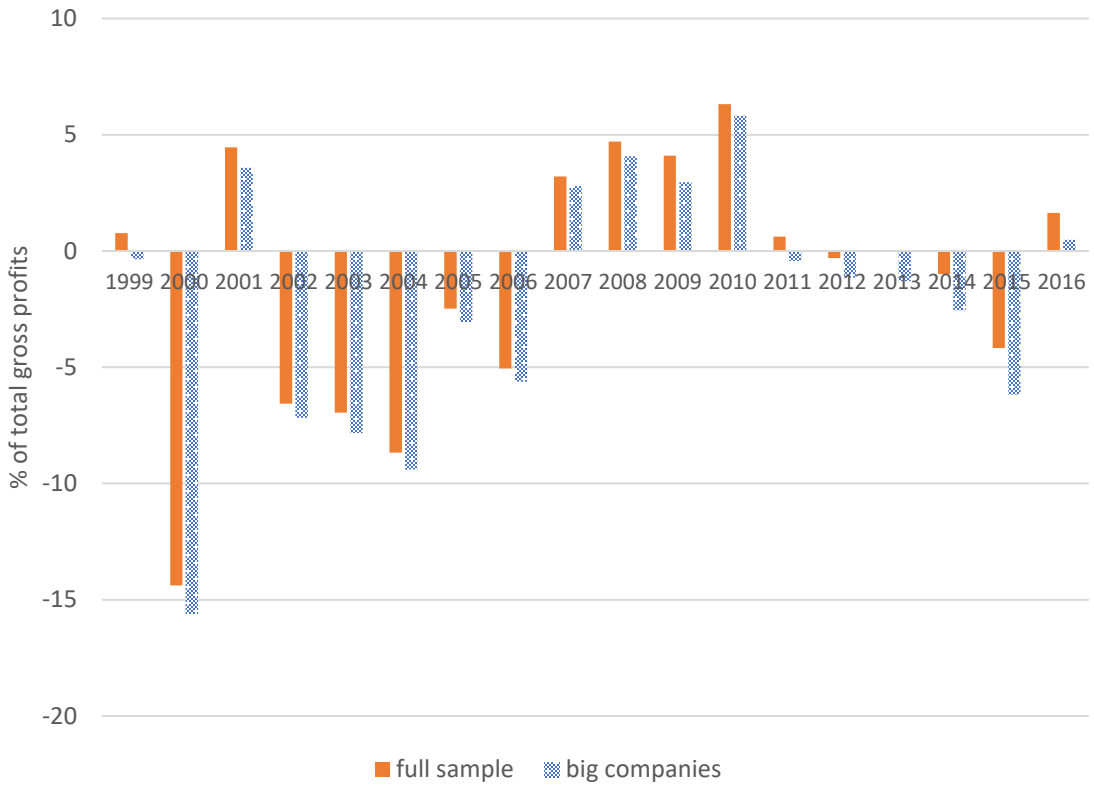
The results do not allow for a clear categorisation of Germany as an excess-profit or missing-profit country. If we look at the results based on statutory tax rates, it seems that German parent companies make less profits than would be in line with their economic activity. However, this does not hold for all years and is mainly driven by the high share of global turnover that is reported in Germany. The share of employees is only slightly higher than the share of profits for the years 2011–2016 on average. The share of assets is much lower than the share of profits. When we look at the distribution of profits computed with effective tax rates, it seems that German parent companies report more profits than economic activity for the years 2011–2015. Here, the result is mainly driven by employees and assets. Still, German parent companies report a higher share of turnover than profits. Accordingly, the result that German parent companies report a higher share of turnover than of profits and a lower share of assets than of profits is consistent across samples, the misalignment in terms of employees and the result for equally weighted factors are not.

If we look at the development of profits and activity reported in Germany over time, we also find a mixed picture. In the years of economic stagnation in the early 2000s German parent companies report less profits than activity (CCCTB) which changes after 2006 (Figure 8). As a robustness check, we drop parent companies with less than 250 employees and their affiliates. The picture changes slightly as excess profits decrease in most years whereas missing profits increase somewhat. It causes a switch from an excess profit to a missing profit country in 1999, 2011 and 2013.

However, in comparison to other countries, the share of misaligned profits seems relatively low, varying between 9% and 0% in both directions if we exclude the outlier of 2000. This contrasts with estimates found in the literature on foreign affiliates which characterise Germany as a missing profit country and also estimate the share of lost profits to be much higher (e.g. Cobham & Janský, 2019; Tørsløv et al., 2018). Our results might be in line with a headquarter bias in profit

shifting, in the sense that parent companies rather shift profits among affiliates in order to minimise their global tax payments but do not shift profits out of headquarters or do so to a lesser extent. This would be in line with Dischinger et al. (2014), who find that European multinational enterprises are reluctant to shift profits away from their headquarters.

Figure 8: Misaligned profits - Germany, full and big company sample, based on NCTR



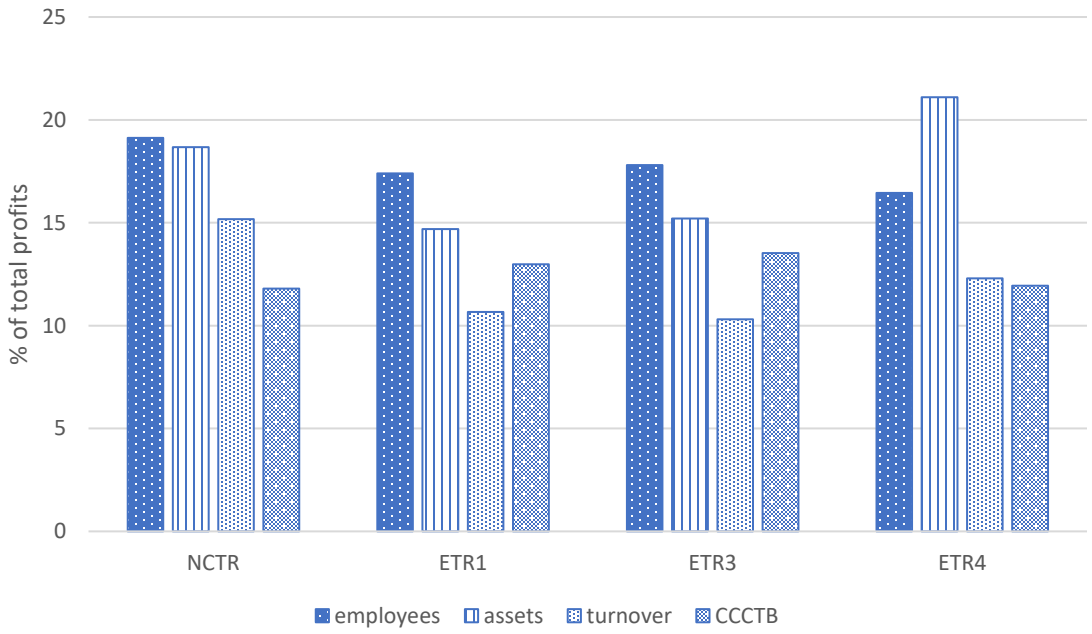
Notes: NCTR – Nominal corporate tax rates. Source: MiDi, JANIS, KPMG, own calculations

2.6. Robustness checks

As the choice of the tax rate variable affects the grossed-up profits of foreign countries, we repeat our analysis using effective tax rates instead of statutory tax rates. As mentioned above, effective tax rates are lower than statutory tax rates for most countries. For this reason, the share of pre-tax profits of German parent companies is likely to be higher when using ETR. At the same time,

ETR are only available for a smaller number of countries, which is why a substantial share of foreign affiliates are missing in this sample (Table A3 in the Appendix). The overall scale of misalignment as a percentage of total profits is broadly similar whether profits are grossed up with statutory or effective tax rates (Figure 9). Misalignment varies between 12% and 13% when measured in terms of equally weighted factors. As with the nominal tax rates, we observe higher misalignment levels for individual factors. When we use the effective tax rates I and III to gross up profits, we obtain slightly higher levels of misalignment (for the equally weighted factors of activity) as compared to using the nominal tax rates.[18]

Figure 9: Misaligned profits, based on NCTR and ETR, 2011-2015



Source: MiDi, JANIS, KPMG, Janský (2019), García-Bernardo et al. (2020), own calculations

As mentioned above, German parents on average account for about 53–56% of the sample's total gross profits in the period 2011–2015 (Table A4 in the Appendix) when computed with ETR. This is in line with our initial assumption that the use of statutory rates might lead to an underestimation of Germany's share of profits. When we compare Germany's share of profits to

[18] We use three different versions of the effective tax rates, with ETR3 and ETR4 serving as lower and upper bounds of ETR estimates as described in García-Bernardo et al. (2020). Note that the sums of net profits of the two country groups 'rest of world tax havens' and 'rest of world' were grossed up with the group-averages of ETR3 and ETR4 of the respective country group.

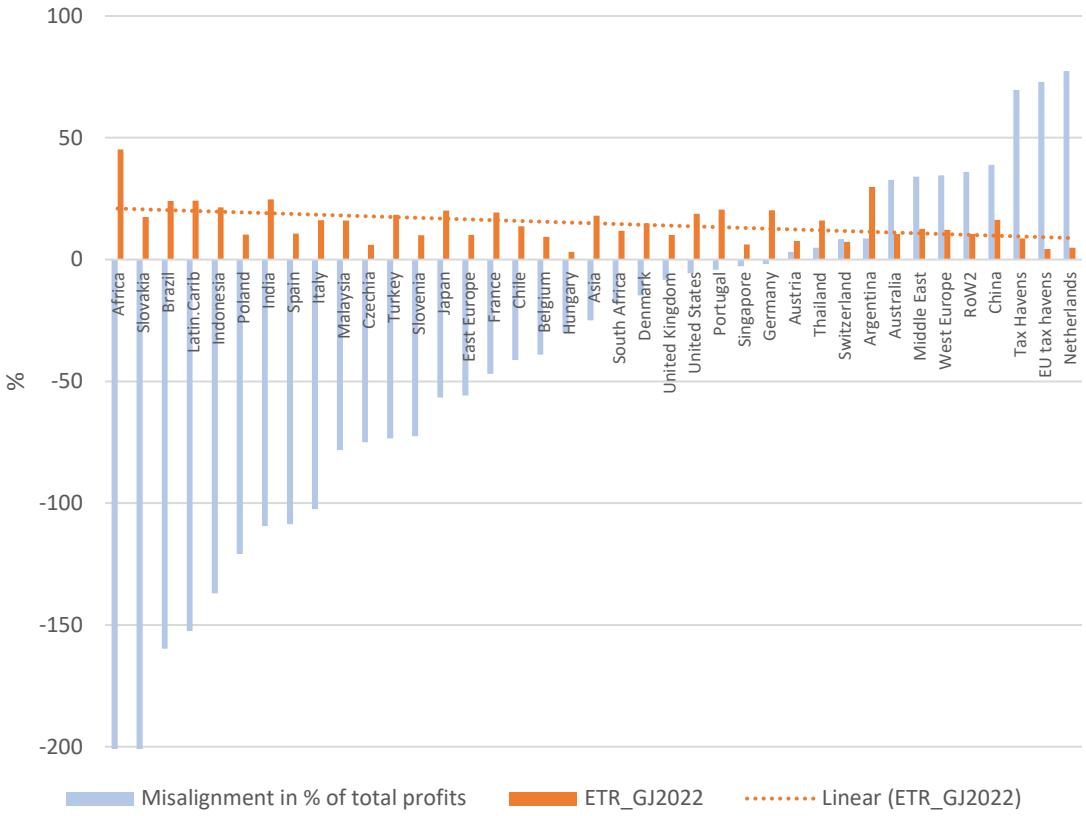
its share of activity measured by equally weighting employees, assets, and turnover (CCCTB), Germany seems to belong to the 'excess profit' countries when based on ETR. As a result, we refer to Germany as a mixed case in the conclusion.

Most country results are confirmed by the ETR sample, most notably the top positions (Figures A1 and A2 in the Appendix). When calculated with ETR1, in China, about 33% of profits are misaligned with economic activity, 75% for the Netherlands, 84% for Luxembourg and 49% for the rest of world tax havens. Also Norway and Australia remain excess profit countries. As many poorer countries are not included in the ETR sample we cannot build the same country aggregates but we see that Latin American and Asian countries are all 'missing profit' countries except for China and Argentina. Also here, Eastern European countries have a high portion of missing profits the top countries being Romania with 303% of profits missing, followed by Slovakia with 239% and Latvia with 225% (see Figure A2, ETR1, in the Appendix). In absolute numbers, Japan is the top looser with about EUR 8 bn which correspond to 86% of its profits (see Figure A1, ETR1, in the Appendix). Unfortunately, there is no African country in the ETR sample.

2.7. Are misaligned profits shifted profits?

Misaligned profits are not necessarily shifted profits. They are the residual profits of a very simplified model which suggests that the true share of a country's profits in MNEs global profits can be predicted by the share of MNEs' economic activity carried out in this country. In this article, we proxy economic activity by the number of employees, tangible and intangible assets, and turnover and we attach a weight of 1/3 to each variable. The share of actually observed profits that cannot be predicted by this simple model, is considered to be misaligned. These misaligned profits seem to be correlated with effective corporate tax rates across countries: For our sample, we observe a correlation of -0.6 (significant at the 5%-level) of relative misaligned profits and effective tax rates as estimated by García-Bernardo and Janský (2022). This implies that high ETRs are more likely to be associated with missing profits while low ETRs are more likely to be associated with excess profits (figure 10). The correlation of misaligned profits and the nominal corporate tax rates is also negative (but not statistically significant at the 5%-level).

Figure 10: Misaligned profits (2011-2016) and ETR by country



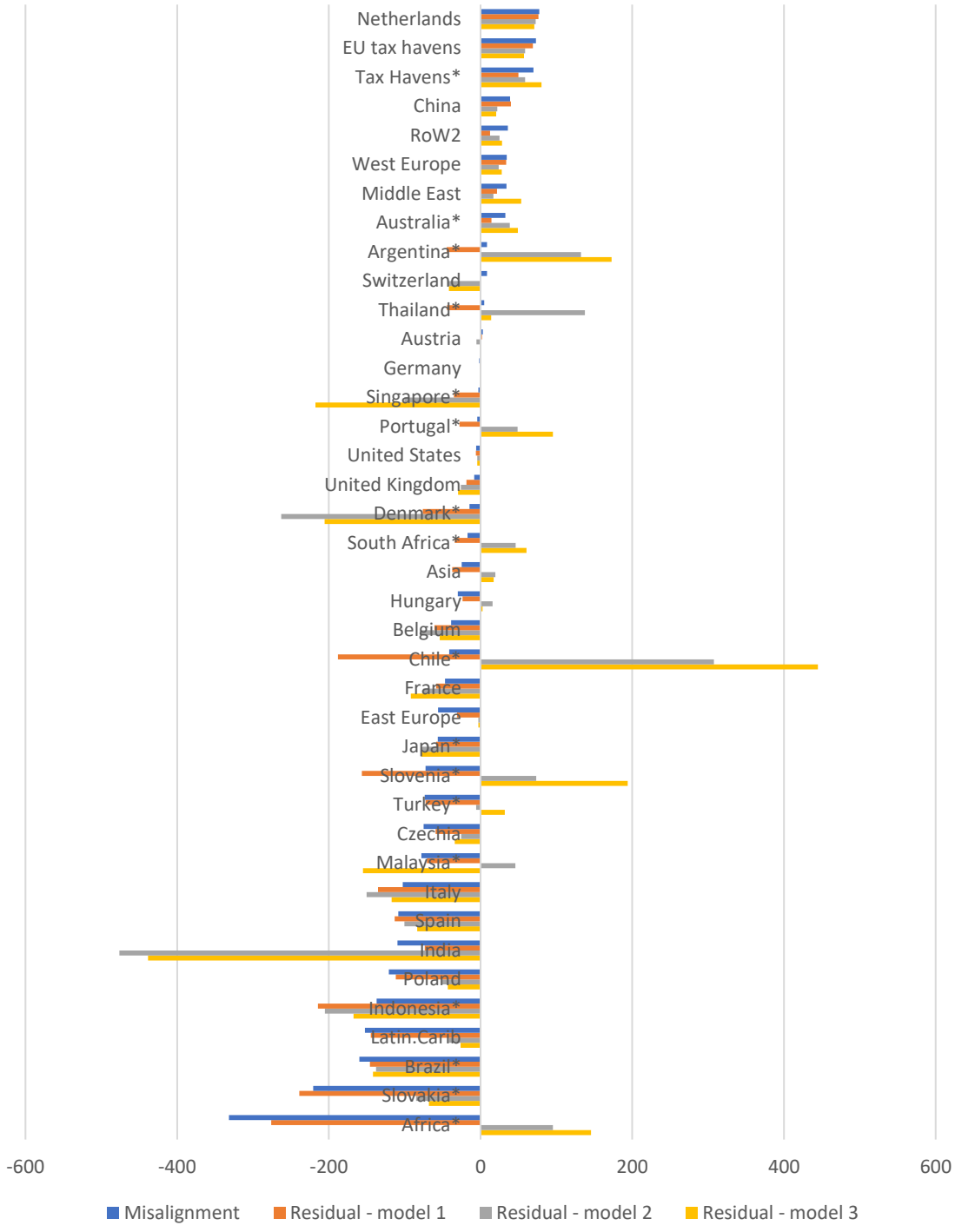
Note: The axis has been cut off at -200% to depict misalignment and ETRs on the same scale (for Africa and Slovenia for which the respective values are -332% and -221%). Misaligned profits represent average misalignment over the years 2011-2016 in % of total profits reported in each country. The ETRs by García-Bernardo & Janský (2021) are based on aggregate country-by-country data as they provide the most comprehensive global coverage.

Simply declaring all residual profits of this simple model to be shifted profits is likely to overstate the true amount of shifted profits. Especially the distribution of misaligned profits in between countries produces some counter-intuitive results: Why should Czechia lose relatively more from profit shifting by German MNEs than France given that both the statutory and the estimated effective tax rate (García-Bernardo & Janský 2021) of Czechia are significantly lower than those of France? Why should German MNEs shift profits to China or Australia? There seem to be factors other than profit shifting that contribute to a below or above world-average profitability which indicates that our misalignment model is oversimplifying. As pointed out by Hines (2010): "profits are not simple scalar functions of employment, sales, or tangible property."

What determines corporate profits apart from the number of employees, the value of assets, and sales? At the firm-level, managerial inputs, the quality of products or popularity of a brand are examples of unobservable factors that help explain why some firms make more profits than others even when using the same quantity of inputs. At the country-level, other factors may be more relevant such as business cycles (see section 2.5.3.), differences in productivity, e.g. due to technology or human capital or quality of infrastructure and governance (Dharmapala 2014). Cyclical swings of profitability should to some extent be mitigated by averaging profits and economic activity over 6 years. Different levels of productivity can be proxied by GDP per capita or average wages.

We illustrate the sensitivity of our residual profits to the inclusion of additional country-level covariates. We estimate simple OLS regressions with profits by country (or country group) as dependent variable. The first model includes only employees, assets, and turnover which is similar to the misalignment model but without constraining the coefficients of the three variables by weighting (model 1). The second model includes GDP per capita and population as proxies for productivity and country size that are often used as covariates in the tax avoidance literature. Model 3 adds the share of high-tech exports in total exports. The inclusion of GDP per capita and high-tech exports have a strong impact on some of the missing-profit countries, most notably Argentina, Portugal, Chile, Slovenia, and the group of African countries which switch to excess profit countries, and India, and Singapore, where the negative residual profits become even more pronounced. This illustrates that misaligned profits are to some extent sensitive to the inclusion of more covariates. Note, however, that all the countries for which we observe a switch of the direction of misalignment, are countries with less than 100 observations per year which is why they should be interpreted with caution, anyway. For the big, industrialised countries and the tax havens, the covariates do not affect residual profits much. Switzerland is an exception, as it switches from an excess-profit country to a missing-profit country after including GDP per capita (figure 11).

Figure 11: Misaligned profits and residuals of other models with more covariates



Note: Residuals are obtained by regressing average reported profits by country on country-level covariates.

Arguably, the distribution of value added along global value chains is not only shaped by the general economic conditions of the involved countries. Also historic path dependencies and specialisations play a role but are harder to operationalise in a quantitative framework. The 'smile curve' literature suggests that value generation tends to be more concentrated at the early and late stages of global production processes (Rungi & Del Prete 2018). In case of MNEs, this would imply that those branches of the MNE responsible for R&D, design, marketing, and after-sales services would likely be the most profitable while value added in manufacturing, especially of primary and intermediate goods, but also of final goods, tends to be lower (Ibid.). This might provide a plausible explanation why the negative misalignment of profits in Eastern Europe is so large: in addition to the tax havens, the headquarters likely attract a significant share of value added produced along the global value chain as they concentrate certain pre- and post-production services.

What might be implications of the smile curve literature for above-average profitability of MNEs in tax havens? Some pre- and post-production services which tend to attract a relatively higher share of value added along supply chains, also happen to be functions which MNEs locate in tax havens. These include financing activities, marketing or sales hubs, provision of insurance or headquarter services. It is debatable why these functions are the most profitable functions. Is it because they generate a lot of value added or because they are located in tax havens? While proponents of the transfer price system assume that the contribution of each entity's activity to an MNEs global value added can be determined with sufficient precision, the misalignment model implicitly challenges this view.

Coming back to the initial question: Overall, our sample MNEs report 10% of their global profits in tax havens. The misalignment model suggests that 60% of these profits are misaligned on average. We do not provide evidence that these 6% of German MNEs' profits are shifted profits but the magnitude seems plausible. For comparison, Fuest et al. (2022), who were able to analyse the German micro CbCR data, find that MNEs headquartered in Germany report approximately 9% of their global profits in tax havens (excluding the Netherlands) and estimate that 40% of these profits are a result of tax-induced profit shifting. With regard to tax-haven profits, the misalignment approach might thus provide a useful upper bound estimate of shifted profits.

Research by García-Bernardo & Janský (2021), suggest that the misalignment approach produces similar results as a more sophisticated tax elasticity estimate based on a logarithmic model. The latter accounts for extreme non-linearity of the relationship between profits and tax rates arguing that shifted profits are highly concentrated in tax havens. This is plausible and in line with our results. However, the somewhat erratic distribution of 'missing' profits between non-haven countries, that our misalignment model produces, are certainly a weak point.

2.8. Conclusion

In this paper we analyse a sample of German parent companies and their foreign affiliates obtained by matching balance sheet data from the JANIS database to information of foreign affiliates from the MiDi database of Deutsche Bundesbank. In order to measure the overall scale of profit misalignment and the distribution of misaligned profits across countries, we compute each country's share in the total reported profits of the sample and compare it to each country's share in total economic activity measured in terms of number of employees, tangible and intangible assets, and turnover.

We find that the misaligned profits on average amount to 10–13% of the sample's total profits. The intensity of misalignment with regard to the location of assets and turnover has increased over time but no such trend can be observed with regard to the location of employees. The distribution of misaligned profits across countries confirms the outstanding role of EU tax havens which attract a relatively large share of excess profits. The most important tax havens for German multinational enterprises are the Netherlands, Luxembourg and Ireland. Another striking case is the huge excess profits reported for Chinese affiliates.

The countries or country groups for which German multinational enterprises report much more economic activity than profits are Eastern European countries, most developing countries and some big European countries such as Spain, Italy and France. The results that most developing countries from Africa, Asia and Latin America can be characterised as missing profit countries and that the missing profits constitute a relatively higher share of their total profits are consistent with previous research on U.S. multinationals.

For the German parent companies the pattern of misalignment is less clear depending on the activity measure we use. When measured in terms of assets, the share of profits reported by

German parent companies are much higher than their share of economic activity. In terms of turnover, German parent companies on aggregate report a lower share of profits than activity. When measured in terms of employees, Germany would also belong to the missing profit countries. However, this result is not robust to the use of effective tax rates for grossing up net profits. As a result, we would characterise Germany as a mixed case.

Misaligned profits are not necessarily shifted profits. They are the unexplained residual of a simplified model which predicts MNEs' profits in host countries based on their share of input factors and turnover. The huge excess profits found for China and some resource-rich countries, the huge missing profits for Eastern Europe, and the sensitivity of some individual countries' results to the inclusion of covariates indicate that this model is an oversimplification. Profitability per employee or per EUR of asset value or turnover might vary across countries depending on the country-specific economic conditions or the mode of insertion into global value chain. The misaligned profits in tax havens which account for about 6% of our sample MNEs' total profits, are however, broadly in line with the relatively moderate profit shifting estimates for German headquarters by Fuest et al. (2022).

A likely limitation of our approach is that our sample of German MNEs is non-random which might cast doubts on the representativeness of our results. Still, we would like to highlight that it is much closer to being representative than samples used in earlier works based on matching MiDi and USTAN due to the improved data availability from the JANIS database. In the absence of publicly available representative data on MNEs and in particular on domestic MNEs, researchers can combine information from different pieces of data as a second best. Our results confirm results based on other data with regard to the outstanding role of tax havens as main attractors of global profits and shed more light on their regional specialisations. The relatively low-profit misalignment that we find for German headquarters might be a bit more surprising and require further analysis. While CbCR data had not, yet, been available at the time of research, an analysis of micro CbCR by Fuest et al. published recently, points into a similar direction. Future analysis on this subject might benefit from increasing availability of CbCR data and from more accurate reporting in future financial years.

Chapter 3: The long way to tax transparency: lessons from the early publishers of country-by-country reports

Sarah Godar, Giulia Aliprandi, Tommaso Faccio, Petr Janský[19]

In this paper, we analyse a hand-collected sample of voluntarily published Country-by-Country reports (CbCRs) of 10 multinational enterprises (MNEs). We assess the value added and limitations of qualitative and quantitative information provided in the reports also based on comparison to individual MNEs' annual financial reports and aggregate CbCR data provided by the OECD. We find that early publishers of CbCRs do not double-count profits by including intra-company dividends but that the inclusion of equity-accounted participation results may bias their CbCR profits by up to 30% or by 10% on average. Our sample MNEs seem to pay higher effective tax rates than the global average and many of them report relatively little profits in tax havens. We only find a very week correlation of the location of profits and effective tax rates. This might indicate that more tax transparent MNEs avoid taxes less aggressively. However, our assessment of different tax risk indicators reveals important variations between companies.

Keywords: multinational enterprise; country-by-country reporting; effective tax rate; profit shifting;
tax haven

JEL Classification: F23; H25; H26

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3.1. Introduction

The introduction of Country-by-Country Reporting (CbCR) can be regarded as a major breakthrough for the internationally coordinated efforts to curb corporate tax base erosion and profit shifting. Country-by-Country Reports (CbCRs), prepared according to the minimum standards of OECD BEPS Action 13, provide a global picture of multinational enterprises' (MNEs) tax payments, profits, and economic activities in each country where they operate and should allow tax administrations to better identify potential tax avoidance risks. The OECD has made aggregated country-by-country data available to the wider public, allowing researchers to refine global estimates of profit shifting (García-Bernardo & Janský 2021) or evaluate the impacts of policy reforms such as the global corporate minimum tax (Barake et al. 2021). Data confidentiality has thus far limited more detailed analyses based on firm-level data including e.g. Fuest et al. (2022) and Bratta et al. (2021). The European Union has decided to make EU-wide *public* CbCR mandatory starting from the first financial year after 22 June 2024 (EU 2021). Until then, most company-level CbCRs will remain confidential. However, an increasing number of MNEs voluntarily publish CbCRs and thereby provide more fiscal transparency.

In this paper we analyse a hand-collected sample of voluntarily published CbCRs of ten MNEs along the following lines: First, what is the value added of CbCR and, more specifically, of these public micro CbCRs for the analysis of corporate tax avoidance, and what are the potential limitations? Second, what can these CbCRs tell us about individual MNEs' tax aggressiveness, and can we observe general differences between MNEs voluntarily publishing CbCRs and the world average with regard to effective tax rates, use of tax havens and other tax risk indicators?

We compare the voluntarily published reports to information obtained from MNEs' consolidated financial accounts and to aggregate CbCR data provided by the OECD to highlight the general benefits of CbCR but also discuss some of their commonly understood limitations (e.g. a known data limitation includes the double-counting of dividends which is considered to be an issue in aggregate CbCR but not in our sample of voluntarily published reports). We also assess to what extent profits of associates and joint ventures might bias global and by-country CbCR profits – another potential issue flagged by the OECD (2017) – and identify only a few individual companies which explicitly correct for this. We explore the reasons individual MNEs provide for low effective

tax rates (ETRs) and find they explain the frequently observed gap between financial profits and the actual tax base to a limited but non-systematic extent.

The additional qualitative information included in many voluntarily published CbCRs helps us to better understand MNEs' use of tax havens and to assess a potential correlation between their global ETRs and their tax haven use. We provide an overview of high-risk activities our sample MNEs perform in tax havens and non-havens and compute additional tax risk indicators such as the share of profits reported in tax havens and the misalignment of profits and economic activity which may be partly explained by profit shifting activities.

We conclude that concerns raised with respect to data quality and interpretation are valid and that some degree of uncertainty remains attached to tax risk indicators based on CbCR data. Illustrating the sensitivity of results to data corrections, whenever possible, suggests that the adjustments are gradual and do not undermine the general qualitative conclusions drawn from the data. However, a few percentage points higher or lower ETRs might make a difference for individual companies. Some MNEs appear to be aware of this and correct their reports accordingly. This might contribute to establishing best practices and increasing data quality in the future.

Early publishers of CbCR seem to pay higher taxes than the global average and the sample majority reports a lower share of profits in tax havens. For the sample as a whole, we find a weak correlation of the location of profits and ETRs, which would be consistent with some tax-induced profit shifting. However, this correlation is not robust and relatively small. Tax risk indicators vary substantially between MNEs, with Shell leading in terms of identified tax risks.

In the tax avoidance literature, the use of data from confidential tax returns has emerged as the best practice on the research frontier, but these have been available – and used – only in particular countries, such as the United States (Dowd et al. 2017), the United Kingdom (Bilicka 2019), South Africa (Reynolds & Wier 2019), and Uganda (Koivisto et al. 2021). Researchers interested in better country coverage and international comparisons have exploited other resources, such as the private databases Orbis (Egger et al. 2009, Fuest & Riedel 2012) and Compustat (Markle & Shackelford 2012, Dyreng et al. 2017), official foreign direct investment statistics (Bolwijn et al. 2018, Janský & Palanský 2019), and foreign affiliate statistics (Tørsløv et

al. 2020). Despite increased research interest in recent years, no single data source has emerged as a clear solution to the enduring trade-off between the quality of confidential tax returns data and the need for comprehensive country coverage (Janský 2020a). Some of the most promising candidates for addressing this trade-off have been, and likely still are, the various types of CbCR data, which have become available in recent years and have been hailed as a potential panacea due to their expected positive impact on corporate behaviour, financial markets and development (Wójcik 2015).

While the private CbCR standard studied in this paper covers the widest range of MNCs, previously implemented mandatory public CbCR standards only focused on specific industries. The longest-lasting one for the extractive industries may have had an effect (Johannesen & Larsen 2016), but the data itself has not proven to be very useful (Janský et al. 2021). By comparison, a greater body of literature has focused on CbCRs in the financial industry. Banks and other financial institutions have been required to publish CbCRs since 2016 as part of the Capital Requirements Directive IV, and a number of papers have observed the effects of this new regulation (Dutt, Ludwig et al. 2019, Joshi et al. 2020) while an increasing number of papers have made use of the data to analyse taxation (Bouvatier et al. 2017, Dutt, Nicolay, et al. 2019, Brown et al. 2019, Fatica & Gregori 2020, Janský 2020b). A growing body of literature studies the relationship of voluntary disclosure of tax information and tax behaviour (Müller et al. 2020) as tax information is becoming more important for the assessment of companies' corporate social responsibility (CRS). For example, the Global Reporting Initiative has included country-by-country tax reporting into their CRS reporting standard in 2019 (Global Reporting Initiative 2020). In extending the range of types of CbCR data studied, we contribute to the broader literature studying how informative various kinds of tax-related disclosure in fact are.

In this paper we pioneer the use of one specific type of CbCR data – prepared according to the OECD BEPS Action 13's minimum standards and voluntarily published by MNCs. We contribute to the literature by assessing the magnitude of frequently mentioned data limitations of early CbCR data and by analysing indicators of tax aggressiveness at the company level. Micro CbCR based on the OECD BEPS standard is likely to become a key data source in future tax avoidance research and we hope to contribute to the understanding of its value added and potential challenges for research.

The chapter is structured as follows: Section 3.2 introduces the data and sample selection. Section 3.3 discusses the benefits and limitations of CbCR data and assesses the potential bias introduced by double-counting of profits and the inclusion of associate and joint venture profits. Section 3.4 analyses our sample based on different tax risk indicators. These include MNEs' high-risk functions and their share of profits located in tax-havens, their global ETRs and an analysis of the tax-sensitivity of profits with regard to tax rate indicators.

3.2. The data

As part of the OECD's Anti-BEPS Action 13, governments have started to collect CbCRs from large MNEs. In those CbCRs, the MNEs must report profits, tax payments and economic activity for each tax jurisdiction in which they operate. Data from these reports have recently been made publicly available but only in aggregated form at reporting country level. Only a few companies have decided to voluntarily publish their individual CbCRs, and we analyse these in this paper. We collected the reports from the companies' websites manually and transformed the data into a processible format when required.

Table 10: MNEs voluntarily publishing CbCRs for 2017-2019.

MNE	Years	Industry	Headquarter	Notes
Anglo American	2018, 2019	Extractives	United Kingdom	
BP	2019	Extractives	United Kingdom	
ENI	2017, 2018, 2019	Extractives	Italy	
Iberdrola	2019	Electricity	Spain	
NN	2018, 2019	Insurance	Netherlands	Not reported: unrelated revenues, tangible assets*
Repsol	2018, 2019	Extractives	Spain	
Rio Tinto	2018, 2019	Extractives	United Kingdom, Australia	
Shell	2018, 2019	Extractives	Netherlands	
Telefonica	2019	Telecommunications	Spain	
Vodafone	2017, 2018, 2019	Telecommunications	United Kingdom	

* NN: total assets reported instead. Source: Authors

We obtain a dataset of ten MNEs, which collectively report activity in 150 jurisdictions. Our variables of interest include profit/loss before income tax, income tax accrued in the current year, number of employees, tangible assets, and unrelated party revenues. Table 10 provides a summary of all companies which – to the best of our knowledge – have voluntarily published at least one CbCR for the years 2017–2019 as well as the availability of our variables of interest.[20]

The largest company in terms of total employee numbers is Telefonica with approximately 117,000 employees reported worldwide, followed by Vodafone with 106,000 and Shell with 80,000. NN is the 'smallest' MNE in the sample with approximately 14,000 employees. Shell and Rio Tinto report by far the highest worldwide sums of profits on average over the available years, and NN the lowest positive profit, with Shell's sum of global profits being approximately twelve times higher than NN's. Vodafone and Repsol report losses on average over available years, Vodafone reports losses in each year (Table 11).

Table 11: Key variables

Company	**Profit** USD million	**Employees**	**Tangible assets*** USD million	**Total revenue** USD million
Anglo American	4,305	63,717	30,243	55,525
BP	6,860	70,100	132,642	434,056
ENI	5,838	41,144	75,274	127,663
Iberdrola	5,498	35,119	87,303	43,308
NN	2,338	14,271	*271,586*	23,291
Repsol	-616	24,565	26,986	124,339
Rio Tinto	1,4312	43,658	60,933	64,554
Shell	27,801	80,502	239,749	737,638
Telefonica	2,619	117,349	36,088	54,223
Vodafone	-68,699	106,012	36,462	74,156

Note: Total assets reported in case of NN.

[20] We identified additional MNEs which publish their tax payments by country but do not publish the remaining CbCR data which we use in our analysis or not for all countries. We thus exclude Allianz, AXA, BT Group, and Equinor.

The distribution of profits across countries reflects the heterogeneity of the MNEs in our sample. While Shell reports significant profits in many different countries, some MNEs such as Iberdrola, NN and Rio Tinto concentrate profits in their headquarter jurisdictions. AngloAmerican's profits are highly concentrated in Australia, and Telefonica's in Brazil.

We note that Vodafone, which was the first MNE to publish its CbCR voluntarily, also publishes supplementary country-by-country data alongside the CbCR because it considers the OECD minimum standards unsuitable for its objectives (Faccio & FitzGerald 2018).[21] To ensure consistency, we do not include this supplementary data from Vodafone in our analysis.

3.2.1. Samples

As we compare the CbCRs to consolidated accounts, we use all available observations from the CbCRs in Section 3.3. In Section 3.4, we adapt the sample to be more suitable for an analysis of tax risk indicators. As we expect only profitable companies to pay taxes, we drop company-country observations when profits are negative on average over the available years. We do not simply drop all negative-profit observations to account for the possibility of loss carryover which might reduce taxes also in profitable periods. We average observations across all available years to reduce the downward bias of ETRs potentially caused by loss carryovers and to reduce the general volatility of profits. For the computations of ETRs, we set negative tax payments to zero and set resulting ETRs of above 100% to 100%. While such ETR outliers are commonly dropped (e.g. Dowd et al. 2017), we prefer to lose the lowest number of observations possible due to the already small sample size.

[21] Vodafone argues that "the OECD report does not provide an explanation of the nature of the activity, or activities, that take place in a jurisdiction, which we believe is vitally important in order to understand the context of a multinational company's CbCR" and that the profit before tax included in their OECD CbCR report "represents the total taxable revenue in each country less expenditure and reflects the starting point for a corporate tax calculation. However, it does not reflect the profit on which we pay tax, as the impact of the tax laws in each jurisdiction are not included, and therefore, tax exempt gains and losses are not taken into account in this number. For example, this number includes dividends received, which are usually tax exempt, as well as all gains and losses arising on the disposal or writing down of a business. We exclude these tax-exempt gains and losses in our voluntary reporting, as these amounts are usually exempt from tax by the standard tax laws of a country. Therefore, the amounts reported in our voluntary report are more closely related to the amounts on which we pay tax in each jurisdiction." (Vodafone 2018).

3.3. Lessons from comparing public micro CbCR to other data sources

For research on the taxation of MNEs, CbCR data constitutes the most promising candidate to address the trade-off between the quality of confidential tax returns and the need for comprehensive country coverage (Janský 2020a). Aggregate CbCR data has been used in recent profit shifting research (Garcia-Bernardo & Janský, 2021) while confidential, country-specific company-level data has been used for Germany (Fuest et al. 2022) and Italy (Bratta et al. 2021). Still, research based on CbCRs faces several challenges, which include the small number of years for which CbCR data is currently available, confidentiality of company-level CbCR and quality issues discussed in detail in the OECD's disclaimer regarding the limitations of the country-by-country report statistics (OECD 2021).

In the following sections we present insight gained from the analysis of a sample of voluntarily published CbCRs with respect to data quality and potential best practices on the way to greater tax transparency. Combining CbCRs with information from consolidated financial reports can shed light on the frequently raised issues of double-counting of dividends in CbCR data and the potential bias of ETRs caused by the inclusion of equity-accounted associates and joint ventures. In contrast to what disclaimers for aggregate CbCR suggest, most sample MNEs explicitly exclude intra-company dividends. Some MNEs correct for equity-accounted participation results or provide sufficient information to correct for potential biases. The qualitative information some MNEs include in their CbCRs to explain low ETRs may improve the public's understanding of where MNEs pay taxes and why. Important limitations remain but some are likely to become less problematic as the reporting standard evolves and longer time series become available.

3.3.1. Double-counting of dividends

Profits in CbCR data may be inflated by the double-counting of dividends as the earlier OECD guidance on CbCR reporting did not specify the treatment of intra-company dividends for the reporting of pre-tax profits. As a result, some MNEs include intra-group dividends both in the country of origin (as profit) and in the receiving country (as dividends). This occurs, for example, when dividends received from a subsidiary are counted as profits of the subsidiary but also added to the parent's pre-tax profits. This biases ETRs as the tax payments related to this income are counted only once, i.e. in the subsidiary's country of tax residence, while the dividends received by the parent are usually at least partly tax-exempt in the parent's country of tax residence.

Italy, the Netherlands, Sweden, and the UK have issued CbCR country notes quantifying the estimated bias in aggregate CbCR profits due to the double-counting of dividends. Estimates at the macro scale also exist for the United States' CbCR data provided by the BEA (Horst & Curatolo 2020, García-Bernardo et al. 2021b).

Based on the comparison of CbCRs and tax returns, the Netherlands suggest that double-counting of dividends amounts to approximately EUR 5.8 billion or 16% of total profits for the Dutch CbCR-positive sample. Italy finds that, on average, the share of received dividends amounts to 38% (median 28%) of Italian MNEs' reported profits (positive-profit sample). For the UK, the HMRC estimates that "approximately 25% of UK headquartered groups had included dividends in CbCR" (OECD, n.d.) and that reported profit intragroup dividends receivable included in profits amounted to GBP 55 billion or 49% of domestic CbCR profit reported by UK MNEs. Sweden's country note suggests that in 2017 tax-free dividends included in corporate income tax returns amounted to SEK 266 billion. If all Swedish MNEs included dividends in CbCR profits, total profits of SEK 512 billion should be reduced by SEK 266 billion (52%) (Table 12).

Table 12: Estimated dividends included in aggregate CbCR profits as provided by OECD for 2017

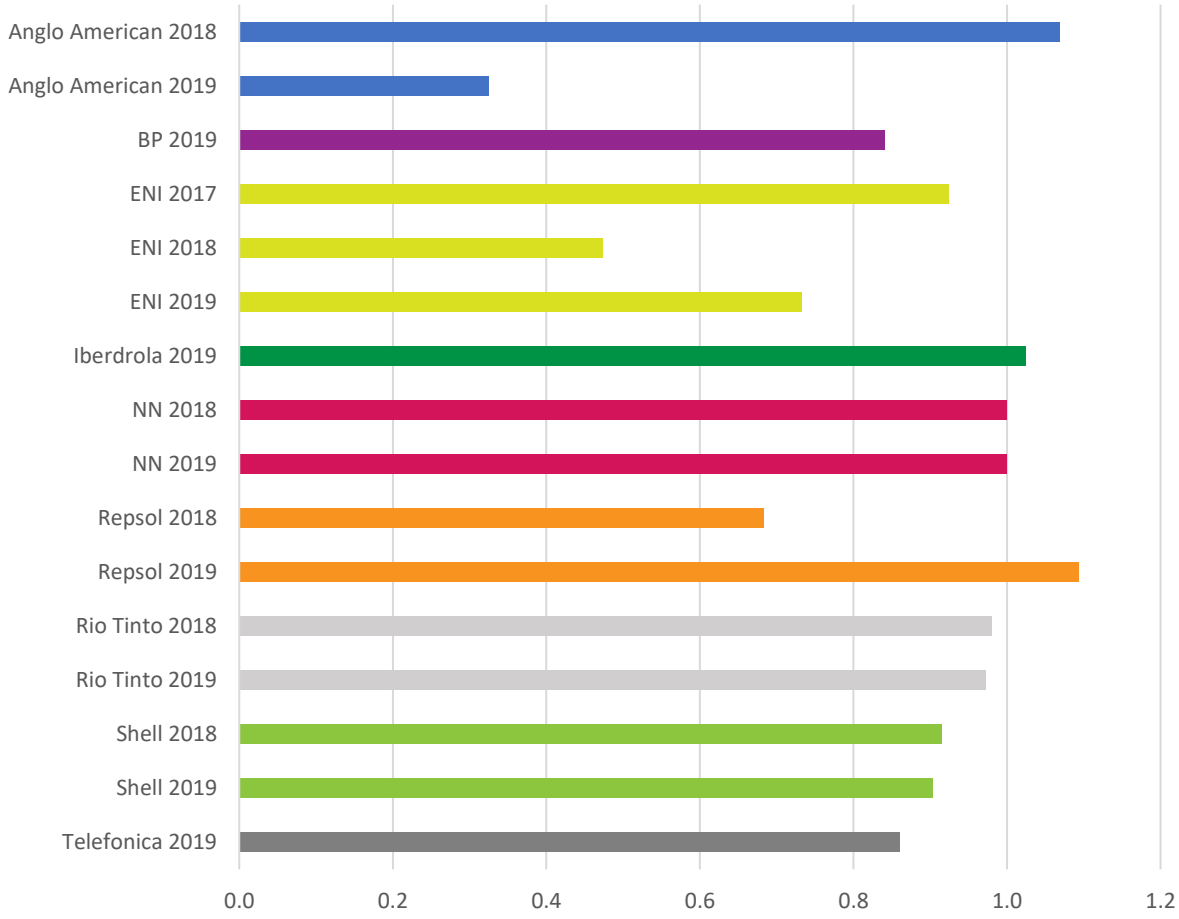
County	Total domestic profits	Estimated share of MNEs that included dividends	Estimated share of dividends included in CbCR profit
Italy	Positive profit sample	90.7%	38%
Netherlands	EUR 36.8 billion (positive profit sample)	49%	16% (EUR 5.8 billion)
Sweden	SEK 512 billion	Assumption: all	52% (SEK 266 billion)
UK	£110 billion	25%	49% (GBP 55 billion)

Source: OECD (n.d.)

Many early publishers of CbCRs explicitly state that they exclude intra-company dividends when compiling CbCR (Anglo American, ENI, Repsol, Rio Tinto, Shell). This can also be confirmed by comparing aggregate CbCR profits to consolidated financial accounts. If the sum of CbCR profits exceeds consolidated global profit, this might indicate the inclusion of intra-company dividends. However, in our sample, the sum of CbCR profits is rarely higher than consolidated profits (Figure 12). The maximum positive deviation is 9% for Repsol in 2019. This contrasts with the comparably

important magnitude of the phenomenon in aggregate CbCR data. Estimates of the latter refer to headquarter profits only and might thus also look less important in relation to MNEs' global consolidated profits. However, some double-counting of profits might also occur in the case of foreign affiliates. For example ENI, which explicitly excludes intra-company dividends from its CbCR, highlights that the inclusion of dividends would mostly affect the headquarter jurisdiction Italy but also the Netherlands and the UK.

Figure 12: Ratio of CbCR and consolidated profit



Note: Excluded profits of associates and joint ventures explain part of the gap between the sum of CbCR profits and the consolidated financial result (see Section 3.3.2.). Source: Authors

3.3.2. Profits of equity-accounted associates and joint ventures

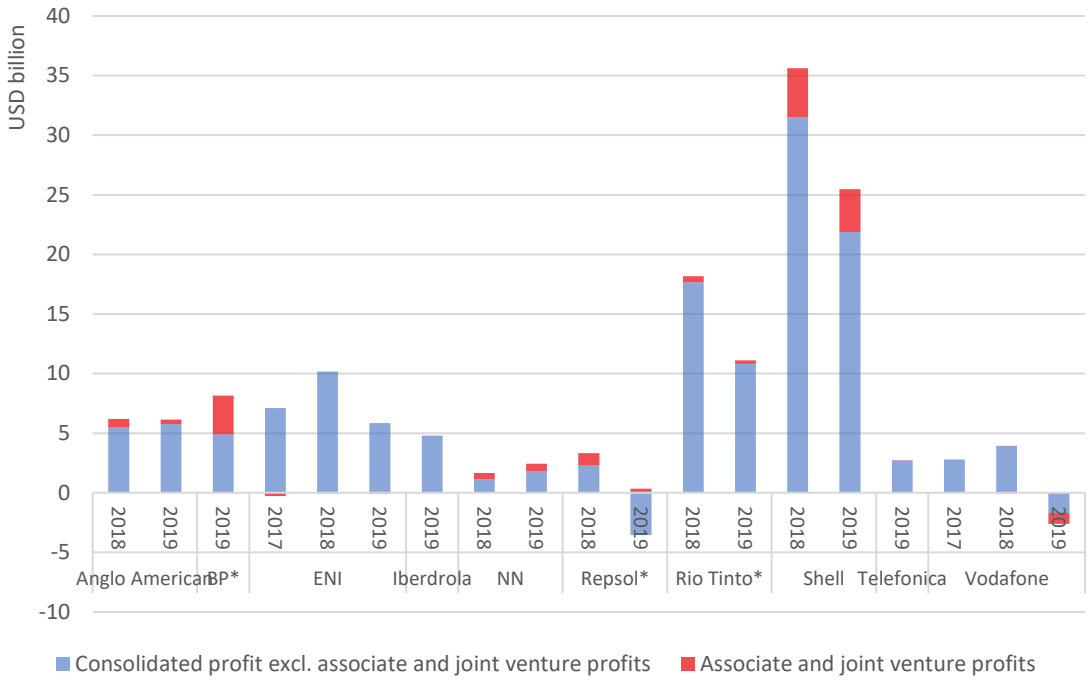
In financial accounting, the net profits of joint ventures and associates may be included in total profits on an accrual basis. As CbCR is based on financial profits, this gives rise to a conceptual challenge: MNEs are allowed to include profits the participation results from associates and joint ventures in CbCR – if accounted based on the equity method. However, in line with financial reporting, taxes paid by the associate or joint venture, its employees or other economic variables, are not included in CbCRs. As a result, the inclusion of associates and joint ventures affects reported profits but not the remaining CbCR variables. This is a potential source of bias when calculating ETRs or other tax risk indicators, as has been pointed out by the OECD (2017). The Netherlands' notes on country-specific analysis, for example, estimate that aggregate positive CbCR profits reported in the Netherlands are biased upwards by 27% "due to shares of result in associates and joint ventures, differences in accounting standards between the two reports, one-off (de)mergers, takeovers, or disposals" (OECD, n.d.).

In our sample the bias of CbCR profits caused by the inclusion of participation results potentially affects all groups except for BP, Repsol, and Rio Tinto which explicitly exclude income from joint ventures from their CbCRs. By combining individual MNEs' CbCRs and consolidated financial accounts we assess the potential magnitude of this bias for our sample. All groups provide net income from associates and joint ventures in their consolidated income statement which accounts for approximately 11% of the sample's total consolidated profits. Among the groups that do not correct their CbCR profits for received equity-accounted incomes, the maximum share in consolidated profit is 27% for NN. Interestingly, the two groups with the highest equity-accounted income (BP and Repsol) correct their CbCR profits, perhaps to prevent misinterpretations resulting from strongly biased profits. For Telefonica and Iberdrola, the net income from associates and joint ventures is close to 0% of consolidated profits (Figure 13). While the annual reports include a list of associates and joint ventures, in most cases with addresses, a breakdown of net income by entity and thus country is not always available or includes only the most important joint ventures and associates. As a result, we can only correct profits by country in an exemplary and non-systematic manner.

Anglo American, ENI, and Vodafone provide a breakdown for the most important joint ventures and associates. Our analysis suggests that, even if moderate at the aggregate level, joint venture

profits may distort individual countries' risk indicators, especially if little economic activity is carried out in the country. For example, ENI's 2017 profit in Spain might increase by 94% (from USD 5 to 76 million with fewer than 100 employees) if losses from its joint venture Unión Fenosa Gas SA were subtracted. However, in Italy, where ENI has more than 20,000 employees, net income from joint ventures and associates would bias profits only by 0.1–28%. Similarly, AngloAmerican's losses in Colombia, where it reports only 1.5 employees would look much bigger after subtracting the positive equity-accounted income from Cerrejón. In contrast, in Australia, Brazil, and South Africa a tentative correction for equity-accounted net income would change profit by much less (0.3–37%) (Figure 14). This indicates that individual company-country ETRs or other measures based on individual company–country profits should be interpreted with caution as net income from equity-accounted entities might bias them both upwards or downwards. They might even be meaningless in branches with little economic activity if most of the local financial profits are actually generated from equity-accounted entities. This, however, does not seem to hold for profits in tax havens as hardly any company reports associate or joint venture income in tax havens.

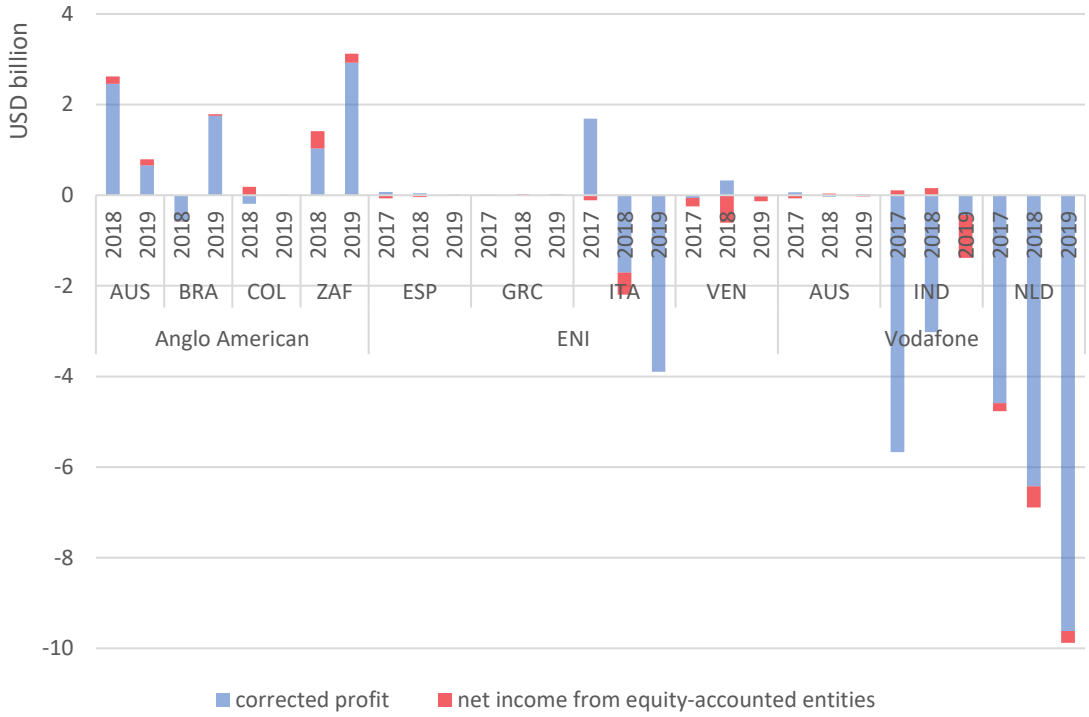
Figure 13: Profit of equity-accounted associates and joint ventures



Note: Share of equity-accounted associates and joint ventures in consolidated profits. Source: Authors

Profits of equity-accounted associates and joint ventures may thus be a relevant source of bias in our analysis of company-level tax risk indicators. As most MNEs report positive profits from equity-accounted investments, their global ETRs likely need to be corrected upwards. The share of profits reported in tax havens would need to be corrected upwards if we exclude these profits from our analysis, as most sample MNEs do not report any equity-accounted income in tax havens (NN constitutes an exception, with associates and joint ventures in its headquarter country, i.e. the Netherlands). The corrections by country would mostly affect non-haven countries and among those countries hosting only small branches.

Figure 14: CbCR profits by country corrected for net income from equity-accounted entities



Note: A by-country correction can only be carried out for Anglo American, ENI and Vodafone as not all companies provide sufficient information on individual associates and joint ventures in their annual reports. Source: Authors

3.3.3. Additional reasons for differences between financial profits and the tax base

The voluntarily published CbCRs are mostly sourced from and thus broadly consistent with consolidated financial accounts. Effective tax rates calculated based on CbCRs thus facilitate the assessment of corporate tax payments in relation to financial profits in each country. However, these financial profits are not necessarily consistent with taxable profits due to differences in financial and tax accounting (Hanlon & Maydew 2009). These include timing differences due to different depreciation rules and permanent differences, e.g. when certain payments are regarded as deductible expense for financial accounting but not for tax purposes. In this regard, ETRs based on CbCR data suffer from similar shortcomings as ETRs based on financial accounts.

As MNEs are not required to publish their tax accounting along with financial accounts, the reasons for observed discrepancies between ETRs and statutory tax rates also remain somewhat opaque in CbCR data. Loss carryover – likely an important share of observed discrepancies – will

be easier to control as longer time series become available. However, the effects of other features of the tax system, such as depreciation schemes and tax incentives, cannot be analysed systematically using publicly available data.

Based on data from MNEs' tax filings, the Netherlands' notes on CbCR data (OECD, n.a.) provide rough estimates of how much the distinctive features of the tax system contribute to the observed gap between MNEs' financial and taxable profits. Having corrected CbCR profits for the double-counting of dividends, the authors suggest subtracting an additional 19% for loss carry-overs, and another 9% to make CbCR profits better comparable to taxable profits. The components of this correction include estimated commercial-fiscal differences and adding interest and costs that would not be deductible for tax purposes. The authors also subtract part of the profit that benefits from intellectual property (IP) tax incentives, which illustrates an important controversy regarding the interpretation of ETRs. While a share of IP profits is exempt from the CIT base under the Dutch tax system, this is not so in other countries. For inter-country comparisons of ETRs, it is thus not ideal to use taxable profits as the denominator as they are defined in a non-consistent way across jurisdictions.

Some of our sample MNEs also provide information that is additional and complementary to what is available in the OECD standard. Notably, some MNEs explain why they pay relatively low ETRs in certain jurisdictions.[22] For example, Vodafone explains in detail the availability of historic losses in Luxembourg which allows a large amount of income received to be offset so that no corporation tax is recorded in Luxembourg. The availability of historic losses does not form part of the data required by the OECD standard but is provided voluntarily to improve the readers' understanding. Vodafone also indicates that it pays "no or little UK corporation tax" (Vodafone 2018) because of a capital allowance and debt interest relief. Similarly, Rio Tinto explains how its entities in Belgium qualify for the Diamond Tax Regime, which results in an effective tax rate lower than the general statutory corporate tax rate in Belgium. Repsol even computes ETRs for each jurisdiction and provides explanations for differences to the statutory rates including tax deductions in Spain, the use of an accelerated amortization tax regime in Peru, losses from the previous year in Mexico, tax credits generated by losses from previous years in Luxembourg, or

[22] This might be linked the GRI standard which requires companies to explain why their effective tax rates differ from statutory rates.

non-deductible losses in Bolivia and the Netherlands which explain why the ETR is higher than the statutory rate.

This information can help explain why ETRs may differ from statutory rates but is not detailed enough to quantitatively adjust the ETRs or to help clarify how much of the gap between an ETR and the statutory rate can be explained by a certain tax incentive. However, the bias due to loss carryovers can be reduced by averaging CbCR data over several years as more data becomes available. When it comes to tax incentives, it depends on the research question whether or not they should be considered a potential source of bias of ETRs. Even if a tax incentive increases the gap between financial and taxable profits, it results in lower tax payments. This may be captured correctly by ETRs computed based on financial profits but not by ETRs based on taxable profits. In addition, individual features of the tax code such as loss carryover, certain depreciation schemes, and tax incentives can also be used strategically by MNEs and form part of global tax optimisation schemes.

3.4. Tax risk indicators

In our analysis of voluntarily reported CbCR data we analyse standard tax risk indicators: the MNEs' activities and profits booked in tax havens, effective tax rates, and the misalignment of profits with reported economic activity. We discuss potential biases introduced to our results by the above described shortcomings of CbCR data and illustrate the effect of corrections where possible. When calculating global ETRs, for example, information from financial accounts allows us to correct profits for participation results as discussed in Section 3.3.2. For the calculation of tax risk indicators, we drop company-country observations when profits were negative on average over the available years as we would not expect these companies to pay tax and are mainly interested in the distribution of positive profits across countries.

3.4.1. MNEs' presence in tax havens

Different channels are used by MNEs for aggressive tax planning. Ramboll & Corit (2015) and ZEW (2016) group them into three channels: aggressive tax planning via interest payments, via royalty payments, and via strategic transfer pricing (e.g. intra-group sale of goods or provision of services). CbCRs facilitate a global view of where each MNE locates some of the functions, risks and assets that can be linked to aggressive tax planning. High-risk functions performed in tax

havens include intra-group finance, IP licensing, marketing hubs, provision of insurance or headquarter services, and holding functions, each of which is discussed in more detail below.

Tax rules typically allow a deduction for interest paid or payable in arriving at the tax measure of profit. The higher the level of debt in a company, and thus the amount of interest it pays, the lower its taxable profit. Intra-group lending arrangements can result in tax avoidance if the interest payment is structured in a way that allows the interest to be received in a jurisdiction that either does not tax the interest income, or which subjects such interest to a lower tax rate than the jurisdiction from which the payment is made.

MNEs can strategically place their profitable IP rights in low-tax locations to reduce overall tax rates. IP owned in low-tax jurisdictions is licensed to an entity in high tax jurisdiction in return for a royalty payment. Tax rules typically allow a deduction for royalty paid or payable in arriving at the tax measure of profit. Intra-group licensing of IP can result in tax avoidance if the royalty payment is structured in a way that allows the payment to be received in a jurisdiction that either does not tax the IP income, or which subjects such income to a lower tax rate than the jurisdiction from which the payment is made.

As supply chains have grown with increasing globalization, MNEs have sought to locate specific elements of their supply chain, such as marketing and logistics management (often referred to as "marketing hubs") within entities in low-tax jurisdictions. Through strategic transfer pricing, these entities can be remunerated through a return on the costs incurred (mark-up basis), a return or commission based on the spend under management (e.g. total purchases) or a share of any gain arising from the contribution to the entity (e.g. a fee is charged as a percentage of the value generated/cost reduction achieved). By allocating the return earned by these entities through strategic transfer pricing in low tax jurisdictions, MNEs are able to reduce their overall effective tax rate.

The provision of intra-group services (e.g. insurance/headquarter services) from an entity located in a low-tax jurisdiction to an entity located in high-tax jurisdictions can result in tax avoidance if the payment is structured in a way that allows the payment to be received in a jurisdiction that either does not tax the service income, or which subjects such income to a lower tax rate than the jurisdiction from which the payment is made.

Holding companies are not necessarily located in low-tax jurisdictions for the purposes of profit shifting, but they can benefit from preferential tax treaty networks, which can ensure that dividend payments are received with either low or no withholding taxes whatsoever. Tax treaties between countries can reduce or exempt the application of withholding taxes on intra-group payments (e.g. dividends, interest, royalties, services) which can reduce the MNE's overall effective tax rate. The ability to receive payments with no withholding tax collected at the source also impacts the location of IP and intra-group services.

Table 13: High-risk functions performed in tax havens

Country/MNE	AngloAmerican	BP	ENI	Iberdrola	NN	Repsol	Rio Tinto	Shell	Telefonica	Vodafone
Tax havens										
Netherlands	CORE	CORE	CORE, HOLD, R&D, SUP	no info	no info	CORE, FIN, HOLD	CORE, HOLD	CORE, FIN, HOLD, SUP	-	CORE, HOLD
Singapore	CORE, HOLD, HUB, SUP	CORE, HUB, SUP	CORE	-	no info	CORE, SUP	FIN, INS, HUB, SUP	CORE, FIN, HUB, SUP	-	CORE
Switzerland	CORE, SUP	no info	CORE	-	no info	SUP	CORE, INS, SUP	CORE, FIN, INS, IP, SUP	-	CORE
Bahamas	-	HOLD	IP	-	-	-		HUB	-	-
Bermuda	HOLD; INS	DORMANT	HOLD	-	-	INS (dormant)	HOLD	FIN, HOLD, INS, SUP	-	-
Belgium	-	-	CORE, FIN, HOLD		no info	-	CORE	CORE	-	CORE
Luxembourg	HOLD	-	-	no info	no info	FIN, HOLD, INS	FIN	CORE, FIN	-	CORE, FIN, HUB, SUP
Hungary	-	-	CORE	no info	no info	-	-	CORE	-	CORE, FIN, SUP
Malta	-	-	HOLD	-	-	-	INS	-	-	CORE, INS
Ireland	CORE, FIN, INS, SUP	-	INS, R&D	no info	-	CORE	-	CORE	-	CORE, SUP
Non-havens										
Australia	CORE, FIN, HOLD, IP, SUP, R&D	CORE	CORE, R&D	no info	-	CORE, HOLD, SUP	CORE	CORE	-	CORE
Canada	CORE, HOLD, SUP	CORE	CORE, HOLD	no info	-	CORE, HOLD	CORE	CORE	-	core
South Africa	CORE, FIN, HOLD, R&D, SUP	CORE	R&D	no info	-	-	CORE	CORE	-	CORE, HOLD
Spain	-	CORE	CORE	no info	no info	CORE, FIN, HOLD	CORE	CORE	CORE	CORE
Libya	-	no info	CORE	-	-	CORE	-	no info	-	-
Oman	-	CORE, HOLD	-	-	-		SUP	CORE	-	-
Brazil	CORE, FIN, HOLD, R&D, SUP	no info	R&D	no info	-	CORE, SUP	CORE	CORE	CORE	CORE
United Kingdom	CORE, FIN, HOLD, IP, R&D, SUP	CORE, FIN, HOLD	CORE, HOLD, IP, R&D, SUP	no info	-	CORE, HOLD, SUP	CORE, FIN, HOLD	CORE, FIN, R&D	no info	CORE, HOLD, IP, SUP
Egypt	-	CORE	CORE; R&D; SUP	no info	-	-	-		-	CORE
United Arab Emirates	CORE	CORE	CORE	-	-	-	SUP	CORE, HOLD, HUB, SUP	-	no info

Activity	Activity type		
CORE	Manufacturing/production/transportation/extracting/sales/distribution	IN	Group insurance
FIN	Intra-group finance	IP	Intellectual property holding/management
HOLD	Holding of shares	R&D	Research and development services
HUB	Marketing/trade hub	SUP	Support services (payroll, management services, other services)

Note: Countries are ranked in terms of total sample profits within categories. A hyphen indicates that the MNE has no presence in this country.

Table 13 summarises MNEs' functions performed in the top ten tax havens (ranked in terms of total sample profits) and contrasts them with the functions performed in the top ten non-haven countries. While most jurisdictions with important profits do host core functions, we also find that, in total, tax havens host a higher share of functions which are commonly used for aggressive tax planning.

A clear pattern emerges for insurance services and marketing or trade hubs. Six of our sample MNEs locate group insurance in the top ten tax havens, while no insurance activity is reported in the top ten non-havens. Anglo American reports insurance activities in Bermuda and Ireland, Eni in Ireland, Repsol in Luxembourg, and Rio Tinto in Singapore, Switzerland, and Ireland. Shell reports insurance activities in Switzerland and Bermuda and Vodafone in Malta. Marketing or trade hubs, are concentrated in tax havens, mostly in Singapore. This is the case for AngloAmerican, BP, Rio Tinto, and Shell. Vodafone has a hub in Luxembourg. Shell reports two more hubs in the Bahamas and in the United Arab Emirates which is not on our tax haven list but ranks tenth on TJN's corporate tax haven index (Tax Justice Network 2021).

Intra-group finance, intellectual property and holding of shares seem to be more equally distributed across jurisdictions. Intra-group finance is still somewhat more frequent in tax havens. Six out of seven MNEs that systematically report business functions locate intra-group financing in at least one of the top ten tax havens. Intellectual property rights, in contrast, are more frequently located in the United Kingdom (AngloAmerican, Eni, and Vodafone) and only twice in the top ten tax havens (ENI in Bahamas and Shell in Switzerland). IP location in the Bahamas by ENI seems to constitute an exception because the MNE does not report any other business functions in this jurisdiction. Holding of shares is widely spread across jurisdictions. Among the top ten tax havens, the Netherlands and Bermuda seem to be popular locations for holding companies – five and four MNEs report holding shares through these two jurisdictions respectively. Six MNEs report holding companies in the UK with four being headquartered there.

When quantifying MNEs' general presence in tax havens, we find that the share of overall profits they record in tax havens varies significantly in between groups and depending on the tax haven list we use. Seven out of ten of the analysed MNEs report significantly lower shares of profits in tax havens than what we find in aggregate CbCR data published by the OECD: Anglo American, ENI, Iberdrola, Repsol, Rio Tinto, Telefonica, and Vodafone all report between 1% and 7% of their

profits in tax havens, while the average share of profits reported in tax havens based on the OECD data is approximately 15% (Table 14).

Table 14: Share of profit in tax havens (average of available years)

Company	Our tax haven list	Adjusted for associates and joint ventures	Gravelle's tax haven list	Adjusted for associates and joint ventures
Anglo American	6.8	7.3	6.7	7.2
BP	18.5		14.3	
ENI	2.1	2.1	1.2	1.2
Iberdrola	1.3	1.3	0.4	0.4
NN	75.8		1.4	
Repsol	3.9		2.4	
Rio Tinto	4.7		4.6	
Shell	30.5	*35.0*	19.4	*22.2*
Telefonica	3.8	3.8	3.8	3.8
Vodafone	4.3	4.4	3.1	3.2
Weighted Mean	16.1	17.1*	9.8	10.4*
Aggregate CbCR	14.6		11.8	

Note: Adjusted means refer to unadjusted tax haven shares for BP, Repsol, and Rio Tinto which correct CbCR profits themselves and for NN and Shell where adjustments are not possible due to missing country-by-country information. Adjustments for associates and joint ventures assume that these are based in non-haven countries which cannot be verified for Shell and does not hold for NN. For this reason, values for Shell are reported in italics and NN is left blank. The shares of profits in tax havens are calculated excluding company-country observations with losses on average over available years. The share of profit in tax havens for aggregate CbCR data is based on the positive-profit sample for 2017.

Three companies in our sample report a higher share of profits in tax havens than the OECD average: BP reports 18.5%, NN 75.8%, and Shell 30.5%. Note however, that NN's high tax haven share is mainly caused by high profits in its headquarter country, the Netherlands. Using Gravelle's tax haven list shrinks NN's tax haven share to 1.4%. Our sample's average share of profits in tax havens, at 16–17%, is higher than the global average based on the OECD data for our preferred tax haven list but lower for Gravelle's tax haven list. Gravelle's list (Gravelle 2012, also used by Gumpert et al. 2016) excludes Belgium, Hungary, and the Netherlands, resulting in a lower sample mean of approximately 10% of profits reported in tax havens versus

approximately 12% for the aggregate CbCR data. The averages mask substantial differences between the companies, with mostly BP and Shell standing out due to their comparably high tax-haven shares across lists. These profits coincide with the high-risk activities of Shell in Singapore, Switzerland, Bahamas, and Bermuda. BP concentrates its tax-haven profits in Switzerland (13% of total profits) without providing details on the functions performed there.

The most important tax havens for our sample in absolute terms are the Netherlands, Singapore, and Switzerland, followed by the Bahamas, Belgium, and Bermuda (see Figure A3 in the Appendix). These results are mostly driven by Shell, which reports the highest absolute amount of profits in tax havens – approximately USD 9 billion– and by NN and BP, which report approximately USD 1.8 and 1.6 billion respectively.

3.4.2. Effective tax rates

The second risk indicator we analyse is the effective tax rate, both at MNE level ($ETR\ MNE_i$) and at country level ($ETR\ country_j$). MNEs characterised by low effective tax rates might employ tax avoidance strategies to minimise their tax burden, while countries where effective tax rates are low might be used as tax havens.

We calculate effective tax rates by MNE and for each country where MNEs are active. We take the means of observations by country and company over all available years, to account for loss offset where possible. We set tax accrued to zero if it was negative on average. ETRs are defined as the ratio between the sum of reported income tax accrued and the sum of reported pre-tax profit (profit/loss before income tax) either by company or by country. For MNE *i* and country *j* the ETR is calculated as follows:

$$ETR\ MNE_i = \frac{\sum_{j=1}^{n} income\ tax\ accrued_{ij}}{\sum_{j=1}^{n} gross\ profits_{ij}} \qquad (4)$$

$$ETR\ country_j = \frac{\sum_{i=1}^{n} income\ tax\ accrued_{ij}}{\sum_{i=1}^{n} gross\ profits_{ij}} \qquad (5)$$

The MNEs' worldwide effective tax rates ($ETR\ MNE_i$) are thus weighted averages which assign more weight to ETRs in locations where MNEs report relatively more profits. Similarly, the effective tax rates by country ($ETR\ MNE_j$) attach more weight to MNEs that account for higher shares of profit in that country.

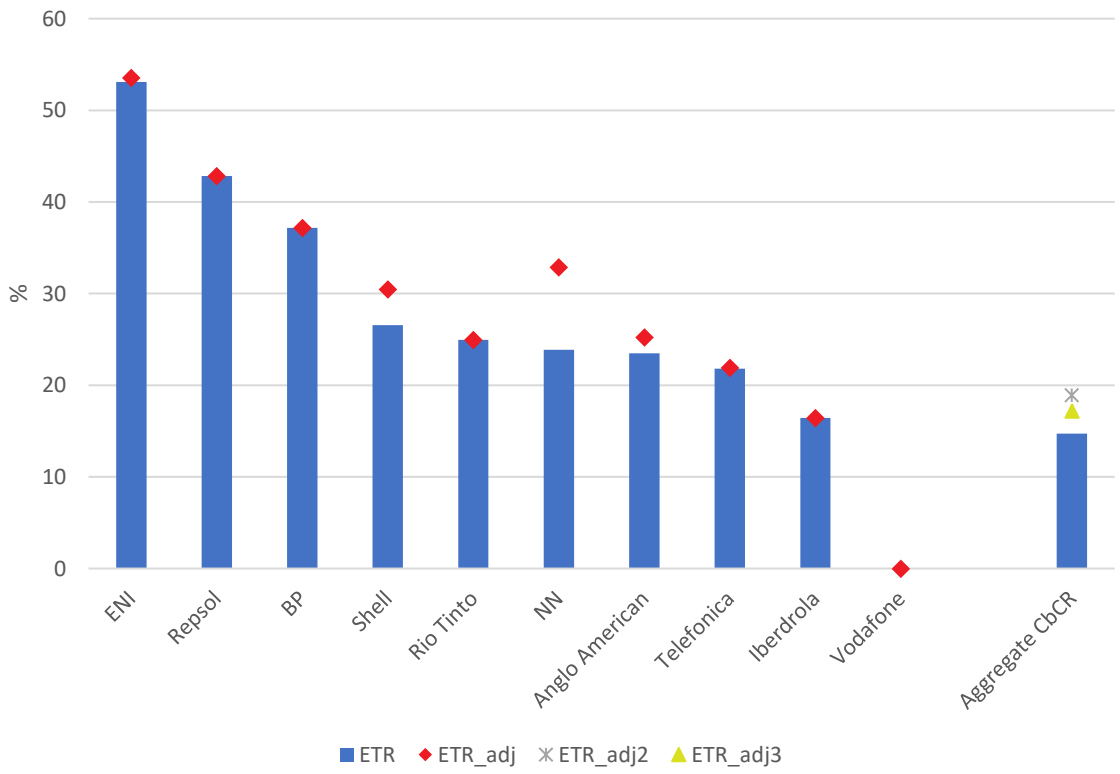
As shown in Figure 15, global ETRs are above 20% for the majority of the MNEs in our sample and exceed 35% in the case of BP, ENI, and Repsol. Shell, Rio Tinto, NN, Anglo American, and Telefonica range between 20% and 30%. Iberdrola has a worldwide ETR below 20%, while Vodafone has an ETR of zero as a result of reporting negative taxes accrued. By adding up all tax payments and dividing them by the sum of profits across the sample, we obtain an average global ETR of approximately 21%. In contrast, the respective worldwide ETR calculated based on the aggregate OECD CbCR statistics (OECD 2020) is 15%. It thus appears that companies which voluntarily published their CbCRs are more likely to pay higher ETRs than the world average. However, as discussed in Section 3.3.1., aggregate OECD data probably overstates total profits, so the global ETR based on this data is biased downwards. As a very blunt proxy for double-counted profits, we may take the mean estimate of the Dutch, Italian, Swedish and UK country notes, which suggests that 38% of headquarter profits might be double-counted due to dividends. Subtracting 38% of domestic MNEs' profits in all headquarter countries (excluding those which have already provided adjusted profits) would increase the global ETR to 19%. Alternatively, we might assume that double-counted profits amount to 14.4% of total profits reported by MNEs in all jurisdictions, as previously established for the IRS-reported country-by-country profits of MNEs headquartered in the U.S. (Horst & Curatolo 2020). If applied to the OECD's aggregate CbCR data, this alternative adjustment would produce a global ETR of 17% (Figure 15).

The comparably high global ETRs of ENI, Repsol and BP reflect high tax payments in resource-rich countries. The three MNEs concentrate more than 50% of their tax payments in only three jurisdictions each, some of them with very high ETRs: ENI's top jurisdictions in terms of tax payments are Libya with an ETR of 76%, Algeria with an ETR of 89% and Egypt with an ETR of 24%. Repsol's top three jurisdictions are Libya, Spain and Indonesia with ETRs of 70%, 27%, and 80% respectively. For BP, the top jurisdictions are the Middle East (which aggregates Bahrain, Iraq, Kuwait, Lebanon, Oman, Saudi Arabia, and United Arab Emirates), Angola, and Australia with ETRs of 89%, 43%, and 34%. These high ETRs might thus be due to special tax regimes such as excess profits taxes which many countries apply in the extractive sector (Otto 2017). For example, in 2018, Libya and Norway charged surtaxes on profits from the petroleum industry, implying composite nominal tax rates up to 65% and 78%. Algeria, Angola, Australia, and Nigeria also have special tax regimes for the oil and gas industry, including resource rent taxes, royalties, or

additional profit taxes (EY 2018). Also in Indonesia, corporate income tax rates oil and gas industries or in mining may be calculated based on Production Sharing Contracts or Contract of Works (Deloitte 2022) and might thus deviate from standard rates.

A negative correlation between the share of profits reported in tax havens and the global ETR might constitute an initial indication of profit shifting. Depending on the tax-haven share and ETR measures we employ, the correlation is remarkably close to zero or even positive (varying between -0.04 and 0.12) and would thus not indicate a profit shifting risk for our sample.

Figure 15: Global effective tax rates



Note: Observations by company and country were averaged over available years before calculating the ETRs. Adjusted ETRs (ETR_adj) take into account that net income from associates and joint ventures would not be considered part of the corporate tax base. The global ETR is based on aggregate CbCR data from the OECD positive-profit sample. The grey Asterix indicates a tentative adjustment for double-counting of profits by subtracting 38% of domestic MNEs' profits in headquarter countries. The yellow triangle was obtained by reducing global aggregate CbCR profits by 14.4%.

3.4.3. Misaligned profits in tax havens

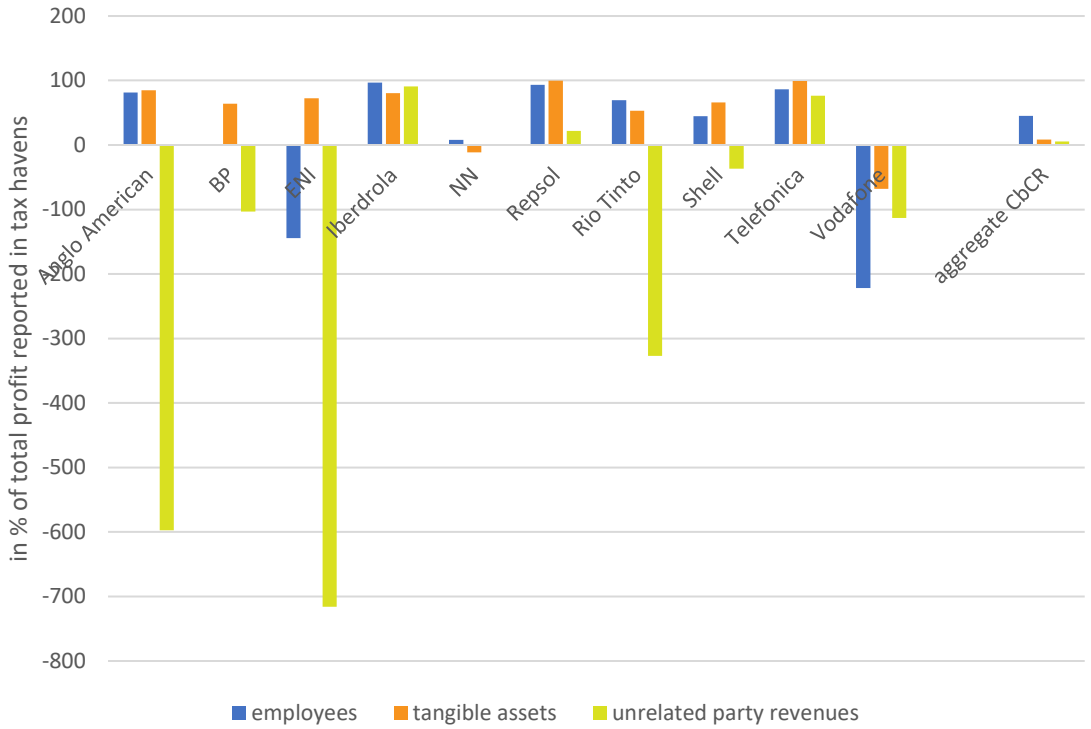
Although several companies report below world-average shares of profits in tax havens, their activities in tax havens are much more profitable than those in other jurisdictions. Average profits per employee are USD 0.2 million worldwide but USD 0.4 million in tax havens: profitability per employee is twice as high in tax havens than the worldwide average or even five times higher if we use Gravelle's tax haven list (see Figure A2 in the Appendix). To assess the misalignment of tax-haven profit with reported activity more systematically, we compare each company i's share of global profits in tax havens to its share of employees, tangible assets and unrelated-party revenues reported there. We compute misalignment by company i and country j as follows:

$$Misaligned\_profit_{ij} = actual\ profit_{ij} - share\ of\ economic\ activity_{ij} * global\ profit_{i} \quad (6)$$

If the reported profits of a MNE in a given country are higher than profits predicted by that country's share of the MNE's total economic activity, this gives rise to 'excess' profit. If the reported profits are lower than the predicted profits based on the MNE's economic activity, this gives rise to 'missing profit.' We obtain relative misalignment by dividing the absolute misaligned profits in each country by the profits MNEs actually report there.

When we measure economic activity in terms of the number of employees or tangible assets, most sample MNEs seem to report excess profits in tax havens which appear to be misaligned with economic activity by 40–100%. Exceptions are BP, ENI, NN, and Vodafone, where misalignment in terms of employees is either close to negligible (<10% for BP and NN) or even negative (ENI and Vodafone). The latter implies that, with respect to the total number of employees reported in tax havens, we would have expected ENI and Vodafone o make more profits there. When measured in terms of unrelated party revenues, misalignment is negative for half of the sample MNEs (Figure 5). This illustrates the sensitivity of the misalignment approach to the activity measure chosen. It also shows that tax havens attract a significantly higher share of the sample MNEs' global unrelated party revenues compared to the share of MNEs' global employees and tangible assets which they host. By strategically routing sales through tax havens, unrelated party revenues might already be over-reported in profit shifting destinations. García-Bernardo & Janský (2022) suggest that even tangible assets may be strategically located as they find that US MNEs report the second highest value of tangible assets in Europe in Luxembourg.

Figure 16: Misalignment of profit and economic activity in tax havens by MNE



Note: The figure shows to what extent profits reported in tax havens are misaligned with reported economic activity in terms of the number of employees, the value of tangible assets and unrelated party revenues. If a company reports a higher share of global profits than its share of global activity in tax havens, this gives rise to excess profits (positive misalignment). If a country reports a lower share of profit than its share of global activity in tax havens, this gives rise to missing profits (negative misalignment).

3.4.4. Misalignment and effective tax rates

We further analyse the misalignment of profits and economic activity at country level to assess whether or not it correlates with average effective tax rates. As in recent applications of the misalignment methodology (Cobham & Janský, 2019) to CbCR data from large US MNEs (Garcia-Bernardo et al., 2021) and to public CbCR data from banks (Janský, 2020b), we compute each country's share in the total profits of the sample and compare it to each country's share in the total economic activity. We use the number of employees as the preferred proxy for economic activity as employees are less likely to be strategically located compared to tangible assets and unrelated-party revenues.

We compute misaligned profit in each country j as follows:

$$Misaligned\ profit_j = actual\ profit_j\ -\ share\ of\ economic\ activity_j * global\ profits \qquad (7)$$

As expected, we find that most tax havens exhibit both excess profit and very low ETR. This holds true for e.g. Singapore, Switzerland, Bermuda, and the Bahamas, for which our sample ETRs range between 0 and 10%; over 70% of profits reported there seem to be misaligned with economic activity. Likewise, Canada and the United Kingdom have ETRs between 0 and 10%, which coincides with excess profits, albeit to a lesser degree. Additional countries with relatively important excess profits include the Netherlands with an average sample ETR of 14%. Countries with a share of resource rent in GDP above 5%, which we refer to as resource-rich countries, often have both high ETRs and relatively high excess profits, e.g. Angola, Norway, Nigeria, Libya, and Oman with ETRs in excess of 40% (Figure 17).

Countries with important missing profits are South Africa, Spain, Brazil, the United States, Italy, and Germany. However, the sample's ETRs in Italy, the United States, and New Zealand also range between 0 and 10% and between 10% and 20% for South Africa and Brazil.

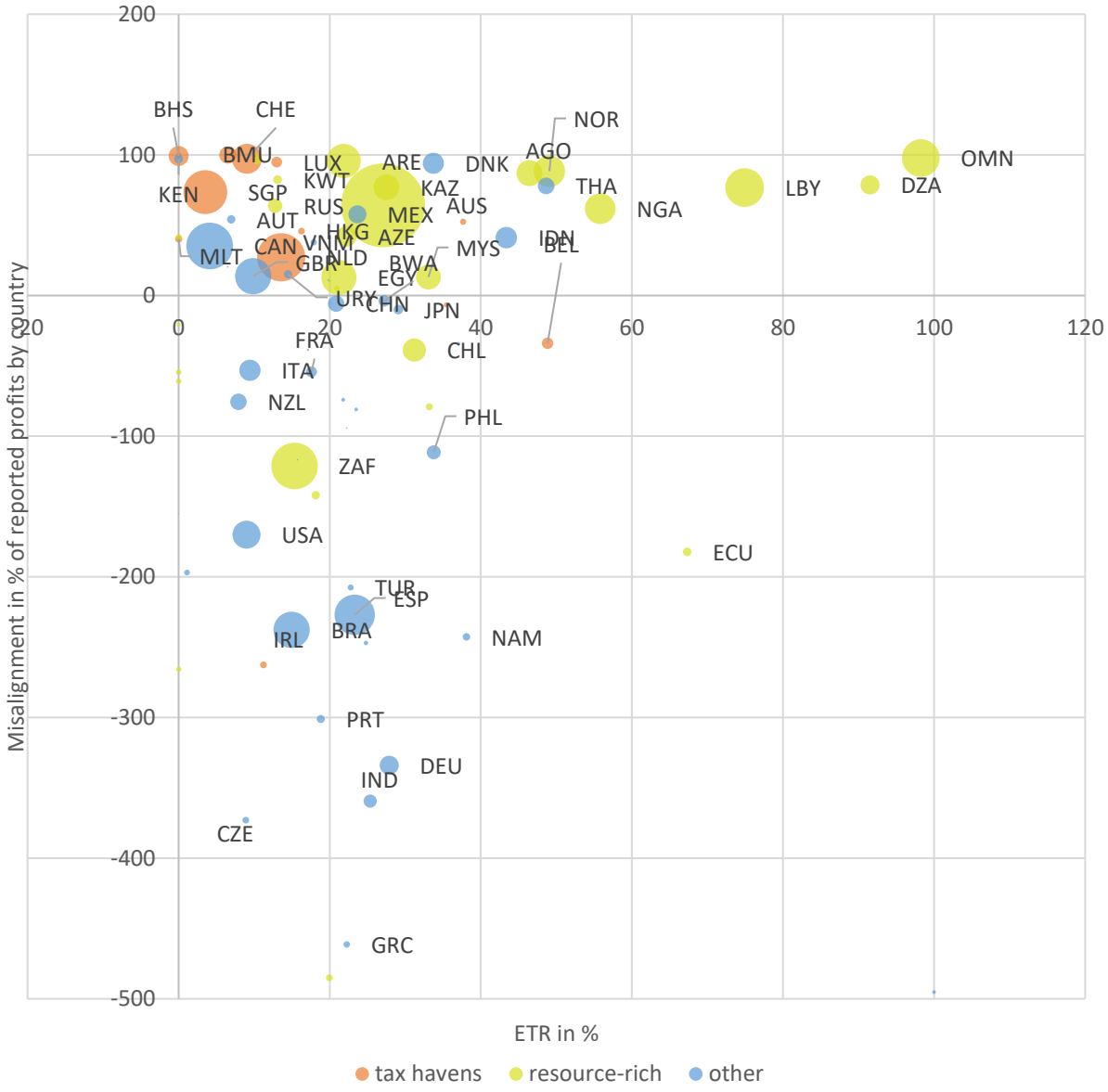
For the total sample, misalignment and ETRs do not seem to be correlated. However, we find a correlation of -0.28 between relative misalignment and ETRs, significant at the 5%-level after excluding countries with a share of resources rent in GDP above 5%. When measuring economic activity in terms of tangible assets, the results are similar: no correlation for the total sample, and a negative correlation of -0.22 when we exclude resource-rich countries, but only significant at the 10% level. The high ETRs and excess profits of resource-rich countries seem to blur the expected negative correlation of ETRs and misalignment which points to the specific role of extractive industries in our sample.

How can the findings of excess profits and high ETR in several resource-rich countries be reconciled? Very high ETR may partly reflect measurement errors e.g. due to the previously discussed differences in financial and tax accounting (Section 3.3.3.). However, as discussed in section 3.4.2. special tax regimes such as excess profits taxes often applied in the extractive sector (Otto, 2017) may also explain the high sample ETRs in resource-rich countries. Despite the high ETRs, the sample MNEs report above-average profits in these jurisdictions, in total but also per employee. Part of these profits may derive from resource rents rather than economic activity measured in terms of employee numbers. Most of them would also be identified as 'excess profit' countries if we used tangible assets as a proxy for economic activity (see Figure A6 in the

Appendix). The misalignment approach identifies them as ‘excess profits’ but this is very unlikely to be related to tax-induced profit shifting.

At company level we observe a negative correlation of relative misalignment with ETRs for ENI (-0.37), NN (-0.45), Shell (-0.37), significant at the 5% level. Taken together with the above-average share of tax-haven profits in total profits for NN and Shell (Section 3.4.2.), this might indicate that these companies locate their profits strategically to reduce global tax payments. While their rather moderate global ETRs of 24–33% for NN and 27–30% for Shell do not look especially suspicious, it can be noted that compared to Shell, the other oil companies in the sample seem to have paid relatively more taxes globally.

Figure 17: Misalignment and ETR by country



Note: Misalignment is based on employee numbers. A country is considered resource-rich if it derives more than 5% of its GDP from resource rents according to the World Bank (2022). The bubble size indicates the absolute amount of profits which the sample MNEs report in each jurisdiction.

3.4.5. Semi-elasticities

The fact that ETRs and misalignment do not seem to be systematically correlated might indicate that our sample MNEs shift little profits to low-tax jurisdictions. Still, some have located high-risk functions and non-negligible profits in tax havens. We thus reassess the correlation of profits and

ETR in a more formalised way, controlling for potential confounding factors. A scatterplot of log profits by company and country and ETRs by country suggests a positive correlation between the two variables (Figure A8 in the Appendix).

We perform a simple regression analysis to estimate the semi-elasticity of the reported profits with regard to a tax incentive variable, as is usually done in related literature (Beer et al., 2020). We use our estimated ETR at country level to operationalize the tax incentive variable. We use the log profit of each multinational group i in country j as the dependent variable and regress it on the estimated ETR of country j, including control variables at the MNE-country level and country level and a set of group dummy variables.

$$\ln \pi_{ij} = \beta_0 + \beta_1 \tau_j + \beta_2 \ln L_{ij} + \beta_3 \ln K_{ij} + \beta_X X_j + \sum_{i=1}^{9} \delta_i D_i + \varepsilon \qquad (8)$$

τ_j is the ETR of country *j*, *L* and *K* are the number of employees and the tangible assets reported by group *i* in country *j*, *X* are country-level controls, which include GDP per capita, population size, an indicator for the rule of law and a dummy variable indicating resource-rich countries based on the share of natural resources rent in GDP. All country-level controls are taken from the World Bank (2022a, 2022b). The share of natural resource rent in GDP accounts for the fact that the extractive industries generate a natural resource rent which is less likely to be explained by labour and capital inputs. D_i are the nine group dummies, leaving out Anglo American as the reference case.

As in Dowd et al. (2017), we compare the linear relationship (1) between profits and ETR to a quadratic form (2):

$$\ln \pi_{ij} = \beta_0 + \beta_1 \tau_j + \beta_2 \ln L_{ij} + \beta_3 \ln K_{ij} + \beta_4 \tau_j^2 + \beta_X X_j + \sum_{i=1}^{9} \delta_i D_i + \varepsilon \qquad (9)$$

As we only have a small number of observations and pool them into a single cross-section, our objectives in applying this tax semi-elasticity method are mostly carried out to formalize the correlations between the variables that we observe in our descriptive analysis and to include additional covariates that help explain the global allocation of multinational profits.

We estimate a simple OLS regression. Controlling for MNE-country and country-level covariates, profits do not seem to be at all correlated with ETRs in the linear model. The coefficients are negative but very small and not significant. Allowing for a non-linear functional form we find a negative relationship between ETRs and the location of profits, but the coefficients are very small. For example, according to regression (4), at an ETR of 5% a one-percentage-point difference between countries would only explain 0.05% of the difference in reported profits. At an ETR of 30% the semi-elasticity would only be 0.03. In regression (3), the respective semi-elasticities would be even smaller with 0.03 at an ETR of 5% and 0.02 at an ETR of 30% (Figure 18).

In line with other researchers' results, the non-linear model would imply that the profit shifting incentive of a one percentage point difference between tax rates is higher at very low ETR levels and approaches zero at moderate ETR levels. For example, the ETRs of Austria, the UK, and Germany are 5%, 15% and 25%, respectively. Our results would imply that the tax difference of 10 percentage points between Austria and the UK explains a more important share of the distribution of profits between these two countries than the tax difference between UK and Germany explains of the distribution of profits between the UK and Germany. Intuitively, it makes sense that very low tax jurisdictions would attract most of the shifted profits while jurisdictions with moderate tax rates would attract none or very little.

As expected, we find that the number of employees and assets are positively correlated with the profits reported by each multinational group in each jurisdiction. At country-level, GDP per capita correlates positively with profits while population size correlates negatively or is not significant. The resource-rich dummy is positive and significant as expected but no longer significant once we exclude observations with ETRs above 80%, as these are found in resource-rich countries. As discussed in the misalignment section, our sample MNEs seem to make above-average profits in resource-rich countries which may confound the correlation of profits and ETR.

For robustness checks we test the pooled regressions with nominal corporate tax rates (NCTRs) and ETRs based on aggregate CbCR data from the OECD. There seems to be no correlation whatsoever with the NCTR. For the ETRs based on aggregate CbCR data, the sign and size of tax coefficients correspond to those of our sample's ETRs but only one is significant at the 10%-level and the quadratic term is not significant (Table A5 in the Appendix). We also run regressions separately for each multinational group to test whether the small average coefficients mask

important differences between companies. However, we do not find any significant and meaningful correlations between reported profits and country-level ETRs (see Table A6 in the Appendix).

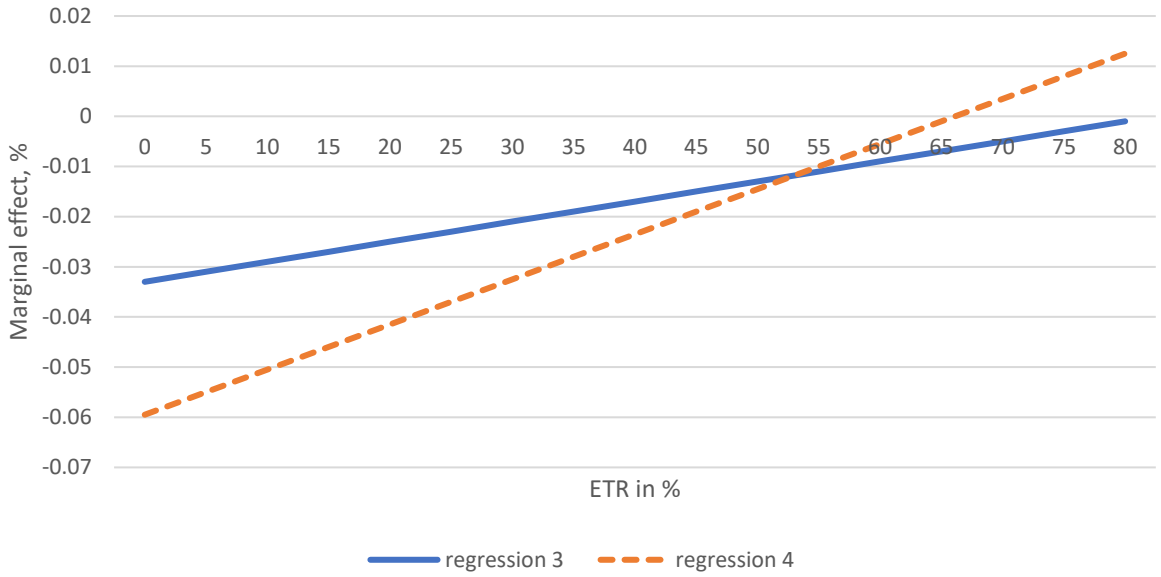
One result from the pooled regressions might suggest that our sample's reported profits are on average negatively correlated with ETRs, which would be consistent with profit shifting activities. However, the estimated average coefficient size is much smaller than in other studies and not robust. Even though the non-linear relationship of profit and ETR makes sense intuitively, and is qualitatively in line with existing literature (e.g. Dowd et al. 2017, García-Bernardo & Janský 2021), the small number and cross-sectional nature of observations do not allow us to identify profit-shifting behavior of the sample MNEs. The relatively weak correlation profits and ETRs is, however, in line with our previous descriptive findings, i.e. the comparably high global ETRs and moderate tax-haven profits of the sample MNEs on average.

Table 15: Pooled regression

	(1)	(2)	(3)	(4)
	linear	linear excl. outliers	quadratic	quadratic excl. outliers
	b/se	b/se	b/se	b/se
ETR_COUNTRY	-0.004	-0.008	-0.033*	-0.060**
	(0.006)	(0.007)	(0.016)	(0.022)
ETR_COUNTRY²			0.000+	0.001**
			(0.000)	(0.000)
LN_EMPLOYEES	0.561***	0.568***	0.562***	0.564***
	(0.100)	(0.101)	(0.099)	(0.100)
LN_ASSETS	0.255***	0.245**	0.254***	0.244**
	(0.074)	(0.075)	(0.073)	(0.073)
LN_GDP_PC	0.419*	0.372+	0.462*	0.358+
	(0.192)	(0.196)	(0.189)	(0.195)
LN_POPULATION	-0.177*	-0.181*	-0.130	-0.115
	(0.085)	(0.086)	(0.087)	(0.091)
RESOURCE-RICH	0.512+	0.435	0.543+	0.461
	(0.291)	(0.303)	(0.295)	(0.306)
RULE OF LAW	-0.010	-0.009	-0.010	-0.005
	(0.008)	(0.008)	(0.008)	(0.008)
R2	0.659	0.653	0.665	0.663
R2_A	0.636	0.629	0.640	0.637
N	249	242	249	242

Note: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Regressions (2) and (4) exclude observations with ETR>80%

Figure 18: Marginal effect of ETR on reported profits



Note: Calculation based on pooled regressions 3 and 4 in table 15.

3.4.6. Evaluation of tax risk indicators by company

To evaluate and compare tax risk indicators by company, we suggest simple thresholds for each indicator which allow us to identify some differences in tax risks between companies. Ideally, a very tax-aggressive company would locate high-risk functions in several tax havens (1), report an above-average share of profits in tax havens (2), and have a below-average global ETR (3). The profits in tax havens would not be aligned with economic activity reported there (4). Instead, the location of profits would correlate with corporate tax rates (5a) even when adding further country-level and company-level covariates (5b). As these criteria depend strongly on their empirical operationalization, we suggest several thresholds for some of them. For example, an above-average share of profits in tax havens may be defined relative to aggregate CbCR data (the population of large MNEs) or to the sample and may vary depending on the tax-haven list. Similarly, the global ETR may be compared to aggregate CbCR or to the sample mean (Table 16). Due to the specific tax rules applicable in the extractive industries, it might make sense to also use sector-specific ETRs as benchmark ETRs to assess an MNE's tax aggressiveness. For example, PWC (2015) finds that the average ETR of the global oil and gas sector was 31.5% on average over

the years 2011-2013 which was higher than in other sectors. Unfortunately, comparable consistent and up-to-date benchmarks are not available for all industries represented in our sample.

We find that none of the sample MNEs fulfil all of the 'tax aggressiveness' criteria across all operationalizations. Notably, most have relatively low shares of tax-haven profits, high ETRs, and no correlation between profits and tax rates. Shell is the only company that surpasses at least one threshold in four out of the five tax-risk indicators. It reports high-risk activity in more than three different tax havens, and an above-average share of profits in tax havens (compared to the sample and to aggregate CbCR data) for both tax haven lists. Its tax haven profits seem misaligned with economic activity in terms of employees and tangible assets, and this misalignment seems to be correlated with ETRs. However, the correlation is not significant when further control variables are included. Shell's global ETR of 27–30% looks moderate compared to the sample but also to the aggregate CbCR data. All remaining MNEs surpass the thresholds of a maximum of two indicators, although it should be noted that BP, Iberdrola, and NN do not report the functions performed in tax havens so that this indicator cannot be assessed.

Do more transparent MNEs avoid taxes less aggressively? Our analysis of tax risk indicators would support this view as most of the sample MNEs fulfil not more than two of the five suggested criteria for tax aggressiveness. The limited sample size and the heterogeneity in terms of company size and industry makes such a general conclusion difficult. As discussed previously, the relatively high global ETRs might be specific to the extractive industries. However, four out of 6 MNEs in extractive industries combine the high to moderate ETR with a relatively low share of profits in tax havens and the location of profits seems not to be correlated with effective tax rates. In our sample, this does not seem to be industry-specific as we find low tax-haven profits and uncorrelated profits and tax rates Iberdrola, Telefonica and Vodafone. Furthermore, recent research by Beer and Loeprick (2017) and Beer and Devlin (2021) suggests significant profit shifting risks in the extractive sector so that low tax haven profits are unlikely to be a general characteristic of the extractive industries.

Table 16: Evaluation of tax risk indicators by company

Tax risk indicator	Thresholds	Anglo A.	BP	ENI	Iber-drola	NN	Rep-sol	Rio Tinto	Shell	Tele-fonica	Voda-fone
(1) High-risk functions	High-risk functions in at least three different tax havens	yes	n/a	yes	n/a	n/a	yes	yes	yes	no	yes
(2) Share of profit in tax havens	Share above aggregate CbCR mean and sample mean (list 1)	no	yes	no	no	yes	no	no	yes	no	no
	Share above aggregate CbCR mean and sample mean (list 2)	no	yes	no	no	no	no	no	yes	no	no
(3) Global ETR	below aggregate CbCR mean	no	no	no	no	no	no	no	no	no	yes
	below sample mean	no	no	no	yes	no	no	no	no	no	yes
(4) Misaligned profit in tax havens	Excess profit based on at least two different activity measures	yes	no	no	yes	no	yes	yes	yes	yes	no
(5) Tax sensitivity	negative correlation of misalignment and ETR	no	no	yes	no	yes	no	no	yes	no	no
	negative correlation of profit and ETR with covariates	no	no	no	no	no	no	no	no	no	no

3.5. Conclusion

In this paper we explore voluntarily published CbCRs by ten MNEs which provide an exceptional level of corporate tax transparency on a global scale. We assess the quality of the data by comparing it to consolidated financial accounts and discuss the role of double-counting of profits, the inclusion of associate and joint venture profits, and other issues which may impede a meaningful interpretation of CbCR data. Based on several tax risk indicators, we assess to what extent our sample MNEs may differ from the global population of large MNEs as included in the aggregate CbCR data. We further provide a tentative framework to evaluate tax risk indicators

across sample MNEs and assess their potential overall tax aggressiveness even in the absence of a clear identification of profit shifting.

Our analysis confirms that CbCR data need to be interpreted with some caution, as reporting across MNEs is not uniform and tax risk indicators may be biased by dividends or profits of equity-accounted entities. However, it seems that MNEs voluntarily publishing CbCRs are aware of these risks as they seem to completely avoid the double-counting of profits in the form of dividends, and some even correct for profits of associates and joint ventures. For those who do not, we find that correction for associates and joint ventures mostly leads to gradual adjustments of aggregate risk indicators, while individual adjustments at company and country level may be more important. Even if those problems can be avoided as the reporting standard improves, conceptual gaps between financial profits and taxable profits remain. While loss carryover can to some extent be addressed by averaging observations over several years, a certain degree of uncertainty with regard to ETRs seems to be unavoidable as long as MNEs' tax accounts are kept confidential. Some MNEs provide additional qualitative information to explain low tax payments in individual countries but the data does not allow for a systematic correction of the calculated ETRs by country. Nevertheless, the voluntary publishing of CbCRs may in itself be regarded as a major step towards greater transparency.

The early publishers of CbCR, which we analyse in this paper, generally seem to score low on typical tax risk indicators. Most of the sample MNEs report comparably low profits in tax havens, moderate to high global ETRs and high-risk functions in tax havens. We also find some degree of correlation between the location of profits and ETRs, but the correlation coefficient seems exceptionally low compared to other studies when controlling for covariates and not robust across specifications. As some tax risk indicators vary substantially between MNEs, we provide a tentative assessment of overall tax aggressiveness by company and find that only one company fulfils three out of five criteria completely.

We cannot conclude that our sample MNEs shift less profits than the global average even if several indicators point into this direction. The comparably high global ETRs may also be explained by high resource taxes applicable in the extractive industries, which are overrepresented in our sample. Sectoral benchmark ETRs might thus improve the operationalization of this tax risk indicator. High ETRs may also be the result of the correct

accounting of dividends and adjustments for associate and joint venture profits, which may distinguish our sample from the average MNE included in aggregate CbCR data or other CbCR datasets used in profit shifting analyses. To draw a more reliable conclusions, further analyses of more CbCRs and from different economic sectors are needed. This will likely become possible in the coming years given that an increasing number of MNEs are voluntarily deciding to publish such data and EU-wide public CbCR will become mandatory in 2024.

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A1. Tables

Table A1: Regression output – robustness checks

	STATUTORY TAX RATE							
DEPENDENT VARIABLE: LN(PROFITS)	direct affiliates only		non-winsorized		sub-period 2000–2016		investor or ultimate owner clusters	
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
	baseline	interaction	baseline	interaction	baseline	interaction	baseline	interaction
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
TAX RATE	0.031**	-0.018	0.040***	0.001	0.036***	-0.001	0.035***	-0.001
	(0.011)	(0.012)	(0.008)	(0.017)	(0.007)	(0.017)	(0.009)	(0.015)
INTERACTION		0.041*		0.057*		0.054*		0.052**
		(0.018)		(0.026)		(0.025)		(0.018)
LN(EMPLOYEES)	0.012	-0.074***	0.029**	0.028*	0.031*	0.031*	0.030	0.029
	(0.018)	(0.020)	(0.011)	(0.011)	(0.012)	(0.012)	(0.019)	(0.019)
LN(TURNOVER)	0.071***	0.186***	0.045**	0.045**	0.036**	0.037**	0.051***	0.051***
	(0.014)	(0.018)	(0.015)	(0.015)	(0.012)	(0.012)	(0.012)	(0.012)
LN(ASSETS)	0.045***	-0.035	0.001	0.001	0.001	0.000	0.034*	0.034*
	(0.011)	(0.031)	(0.012)	(0.012)	(0.011)	(0.011)	(0.014)	(0.014)
LIABILITY RATIO	-0.025***	-0.123***					-0.056***	-0.056***
	(0.004)	(0.005)					(0.003)	(0.003)
SWITCH_10			-8.508***	-8.505***	-8.298***	-8.297***	-8.171***	-8.168***
			(0.406)	(0.405)	(0.424)	(0.423)	(0.305)	(0.304)
SWITCH_01			5.580***	5.608***	5.285***	5.311***	5.435***	5.461***
			(0.826)	(0.826)	(0.868)	(0.869)	(0.434)	(0.434)
N	52,339	61,183	89,897	89,897	80,630	80,630	89,897	89897

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. All regressions include robust standard errors clustered at affiliate and country level with the exception of regressions (27) and (28) where standard errors are clustered at affiliate level and at the level of the investor company or, when available, the ultimate owner company. Small constants were added before logarithmizing to avoid losing zero observations. Liability ratios and log profits were winsorized at the 5th and 95th percentiles to avoid the effect of outliers. Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, own calculations.

Table A2: Regression output – robustness checks tax attractiveness index

	TAX ATTRACTIVENESS INDEX				
DEPENDENT VARIABLE: LN(PROFITS)	non-winsorized		industry clusters		investor or ultimate owner clusters
	(29)	(30)	(31)	(32)	(33)
	baseline	Haven	baseline	haven	baseline
	b/se	b/se	b/se	b/se	b/se
TAX INDEX	-1.861**	-2.028**	-2.509+	-2.690	-1.805*
	(0.567)	(0.584)	(1.382)	(1.608)	(0.819)
LN(EMPLOYEES)	-0.022	-0.041+	-0.023	-0.049	-0.017
	(0.017)	(0.020)	(0.024)	(0.031)	(0.024)
LN(TURNOVER)	0.048**	0.061*	0.048***	0.061***	0.048*
	(0.017)	(0.024)	(0.013)	(0.011)	(0.018)
LN(ASSETS)	0.030*	0.020	0.010	-0.004	0.035+
	(0.012)	(0.017)	(0.016)	(0.028)	(0.019)
LIABILITY RATIO	-0.016***	-0.015*			-0.025***
	(0.004)	(0.007)			(0.005)
N	34,636	16,505	30,661	14,734	34,636

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. Regressions (29) and (30) include robust standard errors clustered at affiliate and country level. In regressions (31) and (32) standard errors are clustered at affiliate and industry level. In regression (33) standard errors are clustered at affiliate level and the level of the investor company or, when available, the ultimate owner company. Small constants were added before logarithmizing to avoid losing zero observations. Liability ratios and log profits were winsorized at the 5th and 95th percentiles to avoid the effect of outliers. Source: Research Data and Service Centre of Deutsche Bundesbank, Microdatabase Direct Investment (MiDi) 1999–2017, own calculations.

Table A3: Sample based on ETR

PARENT COMPANIES

	parent observations by year	average profits in million EUR	average number of employees persons	average assets in million EUR	average turnover in million EUR
2011-2015	1230	52	1100	90	613

FOREIGN AFFILIATES

	affiliate observations per year	average profits in million EUR	average number of employees persons	average assets in million EUR	average turnover in million EUR
2011-2015	4784	11	274	24	120

Source: MiDi, JANIS, based on own calculations

Table A4: German MNCs' global distribution of profits and economic activity, 2011-2015, based on effective tax rates

Country	observations	share of profits	share of employees	share of assets	share of turnover	share of activity CCCTB
Germany (parent companies)	6152	55.12	50.76	48.88	56.80	52.14
China	2145	13.33	8.20	9.60	9.05	8.95
France	1839	1.14	1.82	1.75	2.47	2.01
United Kingdom	1644	2.91	2.10	4.17	4.35	3.54
Austria	1551	1.75	1.83	2.13	1.70	1.89
Netherlands	1300	5.27	1.31	1.45	1.26	1.34
Switzerland	1185	1.98	1.27	2.53	2.07	1.95
Czech Republic	1155	1.28	3.10	2.78	1.57	2.48
Poland	1135	0.73	2.11	1.64	1.23	1.66
Italy	1096	0.55	0.93	1.07	1.54	1.18
Spain	980	0.88	1.60	1.64	1.62	1.62
Hungary	592	1.31	1.96	2.35	1.21	1.84
Belgium	566	0.50	0.61	1.30	0.88	0.93
Sweden	565	0.87	1.06	1.39	0.75	1.07
India	557	0.57	2.56	0.74	0.61	1.30
Russia	553	2.03	3.33	2.38	2.02	2.58
Singapore	476	0.46	0.47	0.84	0.96	0.76
Japan	439	1.55	2.75	3.13	2.77	2.89
Mexico	427	0.49	1.67	1.37	1.04	1.36
Australia	422	0.84	0.34	0.69	0.59	0.54
Romania	405	0.20	1.65	0.49	0.33	0.82
Turkey	371	0.58	1.29	0.94	0.66	0.96
Brazil	363	0.57	1.21	0.57	0.56	0.78
Slovakia	336	0.25	1.04	0.77	0.71	0.84
Korea, Republic of	323	0.40	0.26	0.61	0.50	0.46
Denmark	319	0.21	0.20	0.37	0.25	0.27
Portugal	288	0.37	0.55	0.34	0.37	0.42
Thailand	220	0.22	0.27	0.21	0.21	0.23
Finland	192	0.14	0.10	0.13	0.10	0.11
Luxembourg	189	0.64	0.13	0.11	0.08	0.11
Slovenia	162	0.12	0.29	0.21	0.15	0.22
Taiwan	162	0.16	0.16	0.21	0.19	0.19
Norway	158	0.20	0.09	0.18	0.11	0.13
Argentina	157	0.25	0.30	0.11	0.18	0.20
Bulgaria	137	0.10	0.33	0.23	0.09	0.21
Croatia	134	0.06	0.16	0.20	0.07	0.14
Chile	117	0.08	0.14	0.10	0.07	0.10
Ukraine	99	0.07	0.42	0.07	0.06	0.18
Philippines	70	0.03	0.11	0.05	0.03	0.06
Latvia	67	0.01	0.06	0.04	0.02	0.04
Lithuania	66	0.02	0.04	0.03	0.02	0.03
Colombia	57	0.04	0.10	0.10	0.07	0.09
RoW tax havens	335	1.39	0.25	1.50	0.36	0.71
Rest of World	566	0.31	1.07	0.63	0.32	0.68

Source: MiDi, JANIS, Janský (2019), own calculations

Table A5: Regressions with alternative tax rate variables

	(1)	(2)	(3)	(4)
	linear	quadratic	linear	quadratic
	b/se	b/se	b/se	b/se
NCTR	-0.010	-0.114		
	(0.019)	(0.088)		
NCTR²		0.002		
		(0.002)		
ETR_OECD			-0.016	-0.050+
			(0.013)	(0.028)
ETR_OECD²				0.001
				(0.000)
LN_EMPLOYEES	0.561***	0.559***	0.570***	0.574***
	(0.101)	(0.102)	(0.099)	(0.099)
LN_ASSETS	0.256***	0.259***	0.246***	0.240**
	(0.075)	(0.075)	(0.073)	(0.073)
LN_GDP_PC	0.405*	0.408*	0.413*	0.394*
	(0.193)	(0.192)	(0.191)	(0.191)
LN_POPULATION	-0.155+	-0.147+	-0.165+	-0.131
	(0.090)	(0.084)	(0.088)	(0.089)
RESOURCE RENT IN GDP	0.478	0.547+	0.548+	0.578+
	(0.290)	(0.285)	(0.304)	(0.305)
RULE OF LAW	-0.009	-0.008	-0.012	-0.010
	(0.008)	(0.008)	(0.008)	(0.008)
R2	0.659	0.663	0.662	0.665
R2_A	0.635	0.638	0.639	0.640
N	249	249	247	247

+ P<0.10, * P<0.05, ** P<0.01, *** P<0.001

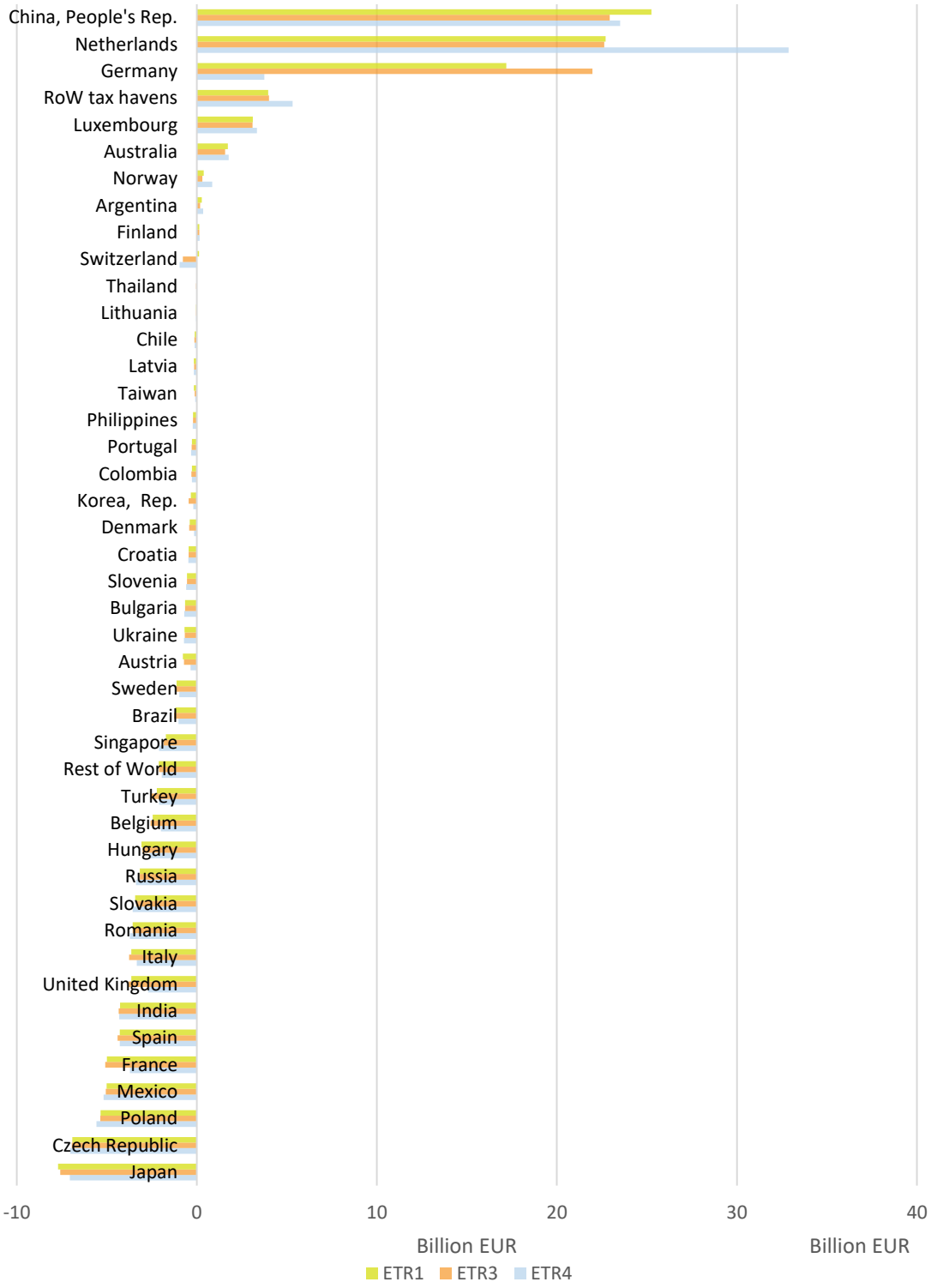
Table A6: Regressions by multinational group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Anglo American	BP	ENI	Iberdrola	NN	Repsol	Rio Tinto	Shell	Telefonica	Vodafone
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
ETR	-0.01	-0.05	0.05+	-0.18	0.01	0.10*	-0.03	-0.04	-0.09	-0.13
	(0.05)	(0.04)	(0.03)	(0.17)	(0.06)	(0.02)	(0.04)	(0.04)	(0.11)	(0.11)
ETR2	-0.00	0.00+	-0.00	0.01	-0.00	-0.00+	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LN_EMP	0.05	0.39+	0.17	0.72***	0.14	-0.02	0.90***	0.83***	1.37	0.62
	(0.64)	(0.20)	(0.24)	(0.13)	(0.17)	(0.16)	(0.18)	(0.19)	(1.12)	(0.38)
LN_ASSETS	0.84*	0.31***	0.54**	0.05	0.51**	0.54**	0.12	0.08	-0.55	0.12
	(0.37)	(0.08)	(0.17)	(0.13)	(0.12)	(0.11)	(0.09)	(0.08)	(0.67)	(0.37)
LN_GDP_PC	0.35	0.02	0.34	-0.10	0.99**	0.05	0.86**	0.67*	0.58	0.30
	(0.33)	(0.22)	(0.23)	(0.23)	(0.26)	(0.25)	(0.26)	(0.30)	(0.84)	(0.46)
LN_POPULATION	-0.51	0.11	0.06	-0.13	0.09	-0.41	-0.11	-0.42	-0.25	0.52
	(0.39)	(0.14)	(0.24)	(0.23)	(0.10)	(0.39)	(0.14)	(0.29)	(1.00)	(0.31)
RESOURCE RENT IN GDP	0.53	-0.12	0.31	-2.17*	0.00	-1.15	0.02	1.28+	0.33	0.83
	(0.57)	(0.63)	(0.58)	(0.94)	(.)	(0.86)	(0.67)	(0.65)	(0.87)	(1.26)
R2	0.91	0.77	0.80	0.95	0.86	0.94	0.91	0.52	0.78	0.69
R2_A	0.85	0.73	0.73	0.91	0.79	0.83	0.85	0.44	0.00	0.58
N	18	46	30	17	19	12	20	50	10	27

+ P<0.10, * P<0.05, ** P<0.01, *** P<0.001

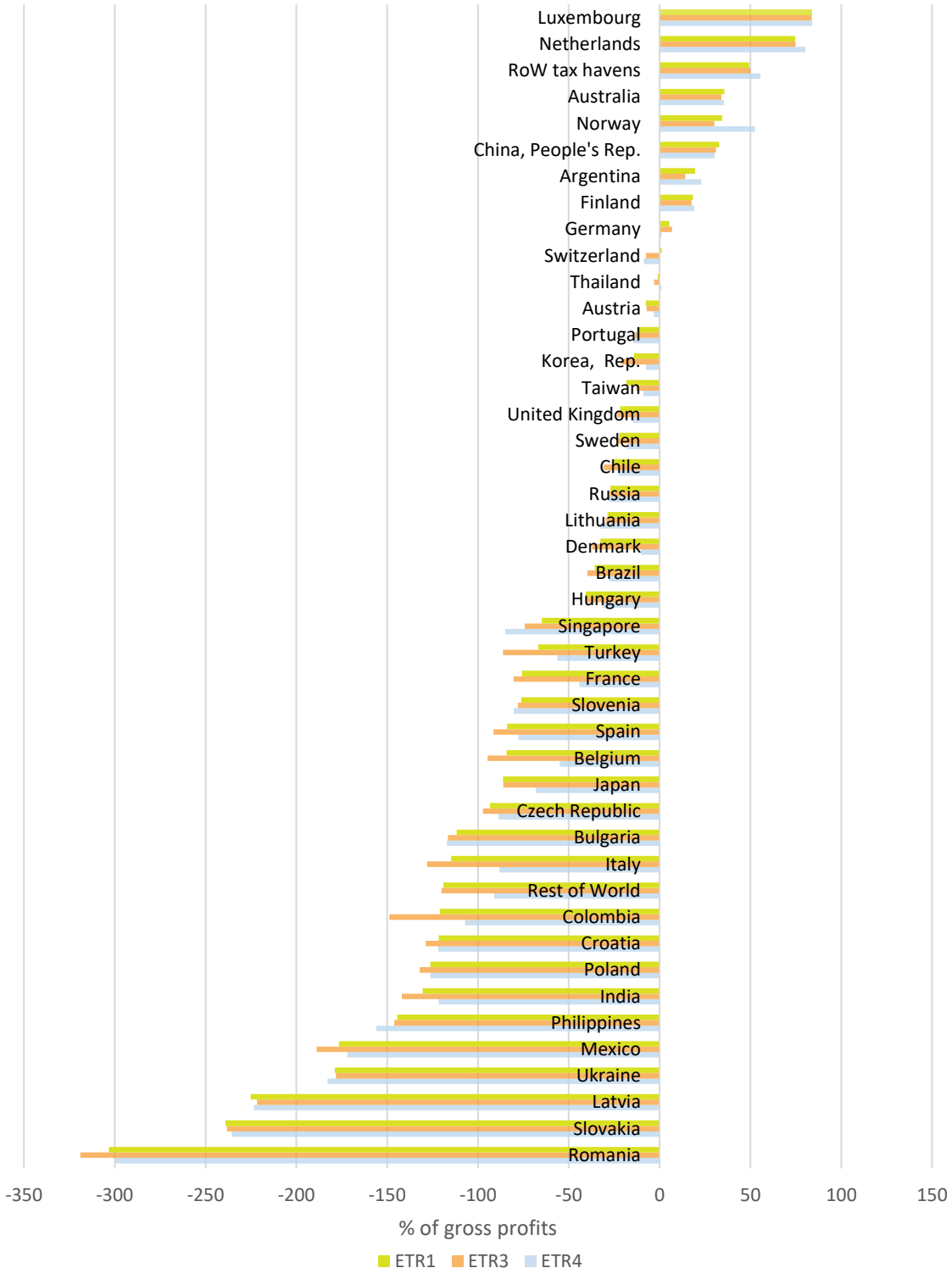
A2. Figures

Figure A1: Excess profits and missing profits in bn. EUR, based on ETR, 2011-2015



Source: MiDi, JANIS, Janský (2019), García-Bernardo et al. (2020), own calculations

Figure A2: Excess profits and missing profits in % of gross profits, based on ETR, 2011-2015



Source: MiDi, JANIS, Janský (2019), García-Bernardo et al. (2020), own calculations

Figure A3: Absolute profits by tax haven

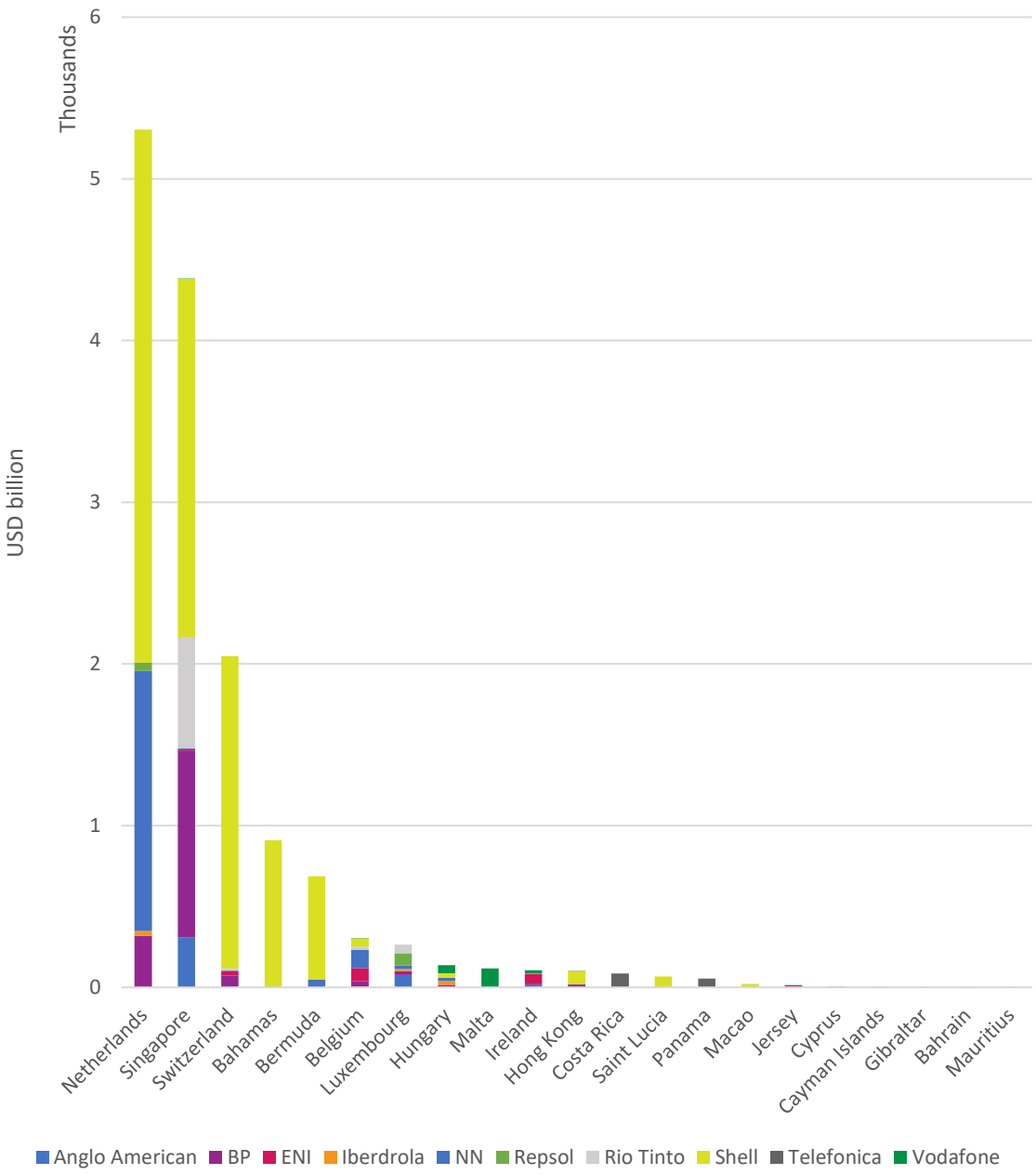
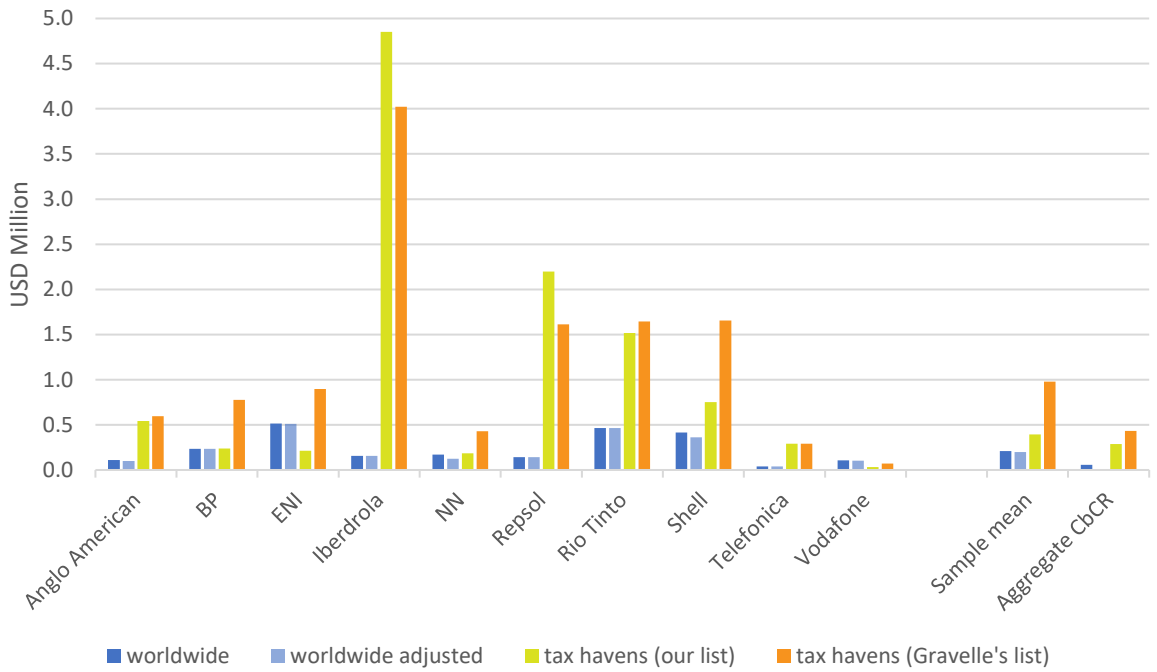
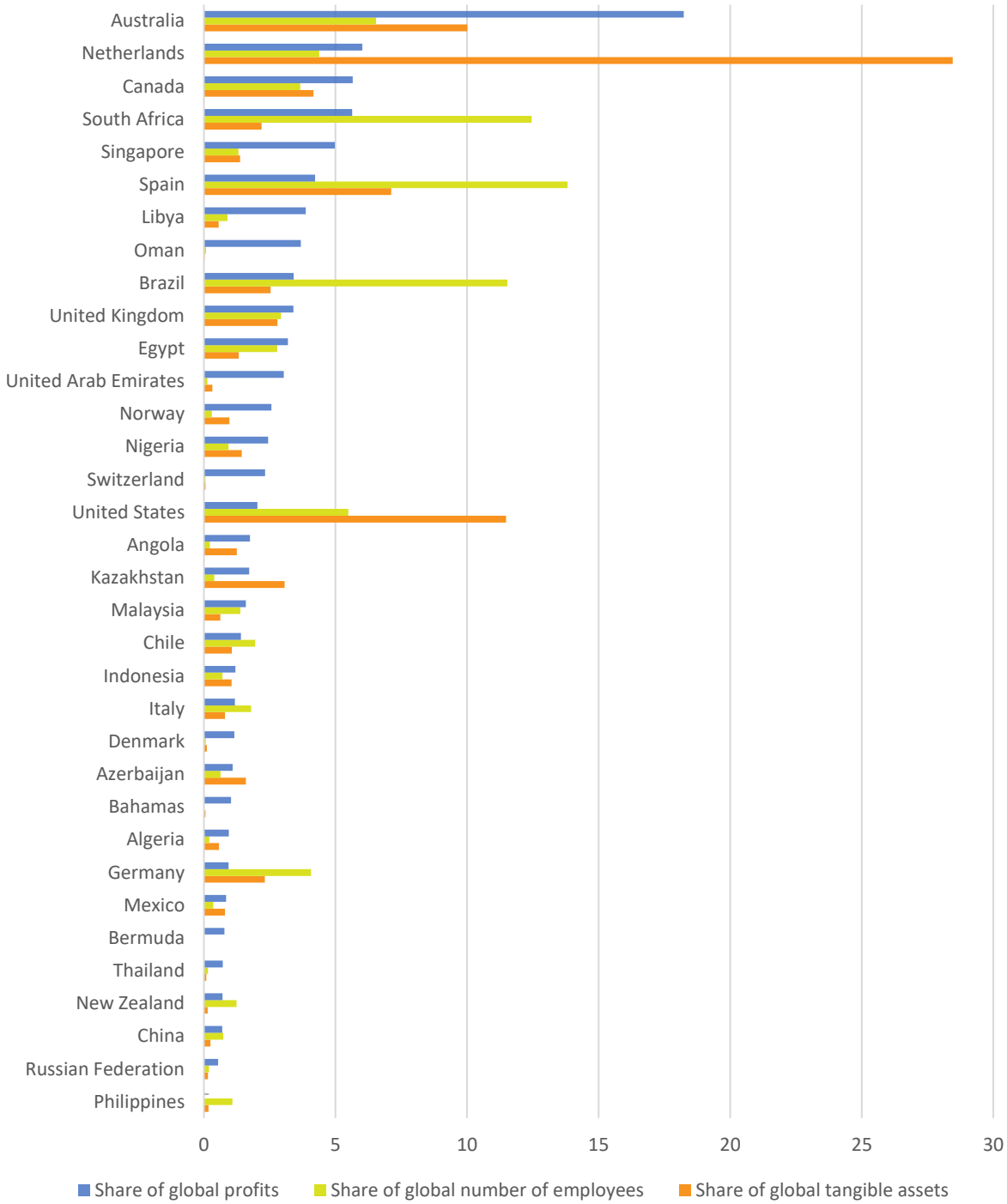


Figure A4: Profit per employee worldwide and in tax havens



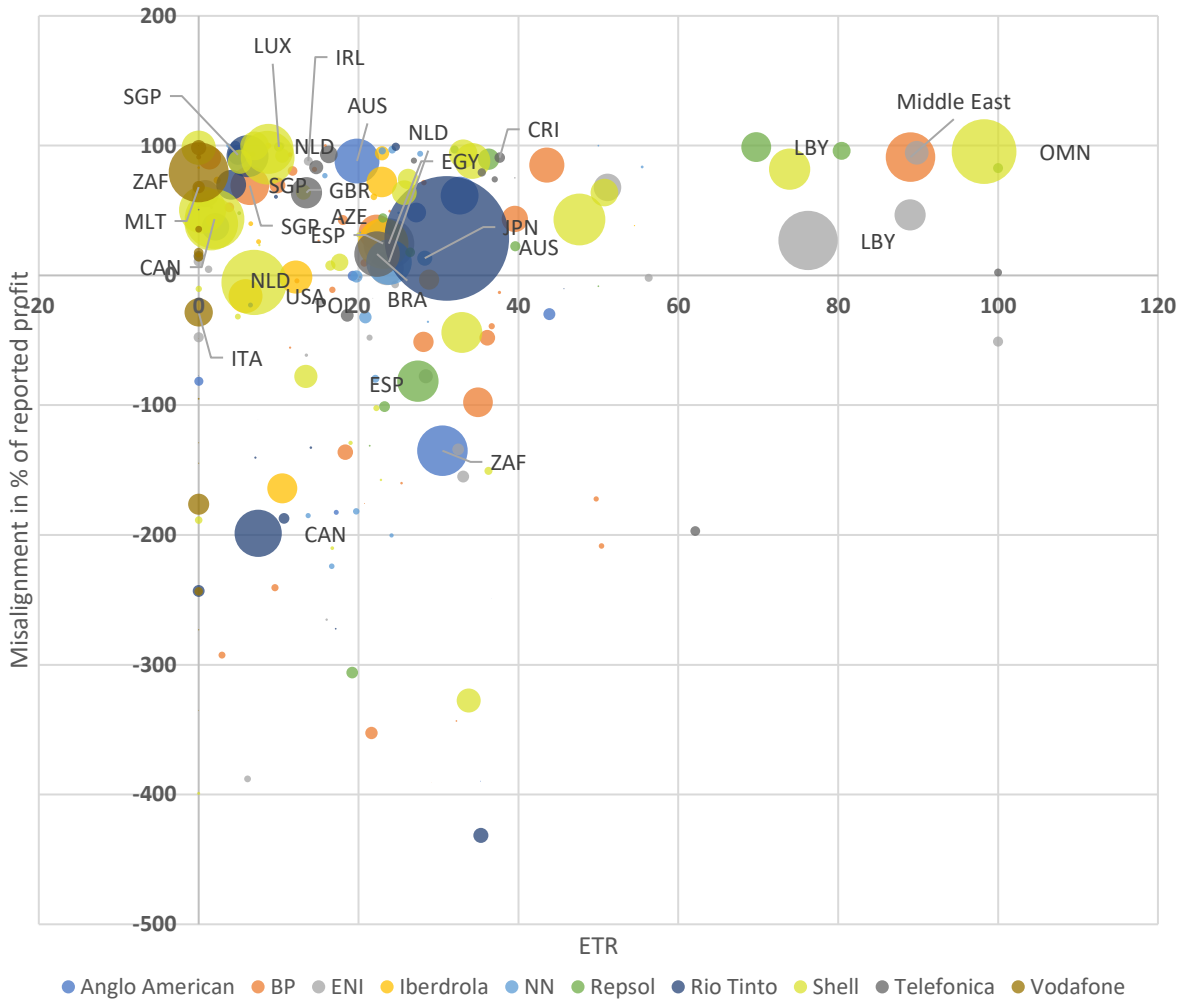
Note: Average profits per employee are USD 0.2 million worldwide but USD 0.4 million in tax havens: profitability per employee is 2 times higher in tax havens than the worldwide average or even 5 times higher if we use Gravelle's tax haven list. We identify the largest discrepancy between worldwide and tax haven profits per employee for Iberdola and Repsol. The extreme value by Iberdrola is mainly caused by its Cyprus location where it reports USD 3 million of profit and one employee. In relation to its total profit, these Cyprus profits seem negligible though (see section 4.2.). For BP, ENI, NN, a positive discrepancy between profitability worldwide and in tax havens can only be observed if tax havens are defined according to Gravelle's list, not according to our preferred list. Vodafone's activities seem to be less profitable in tax havens than in the rest of the world.

Figure A5: Shares of global profits and activity by country



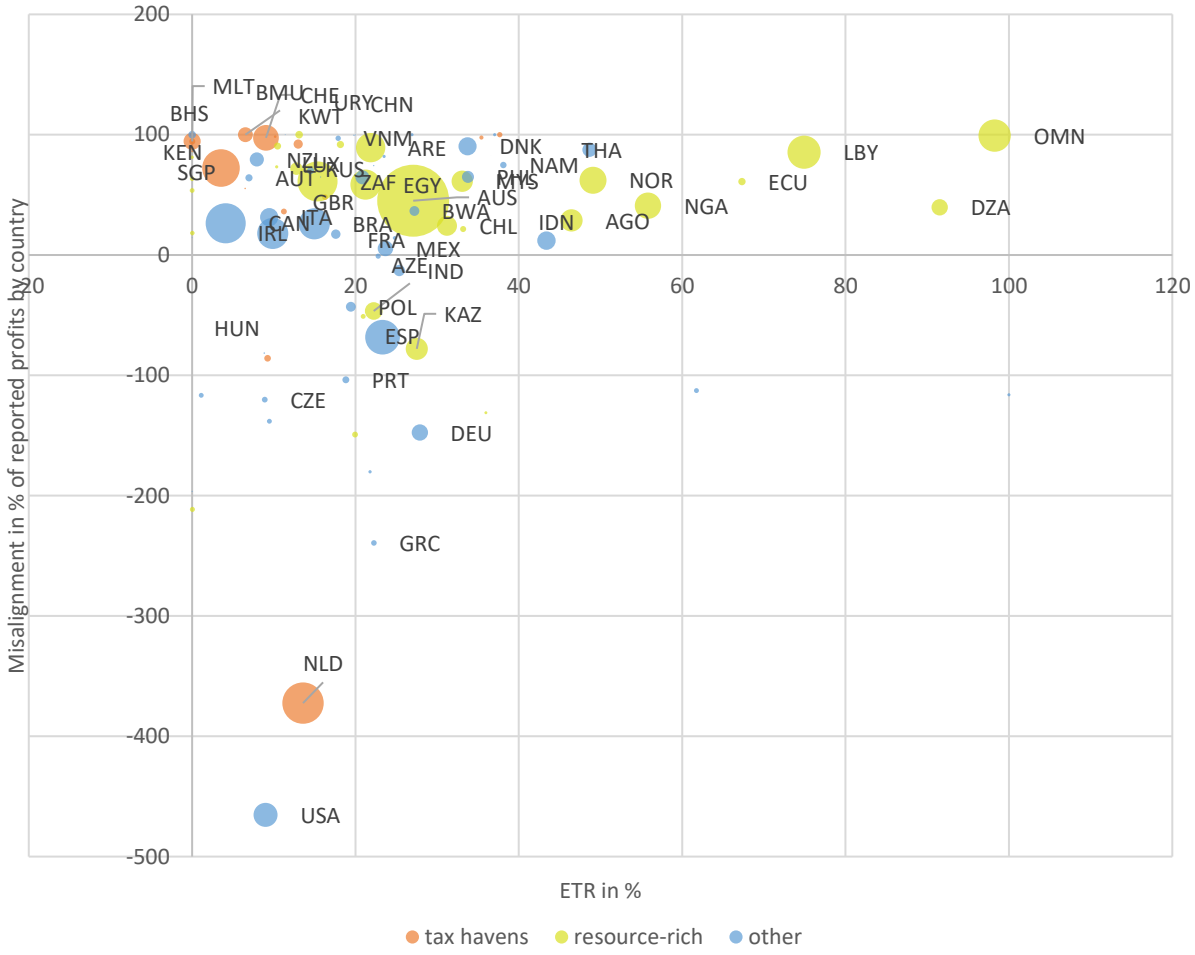
Note: This figure plots each country's share in the sample's total global profits, number of employees and total tangible assets. The figure includes only countries with a share of global profits above 0.5%.

Figure A6: Misalignment and ETR by company and country



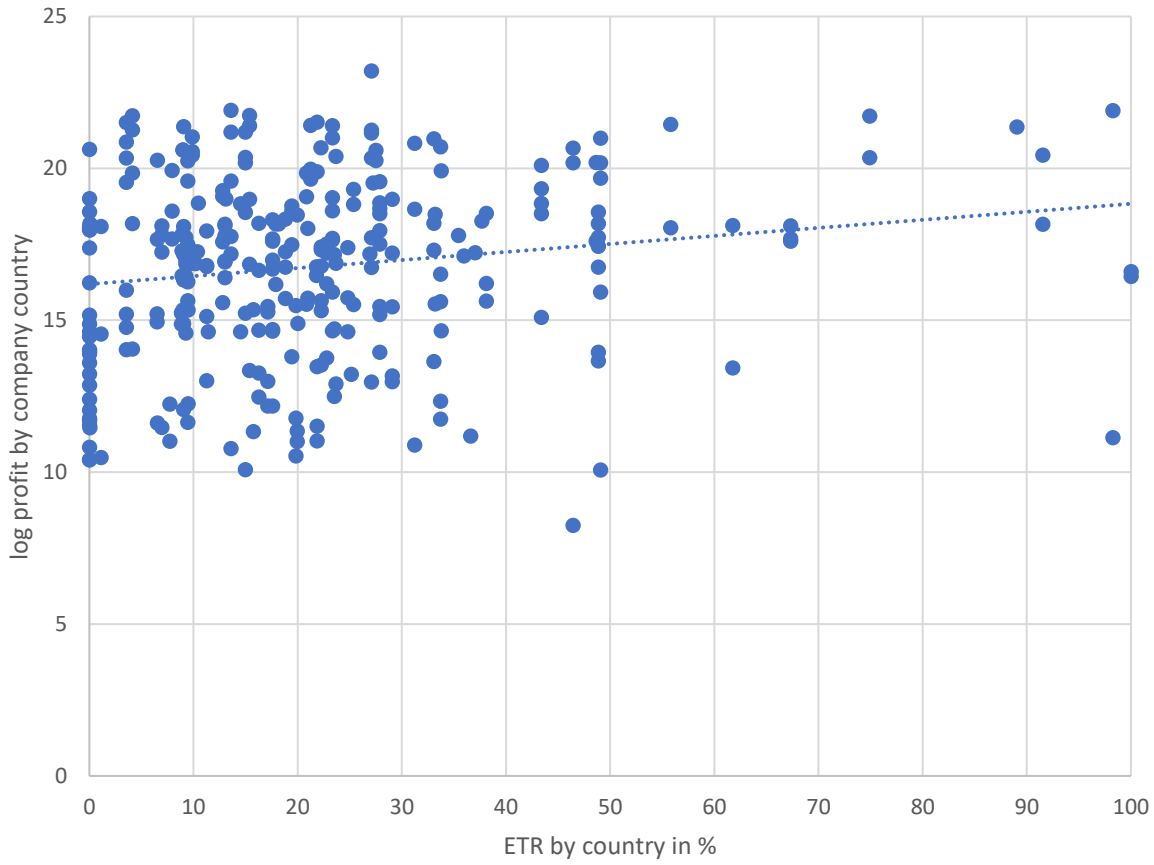
Note: Misalignment based on number of employees. The bubble size represents total reported profits by each company reported in a jurisdiction. BP reports Algeria, Egypt and Libya subsumed under "North Africa". Annotations are displayed for two most important non-havens and tax havens in terms of total reported profit by company.

Figure A7: Misalignment in terms of tangible assets and ETR by country



Note: Misalignment based on the value of tangible assets. The bubble size indicates total profits reported by the sample MNEs in each jurisdiction. Annotations are displayed for two most important non-havens and tax havens in terms of total reported profit by company.

Figure A8: Log profits and effective tax rates



Note: The figure plots log profits by company country and ETR by country as used in the regressions in Section 3.4.5.

A3. Responses to reviewers' comments

Reply to reviewers' comments I

Reviewer: Arjan Lejour

Comments are discussed chronologically. The original comments by the reviewer are pasted in italics, replies are in blue.

a) *"Here I want to discriminate the contributions of the various chapters to the academic literature and the contributions of the author. Starting with the latter, chapters 2 and 3 are joint work of which chapter 3 is even a product of four authors. Because chapter 2 is joint work with the supervisor, I am confident that the Phd candidate has made a large and probably the most substantial contribution to the chapter. Regarding the last chapter I cannot judge. This is not necessarily a problem, but I am also not satisfied with the quality of that chapter."*

Yes, I have made the most substantial contribution to the chapter 2. I have been the lead author on most aspects of the third paper including empirical analysis and drafting, and even more so for the most recent, substantially revised version (see comments to chapter 3).

"Regarding original contributions to the economic literature, this is for sure the case with the first chapter. Although the database with firm level data of German multinationals is often explored, the candidate answers an original research question using statistical and econometric techniques. The candidate uses the same database in chapter 2 and addresses an original question. However, the methods are not very sophisticated, and the analysis and the results are mainly descriptive. The research question in chapter 3 is original regarding the use of public CBCR data of individual firms but are the number of observations is too little and not representative for conducting high-quality research in my view."

I agree that the analysis and results of chapter 2 are purely descriptive. In general I think that descriptive economic analysis can be a valuable contribution, and even more so if based on an original dataset. The second paper combined data of German headquarters and their foreign affiliates at a time when German country-by-country reporting was not yet accessible and most of the profit shifting literature at macro level referred to foreign affiliates only or U.S. MNEs. I agree that further covariates could have improved the analysis. I have thus added a section 2.7. "Are misaligned profits shifted profits?" to the chapter, where I discuss the lack of identification and potential biases due to omitted covariates at country-level. In my reply to comment c) I also explain why I do not apply more sophisticated statistic methods to the data.

With regard to chapter 3, I agree that the dataset is too small to carry out a meaningful quantitative analysis. For this reason, we have adapted the research question and methodology to make it more suitable for the sample and to make better use of the available information (more details in my response to comment c).

c) *"No, I do not think so. The thesis is promising, but the quality of the thesis originates mainly depends on the first chapter. In my view that is too meagre for a PhD thesis. The introduction and chapters 2 and 3 are not very critical to the methods and firm level data applied. The data and the methods have*

their limitations, and I would expect that the candidate would discuss these more extensively in the thesis (in the general introduction or in the relevant chapters). I also miss a motivation why these methods and data are used despite their limitations. I do not say that these data and methods should not be used, but the candidate should also point out to the weaknesses in order to assess the conclusions of her research.

To become more specific: chapters 2 and 3 use a method of determining misaligned profits by relating this to economic activity to the multinationals in various countries. This method is taken from Cobham and Janský (2019) without much discussion. The method is closely related to formula apportionment rules and has its merits in its simplicity. The method more or less assumes that the global profits of a multinational firm should be related to the distribution of employment, assets and sales over the jurisdictions. However, firms optimise the production processes over countries, based on the prices of the production factors and intensity of these factors in the production factors. This suggests that employment and assets in these various countries will be related to the production value chain of the multinational. This could also explain the location of profits to some extent. I would like to see more discussion on these methods and the relation to the global value chain of the multinationals and I would even see alternatives to be discussed in the thesis."

The reviewer makes a valid point on the limitations of the misalignment approach. In response to the comments, I have now added a new section to the second chapter ("2.7 Are misaligned profits shifted profits?") where I add additional co-variates at country-level and discuss their potential contribution to the unexplained residual of "misaligned profits" a bit further. These co-variates include GDP per capita or average wage, population, and the share of high-tech exports in total exports. I show that for some countries, the residual profits are quite sensitive to the model specification but for the majority of countries adjustments are more gradual. I add some comments on potential unobserved covariates. I illustrate that misalignment correlates with effective tax rates but state clearly that the descriptive framework does not allow for an identification of profit shifting. I do not apply a more sophisticated statistical methods to the data for the following reasons:

- **Data limitations**: The MiDi data includes only post-tax profits of the foreign affiliates, pretax profits were proxied applying statutory and (external) effective tax rates. The standard explanatory variable in profit-shifting research could thus not be applied in a meaningful way as there is likely a problem of endogeneity (Weichenrieder 2009). Second, as the JANIS database is based on non-obligatory reporting by financial institutions, companies appear and drop out quickly so that a panel regression with company-level fixed effects would have been limited to a relatively small sub-sample.
- **Research interest and availability of CbCR data**: The main purpose of the second chapter was to explore the location of profits by Germany-based MNEs and indication of profit shifting out of German headquarters (of which we do not find much). Maybe the research question could have been more ambitious. However, I think that general research progress has made a fundamental revision based on MiDi data a bit obsolete given that German CbCR data (aggregate and micro-level) has become available in the meantime. These data are much more suitable for this type of analysis and have already been analysed by Fuest et al. (2022).
- **Upper bound vs. lower bound estimates**: Most profit economic profit-shifting analysis today insists on exploiting only within-country or within-firm variation of tax incentives for the identification of profit shifting. While the control of constant unobserved country or firm characteristics in fixed effects models is scientifically sounder, it leads to an underestimation of

profit shifting as it ignores profit-shifting at the beginning of the sample period (I discuss this also in chapter 1 where I apply this kind of method). I think that identifying profit shifting with statutory tax rates makes estimates even more conservative as statutory rates correlate only weakly with actual tax profit shifting incentives. Time series of backward-looking ETRs cannot be produced from the MiDi dataset and are not available elsewhere. A cross-sectional correlation of misaligned profits and ETRs as I illustrate in the new discussion chapter would hardly convince any economist as a suitable identification. I therefore admit that the second chapter is descriptive. The misaligned profits may still be interpreted as an upper bound of profit shifting. It is comparably low for German headquarters, which I find a modest, but valuable contribution to the literature.

- **Limited data access**: The JANIS database is only accessible on site at the research centers of the Bundesbank in Frankfurt, Munich, and Duesseldorf. Export of descriptive statistics is extremely constrained for confidentiality reasons which is why key statistics could only be exported for large countries or country groups and period averages. I think the likelihood of obtaining much more convincing results given the above-mentioned limitations is small relative to the time and effort which a renewed application for data access and additional research stays at Frankfurt would require.

The doubts about the misalignment approach refer also to the third chapter which I have fundamentally revised (see more details in the reply to the next paragraph).

"Second, I like the attempt to use public CBCR data in chapter 3, but it is only data of ten multinationals, mainly in the extractive industries. I know it was and is very hard to obtain these data and have respect for the effort, but this makes it very hard to do a meaningful analysis. In my view the outcomes show that there is hardly any corporate tax avoidance, at least it is not proved in the paper. There are more reasons to argue that there is no corporate tax avoidance than there is. In most regressions the relevant coefficients are not or hardly significant. Although the candidate describes the weaknesses of the data, the analysis and reasoning are less rigorous in taking account of these weaknesses. The high ETRs are driven by the high profit taxes in the extractive industries. Sometimes the candidate seems to be aware of this (and it is also mentioned but this is not done consistently. It is suggested that multinationals that publish these data voluntarily have higher tax rates than those not. If this is purely driven by the high tax rates in the extractive industries, the question is whether this outcome is determined by voluntarily publication. Table 13 at page 76 already points to a serious positive correlation between ETRs and resource rich countries. In my view this suggestion cannot be underpinned and is an example that the analysis and writing should be more rigorous in this chapter."

The third paper has been fundamentally revised in terms of methodology and research question. I share the concern of the reviewer that the small sample size impedes a meaningful econometric analysis. Still, I find that this new and unique data is worth of scientific analysis. Improvements of the revised version include:

- A slightly better sample: Exclusion of AXA and BT Group which did not report proper CbCR data; inclusion of BP and Telefonica and more years for each company as more CbCR data has become available.
- Comparison of micro CbCR to consolidated accounts and aggregate CbCR to illustrate benefits and shortcomings of CbCR, including an assessment of double-counting of dividends (section 3.3.1.) and associate and joint venture profits (section 3.3.2.)

- An analysis of individual MNEs' functions in tax havens to make better use of the qualitative information included in micro CbCR
- Discussion of results by company to better account for heterogeneity in the sample
- I have rewritten the whole chapter from scratch, which is also reflected in a new structure and several new analytical sections

"It is also not clear why the data of individual multinationals are compared to the aggregated CBCR data published by the OECD. In general, these data also have their limitations also addressed in OECD publications and could have doubt whether these are representative. For instance, various reporting OECD countries aggregate the CBCR data over many foreign jurisdictions so that tax havens cannot be discriminated. In the 2016 data dividends from daughter companies are often double reported (by the parent and daughter company). Moreover, the amount of accrued taxes in a jurisdiction could be affected by carry forward and backward rules on subtracting losses from profits in other years. These kinds of issues should be discussed more extensively in the chapter. Why are these public CBCR data of ten multinationals not compared to CBCR data on individual financial institutions for example? The research design should be improved despite the inherent difficulties."

The comparison to aggregate OECD data has now been limited to illustrate potential differences between the sample and the population of MNEs falling under the CbCR standard (e.g. share of profits in tax havens, worldwide ETR). A sub-section of section 3.3 is now entirely dedicated to the discussion of double-reporting of profits by parents and affiliates which MNEs voluntarily publishing CbCR seem to consciously avoid. We further illustrate the role of associate and joint venture profits (section 3.3.2.) which are also a known limitation of CbCR data.

The data has not been compared to banks' CbCR as the research interest lies in non-financial firms and the value added of new data which adheres to a stricter reporting standard than the transparency requirements for EU banks. Instead we combine the CbCR data with information from consolidated financial accounts to assess potential limitations of the data.

"Moreover, Chapter two is mainly descriptive and is coping a method of another article on another data base. This is fine, but I miss a new twist, e.g., an econometric analysis at the country level to explain the location of profits over the various countries."

See discussion above and new discussion section in chapter 2.

"Another issue is that the role and purpose of the introduction is not very clear. It is to some extent a summary and a reading guide. It also tries to give some overview of the literature, but very briefly. Because all chapters use firm level data of multinationals and use similar methods, I would like to have seen an overview chapter. Starting from the empirical literature on corporate tax avoidance, I would have expected an extensive discussion on the empirical estimates and the use of macro and firm level data, with their advantages and disadvantages. Subsequently, I expect a critical discussion on the methods of estimating tax avoidance and in the end a discussion on the contribution of the thesis in the general literature. I would be interested in the views of the candidate on her contribution to the literature. I realize this is a matter of preference and may be not a requirement of your university."

The first paper includes a systematic review of literature on tax revenues losses for Germany due to profit shifting. Despite the focus on Germany, I briefly discuss general advantages and disadvantages

of the approaches and highlight the main advantage of firm-level data: the ability to control for unobserved firm characteristics in regressions. This advantage is, unfortunately, not utilized in the second paper mainly for the reasons explained above.

I agree that a more critical discussion of the limitations of the misalignment approach would improve the thesis. For this reason, I have added section 2.7. as described above. In the third paper, the misalignment approach has been downgraded to a sub-section in the tax risk indicators, the limitations of which are flagged more clearly in the conclusion of the paper.

The introduction has been adapted a bit to account for the changes in chapter 2 and 3 and to highlight the contributions to the literature a bit more. I am reluctant to prolong the introduction much more, as it is not very common at Charles University to have much longer introductions and would create several overlaps with the introductions of the individual chapters.

d) *"The results of the first chapter are already accepted for publication in Finanz Archiv. As said before, this is in my view the best and high-quality chapter. The other two chapters are not publishable in respected peer reviewed economic journals at this moment. For me it is not important that both chapters should be publishable in this stage, but I would expect that one of these chapters (2 or 3) would be potentially publishable."*

The substantial revision of the third paper was partly inspired by critical comments by an anonymous reviewer of a journal which partly overlap with the comments by the thesis reviewer. I am thus confident that the revised version of the paper will have a better chance to be published in a peer-reviewed journal.

e) I already discussed my main points above. I include a list of minor points at the end of this report, which could be beneficial for the candidate.

(see below)

f) "In my view (b) the thesis can be defended after a revision indicated in line with my comments. Now the quality of chapters 2 and 3 and the introduction does not meet my quality criteria related to the research design (chapter 3), a criterial approach, the used methods, and the analysis. I have no doubt that the quality of the thesis can be improved. I would propose to write an extensive and critical introduction /overview of the topic, try to make chapter 2 less descriptive by adding more sophisticated statistical methods and to improve the quality of chapter 3."

I have fundamentally revised the third chapter and adapted the methodology to the limitations of a small non-representative sample by giving more weight to a qualitative analysis and by assessing the CbCR data quality in more detail. I have improved the second paper by adding a discussion of potential covariates and by discussing the limitations of the misalignment approach. As a shorter introduction seems to be the common practice at Charles University, I have extended the introduction only a bit, hoping that the other changes and additions in the individual chapters will convince the reviewer sufficiently.

The remaining "minor points" raised by the reviewer:

"P11. I would expect a more extensive discussion of the literature. Why do the results differ in the various papers? The articles cover a period of about two decades. Could the differences in results also be explained by the period, maybe there was in 1999 less profit shifting than in 2015?"

The earliest (Huizinga & Laeven 2008) and the latest estimate (Fuest et al. 2022) produce the lowest profit shifting estimates which speaks against attributing the differences to the time period under study. Instead, I would suggest that most of the variation in results stems from methodological or data choices. Both lower-bound estimates are more restrictive in terms of identification as they use a tax semi-elasticity estimate obtained from micro data to estimate shifted profits and control for industry fixed effects (Huizinga & Laeven) and for multinational group fixed effects (Fuest et al.). Clausing in contrast uses an elasticity estimate based on data aggregated at country level and can thus only control for country fixed effects. As discussed by Dharmapala (2014), the magnitude of profit shifting estimates tends to be lower the more unobserved heterogeneity between countries, industries or firms is taken into account. The comparably low profit-shifting estimate by Fuest et al. might further be explained by sample characteristics: They use only MNEs headquartered in Germany which might shift less profits out of Germany either due to a headquarter bias in profit shifting or because German MNEs generally shift less profits. For example, results by Garcia-Bernardo & Jansky (2021) suggest that MNEs headquartered in the U.S. and in China shift profits more aggressively than others. Another potential explanation might be that headquarter profits in the German CbCR data are biased upwards due to the inclusion of intra-company dividends which would lead to an underestimation of outward profit-shifting.

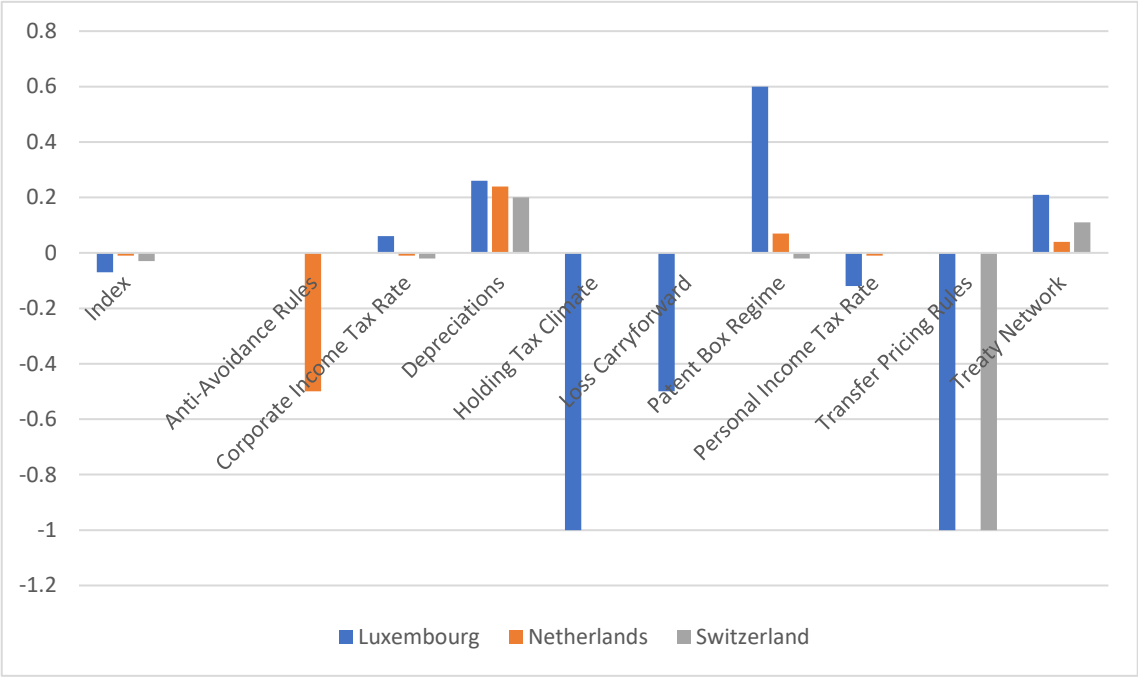
A more aggressive profit shifting behaviour of U.S. MNEs would additionally explain the high profit shifting estimates by Clausing (2016) and Cobham & Jansky (2019) who use BEA data. Cobham and Jansky, Finke, and Tørsløv et al. (2020) are also less restrictive in their identification strategy as they attribute all residual profits which they cannot explain by observable variables to profit shifting.

- *"P15. The tax attractiveness indicator covers many features. Could it also be useful, to use (relevant) parts of the indicator instead of the whole indicator?"*

Depending on the research question, individual components of the index might be used as variation of the components differs from the overall index variation. Figure 1 shows the components that have changed between 2007 and 2018 for the three most important investor countries. While the overall index value hardly changed, depreciation rules became more generous and the treaty network improved in all three countries. Luxembourg lost attractiveness due to the holding tax climate, loss carryforward and transfer pricing rules but gained due to its patent box regime. The Netherlands strengthened anti-avoidance rules which seems to compensate all other improvements in tax attractiveness.[1] Building a customized index concentrating on the features which might make a country an attractive profit-shifting destination (as opposed to being just "tax-attractive" might be an interesting avenue for future research. However, estimates of profit shifting based on variation of these tax incentives over time might still fail to grasp profit shifting that occurs because of time-invariant attractiveness.

[1] No change occurred in CFC rules, EU Membership, Loss Carryback, R&D tax incentives, taxation of capital gains, taxation of dividends received, thin capitalisation rules, withholding tax rates on dividends, interests and royalties, which is why they are omitted from the figure and discussion.

Figure 9: Changes in individual components of the tax attractiveness index, 2007-2018.



- *"P20. You winsorize log profits and the liability ration at 5 and 95%. From the perspective of the data this makes sense. On the other hand, we also know from the literature that the largest multinationals are on average the largest avoiders and this top of evaders determines to a large extent the overall outcome. So, do you not throw away the most interesting outcomes by winsorizing, and why are you doing this?"*

  The purpose of winsorizing the data is to not have the elasticity estimates biased by extreme outliers and I follow the approach by Weichenrieder (2009) here. As a robustness check, I run the preferred regression also without winsorizing which indeed leads to slightly higher tax semi-elasticity estimate with the coefficient of the interaction term increasing from 0.039 to 0.04 (see regression 24 in Appendix table A1). This might be consistent with more profit shifting occurring in the biggest companies but the winsorizing does not seem to have a relevant effect on the average result.

- *"P24 and 26. I would like to have seen the results for the cit rates and the tax attractiveness indicator for the same observations. It is now not very clear why results differ, is it the indicator or the dropped observations."*

  The regression results with the statutory tax rate were also less robust for the post-2006 sub-period so I concluded that the reduced variation of the tax incentive variable over time made the difference in both cases.

- *"P27. table 6. In sample only with tax havens links or also without tax havens links?"*

  The column "sample" indicates on which sample the coefficient estimate is based (full sample or with tax haven links, …). The column "shifted profits, EUR" indicates the amount of shifted profits by

the relevant sub-sample used in the regression and the last column sets this into relation to the total sample's profits. For this reason, the share of shifted profits as % of the whole sample's profits is higher for regression (1) than for regression (2) despite regression (2) yielding a higher coefficient estimate (but only valid for the sub-sample of affiliates with tax haven affiliates).

- *"P42 table 8. Why drops the number of observations so sharply between 2001 and 2002? Why do not start the analysis in 2002?"*

  Reporting requirements of the MiDi database changed between 2001 and 2002: Firms with a balance sheet total of less than EUR 3 million were not required to report anymore. I corrected the sample in the first chapter but in the second chapter I faced the trade-off of either having more matches between MiDi and JANIS or creating a more consistent sample. As the sample was already small and not necessarily representative due to the selection criteria for JANIS, I opted for the first.

- *"References are not always complete. Mis page numbers at Alvarez and wrong page numbers at Dharmapala, 2014 and Gunn. Page numbers start with : or , (which is not consistent)."*
  Yes, thanks for pointing it out. I have corrected the references.

- *"Figures A1 and A2. Half of the country names seems to be missing."*

  Yes, I have corrected the figures.

References:

Clausing, K. (2020b). Five Lessons on Profit Shifting from the US Country by Country Data. *Tax Notes Federal 169*(9): 925-940.

Cobham, A., Janský, P. (2019). Measuring Misalignment: the Location of US Multinationals' Economic Activity versus the Location of their Profits. *Development Policy Review 37*: 91-110.

Fuest, C., Hugger, F., Neumeier, F. (2022). Corporate Profit Shifting and the Role of Tax Havens: Evidence from German Country-By-Country Reporting Data. *Journal of Economic Behavior & Organization 194*(2022): 454-477.

García-Bernardo, J., & Janský, P. (2021). Profit Shifting of Multinational Enterprises Worldwide. ICTD Working Paper 119: 1–72.

Huizinga, H., Laeven, L. (2008). International profit shifting within multinationals: A multi-country perspective. *Journal of Public Economics 92*: 1164-1182.

Tørsløv, T., Wier, L., & Zucman, G. (2020). The Missing Profits of Nations. National Bureau of Economic Research Working Paper 24071, 2018, revised April 2020.

Reply to reviewers' comments II

Reviewer: Alfons Weichenrieder

Comments are discussed chronologically. The original comments by the reviewer are pasted in italics, replies are in blue.

Chapter 1:

"The discussion in section 1.4.2 could have benefitted from a comparison with Mintz and Weichenrieder (2010), who discuss changing patterns of conduit countries for German multinationals."

Yes, I agree. Unfortunately, I was not aware of this analysis based on MiDi data when my article got published. Mintz and Weichenrieder (2010) analyse the development of foreign ownership of Germany-based affiliates through conduit entities between 1989 and 2002. They observe the rise of the Netherlands as most important conduit jurisdiction for German inbound FDI which they relate to the EU parent-subsidiary directive coming into effect in 1992 and a special tax provision adopted by the Netherlands in 1997 which reduced the effective tax rate on foreign interest income. In the section 1.4.2. I analyse the share of affiliates held directly or indirectly by tax haven investors. I do not provide a breakdown by country but I find that the share of EU tax havens has continued to increase since 1999. As pointed out by Mintz and Weichenrieder, many of these entities might indeed be conduit entities as e.g. the Netherlands levy a moderate tax rate on corporate profits. The authors suggest that conduit entities are likely to be used to avoid withholding tax on dividends repatriated to countries for which withholding taxes would apply otherwise. Furthermore, conduit entities can be used by MNEs to achieve double-dip interest deductions: A parent located in a high-tax country makes a loan to a German affiliate routed through a conduit. The interests can be deducted from the German affiliate's profit and are subject to a very low tax rate in the conduit jurisdiction. The conduit entity distributes them back to the parent in the form of dividends. In addition, the parent can take a loan in the home country to finance equity investment in the country and use the interest payments to reduce its own taxable profit at home.

"The empirical analysis in section 1.6 is professionally executed, although a better description of the exact non-German MNE structure that can be observed by the researcher may have been helpful."

Yes, this is a good point as knowing more about the type of investors and the nature of the investment relationships helps interpret the results. For example, the ownership link to tax havens as I define it can refer to a conduit or an ultimate owner. MiDi data includes information on the location of the immediate foreign investor and the ultimate beneficial owner or ultimate controlling institutional unit of a foreign affiliate but sometimes information about the latter is missing. The data does not allow me to observe other parts of the corporate group, e.g. affiliates located in other countries owned by the same investor.

"At the same time, the observation that German affiliates' profit is more sensitive to the parent's tax rate when there is evidence of the parent's use of a tax haven could have been discussed a bit more. In any case, the author avoids causal language here, which is a wise decision."

As MiDi does not contain economic information about the foreign owners such as profits or economic activity, I can only see that profits of companies with ownership-links to tax havens are more sensitive to tax rate changes in investor countries but I cannot see to where profits are actually shifted. As companies can have several owners located in different countries, it might be that companies directly shift profits to the tax haven investor. In this case, I could interpret the higher coefficient of the interaction term as evidence of a non-linear relationship between profits and tax rates: Tax havens remain the most attractive profit-shifting destination even if some non-haven country such as Italy decreases the corporate tax rate or adopts a patent box. However, in principle, the profits might also be shifted to another entity which we cannot observe. The tax-haven link might thus also be interpreted as an imperfect proxy of a multinational group's tax aggressiveness. A group which has established entities in tax havens is more likely to have an aggressive tax planning strategy.

"One limitation that is shared with previous papers using the inbound side of the MiDi data is that affiliated companies other than the ultimate an immediate owner are not observable. The possibility that these other affiliated firms may also be recipients of shifted profits could account for a further downward bias in the estimates."

Yes, I agree that this is a serious shortcoming of the data. Databases such as Orbis might allow to get a more complete picture of the multinational group as affiliates can also be identified. However, in Orbis tax haven affiliates are often missing which might lead to similar problems. I hope that increasing availability of micro CbCR data will help addressing this problem.

Chapter 2:

"When it comes to the relationship between imputed and actual profits it is held that "[if] profits were perfectly aligned with economic activity, this would give rise to a perfect correlation." This seems to assume away that profit may depend on off-balance sheet items, such as firm specific assets, and ignores the possibility that the weighing of observable factors may be wrong. See Hines (2010) for a discussion of the resulting errors when trying to predict profits by these three factors. In particular, the result that Eastern European countries host few profits may have to do with the initial role as a workbench for western firms after the fall of the iron curtain."

I agree that further covariates could have improved the analysis. I have thus added a section 2.7. "Are misaligned profits shifted profits?" to the chapter, where I discuss the lack of identification, refer to Hines (2010) and explore the sensitivity of residuals to different model specifications.

Chapter 3:

"At the same time, the regressions only include per-capita income as a country characteristic, nut not a measure of country size. Given the well-known correlation between business tax rates and country size, the results are not convincing. Given this, the cross-section and the special sample, the value of the conclusion is limited and the authors are essentially open about the limitations."

It is true that the regression included only very few variables and I have now added population and a rule of law index in response to this comment. Due to the small sample size and cross-sectional character of the dataset, we make it clear in the paper that the regression does not establish any causal relationship but serves to formalise the correlations observed in the previous analysis. In the substantially revised version of the paper, the regression has been downgraded to a sub-section in the tax risk indicators, and the limitations are flagged more clearly in the conclusion of the paper.

Evaluation:

"Some concerns may be raised about the number of co-authors and the question about the specific role of the doctoral student, in particular when it comes to the last paper with three co-authors. I presume that most of the data work has been carried out by Ms. Godar, but this is not clear from the thesis."

Yes, I have made the most substantial contribution to the chapter 2. I have been the lead author on most aspects of the third paper including empirical analysis and drafting, and even more so for the most recent, substantially revised version (see following comments to chapter 3).

"Improvements are possible in the second paper. My understanding is that all estimation errors by design are treated as misaligned profits. Reducing the errors by further covariates should be possible. It is also unclear if equal weighting of real factors is adequate for all industries."

The reviewer makes a valid point on the limitations of the misalignment approach. In response to the comments, I have now added a new section to the second chapter ("2.7 Are misaligned profits shifted profits?") where I add additional co-variates at country-level and discuss their potential contribution to the unexplained residual of "misaligned profits" a bit further. These co-variates include GDP per capita or average wage, population, and the share of high-tech exports in total exports. I show that for some countries, the residual profits are quite sensitive to the model specification but for the majority of countries adjustments are more gradual. Especially for the tax havens, results are hardly affected. I add some comments on potential unobserved covariates. I illustrate that misalignment correlates with effective tax rates but state clearly that the descriptive framework does not allow for an identification of profit shifting.

"Improvements in the third paper are difficult given the very limited data. What should be possible right away is to include more country characteristics, like total GDP or population, rule of law, etc. There could also be more comparison with previous papers on country-by-country reporting."

The third paper has been fundamentally revised in terms of methodology and research question. I share the concern of the reviewer that the small sample size impedes a meaningful econometric analysis. Still, I find that this new and unique data is worth of scientific analysis. Improvements of the revised version include:

- A slightly better sample: Exclusion of AXA and BT Group which did not report proper CbCR data; inclusion of BP and Telefonica and more years for each company as more CbCR data has become available.
- Comparison of micro CbCR to consolidated accounts and aggregate CbCR to illustrate benefits and shortcomings of CbCR, including an assessment of double-counting of dividends (section 3.3.1.) and associate and joint venture profits (section 3.3.2.)
- An analysis of individual MNEs' functions in tax havens to make better use of the qualitative information included in micro CbCR
- Discussion of results by company to better account for heterogeneity in the sample
- I have rewritten the whole chapter from scratch, which is also reflected in a new structure and several new analytical sections

We systematically compare the micro CbCR to aggregate CbCR data by OECD. The data has not been compared to banks' CbCR as the research interest lies in non-financial firms and the value added of new data which adheres to a stricter reporting standard than the transparency requirements for EU banks. Instead we combine the CbCR data with information from consolidated financial accounts to assess potential limitations of the data.

"I would suggest a thesis defense after some efforts to improve the regressions of the third paper and to acknowledge more openly possible mismeasurement problems in the second one."

As explained above, I added a discussion section to the second chapter and revised the third paper substantially. I adapted the methodology to the limitations of a small non-representative sample by giving more weight to a qualitative analysis and by assessing the CbCR data quality in more detail.

I think that my thesis has improved significantly during this revision process and I hope that this will also convince the reviewer.

References:

Hines, J. (2010). Income misattribution under formula apportionment. *European Economic Review 54*: 108-120.

Mintz, M. & Weichenrieder A. (2010). The indirect side of direct investment. MIT Press.

Reply to reviewers' comments III

Reviewer: Salvador Barrios

Comments are discussed chronologically. The original comments by the reviewer are pasted in italics, replies are in blue.

First chapter

"My first comment concerns the classification of countries into tax haven vs. non-tax havens. The period considered is fairly long and policies to address global tax avoidance and profit shifting have evolved significantly, most notably under the BEPs initiatives, and specific measures taken in some regions of the world, in particular in the US and the EU. However, the analysis does not take the evolution of policies over time into account. The dummy variable categorising tax havens remains unaltered and the long time-period is not exploited in order to possibly consider the impact of policy changes. Furthermore the modus operandi of tax avoidance has evolved over the period considered. Tax avoidance based on the use of intangible (e.g. patents) has gained adepts along technological changes and the changes operated in the production of value added across sectors of activities (e.g. the rise of digital businesses). This aspect is not considered or even discussed neither. I believe the analysis could have better exploited the long-time series available to look into these new forms of tax avoidance schemes, the influence of global policy changes (and policy changes operated in tax havens)."

It is true that the definition of tax havens used in the paper is completely static and that evolving tax policies might affect the categorisation of countries as tax havens. I think, however, that the Netherlands, Luxembourg and Switzerland which I find to be the most important investor countries for Germany-based affiliates would be considered tax havens throughout the sample period. I assume that including newly emerging tax havens, such as Hungary, would not have a big quantitative impact on my results, but it might be worthwhile to explore this question further in a different research design.

I agree that a sectoral analysis might reveal important insights on the heterogeneity of profit shifting between firms and should be incorporated in future research. For example, a recent paper by Dyreng et al. (2022) suggests that most of the profit shifting by U.S. MNEs occurs in the technologies and pharmaceutical industries and that it is heavily concentrated among the biggest MNEs. As the MiDi data does not provide much information on the investor companies apart from their location, I cannot identify the size of the multinational group but only of the affiliate which might be misleading.

"I would have also appreciated a deeper discussion on the advantages of exploiting the Midi data. I am personally not familiar with it, but the differences and advantages with respect to other databases (e.g. Orbis) could have been explained in more details. For instance the possible changes in ownership structures that may have taken place in some cases given the length of the period considered (and that can be analysed to some extent with Orbis type of data) is not considered or even discussed."

The MiDi data covers the population of Germany-based firms with balance-sheet totals of over EUR 3 million and foreign participation above certain thresholds. As reporting is obligatory and subject to quality controls by the Deutsche Bundesbank, the data is reliable and might include parent-affiliate relationships not necessarily included in Orbis. This might be especially relevant for the foreign affiliates of German MNEs as affiliates in tax havens and developing countries are underrepresented in Orbis. MiDi data has

been used frequently in research on German MNEs but, to the best of my knowledge, nobody had used it, yet, to provide estimates of profit shifting in Germany at a macro scale. Another important reason for using the MiDi data is the free-of-charge access. In response to this comment I have included a short paragraph on the advantages of the MiDi data in the introduction of the thesis.

MiDi data includes information on the location of the immediate foreign investor and the ultimate beneficial owner or ultimate controlling institutional unit of a foreign affiliate but sometimes information about the latter is missing. The data does not allow me to observe other parts of the corporate group, e.g. affiliates located in other countries owned by the same investor. This is a clear disadvantage compared to Orbis. Other disadvantages of the MiDi mentioned in chapters 1 and 2 are the lack of tax information and the aggregation of tangible and intangible assets in MiDi data.

"On a more technical level, I find the statement at the bottom of page 27 rather puzzling stating that: "I conclude that extrapolating from the average coefficient estimated for the whole sample would be misleading. Instead, the coefficient of the interaction term that is higher but valid only for the subsample of affiliates with tax-haven links seems more accurate." My understanding is that in this type of exercise the estimates are based on the hypothesis that, absent CIT differences, profits would shift back home. But this does not need to be the case, profit could remain abroad still in low tax countries that are not considered as tax havens. Finally, the author uses panel data estimates without considered possible issues related to heterogeneity. Profit shifting is largely skewed, possibly towards large companies. While estimates control for company size, they could have done a better job at considering heterogeneity issues and potential bias this entails in the econometric estimations."

To extrapolate the total amount of shifted profits, I apply the estimated semi-elasticities to the average tax difference between Germany-based affiliates and their foreign investors. Indeed, the hypothesis is that there would be no profit shifting in the absence of tax differentials. When including the interaction term, the coefficient of the tax rate variable of companies without tax haven ownership links is not significant anymore. In my extrapolation based on this regression, I thus assume that only the companies with tax haven links shift profits. This does not imply that they only shift profits to tax havens as the tax rate variable on which I use in the regression and in the extrapolation is the average of tax rates in all investor countries of an affiliate. I hope this clarifies the method.

Indeed, recent research suggests that most of profit shifting seems to be concentrated in very big MNEs (Dyreng et al. 2022, Reynolds & Wier 2019). In the data used for chapter 1, I do not observe the size of the multinational group but only the size of the Germany-based affiliates. I would not expect the size of the affiliates to affect profit shifting substantially as I think that profit shifting strategies are set up at a global level and that the fixed costs of setting up such a strategy need to be seen in relation to the global income of the MNE.

Second chapter

"In general, the approach is based on the idea that one would expect some proportionality between the size of profit reported in one constituency and the level of activity in this constituency. But there are many reasons to consider that this is not necessarily the case, aside from tax avoidance considerations. First,

internal firm accounting and the nature of operations across locations is not necessarily homogenous across firms and sectors of activity.

Second, large companies with high dependence on public markets (e.g. in transport infrastructures, in the energy sector, etc.) may be considered as more constrained as their activity can depend to a large extent on national governments spending and public markets. They must also face higher corporate and social responsibility and be exposed more to public scrutiny. So, one would not expect all firms in all sectors of activity to be equally prone to avoid taxes. Third, and maybe more importantly, there are strong differences in terms of productivity, factor shares and capital intensity across firms and sectors of activity. All this blurs the expected proportionality between, say, capital, labour on the one side and profits on the other side. The proportionality issue is especially intriguing when considering assets. The data does not allow the authors to distinguish between tangibles and intangibles. But given the increased prevalence in intangibles in tax avoidance schemes, especially in sectors whose value lies heavily on this type of asset, one could expect that the proportionality between profit and assets to be largely influenced by the relative proportion of intangibles. The reported value of intangibles itself is likely to be distorted by tax avoidance practices, however. All this makes the results of the proportionality approach more difficult to interpret. On intangible, a possible combination of the data used with the Orbis data (that has information on intangible) or any other database, and/or the consideration of cross-sector differences in the importance of intangibles would warranted in order to go a bit further. The higher misalignment for assets found by the authors make me think this would be the way to go. More generally, the prevalence of different forms of profit shifting schemes (debt shifting, distortions of intangibles assets prices, transfer pricing) could have been considered, in order to go further in the analysis of firm and sector specific aspects of tax avoidance."

I agree that the analysis could have been improved by allowing for sectoral differences. Unfortunately, the JANIS database is only accessible on site at the research centers of the Bundesbank in Frankfurt, Munich, and Duesseldorf. Export of descriptive statistics is extremely constrained for confidentiality reasons which is why key statistics could only be exported for large countries or country groups and period averages. A data export by country and industry would not have been possible at the same level of detail in terms of country groups and time periods, if at all.

The aggregation of tangible and intangible asset into one variable is indeed a shortcoming of MiDi data also flagged in the chapter. I would expect that the misalignment measured in terms of assets would have been higher if based on tangible assets, only. Unfortunately, a combination with Orbis data was not possible as my university does not have access to this private database. I would still like to highlight, that despite the shortcomings, correctly pointed out by the reviewer, the misaligned profits in tax havens are relatively close to profit shifting estimates by Fuest et al. (2022) based on the probably best dataset available and obtained with more sophisticated methods. For comparison: Overall, our sample MNEs report 10% of their global profits in tax havens. Our misalignment model suggests that 60% of these profits are misaligned on average. Fuest et al. (2022), who were able to analyse the German micro CbCR data, find that MNEs headquartered in Germany report approximately 9% of their global profits in tax havens (excluding the Netherlands) and estimate that 40% of these profits are a result of tax-induced profit shifting. I would thus argue that despite the shortcomings of our data and the oversimplification implied by the misalignment approach, we obtained relatively plausible results which might thus serve as an upper bound estimate of shifted profits.

"Another possible consideration not discussed in the paper concerns the differences between EU and non EU-countries. The authors find a particularly larger role played by EU tax havens. The relative importance of the latter for Germany and in general for EU countries, could be well linked to the single EU market and the free flow of capital across countries. MNEs need a platform within the EU for their EU-based operations and this is something that makes tax avoidance very specific in the European case (many authors, in particular Zucman & others, highlighting this specific feature for EU countries). Furthermore, the prevalence of Spain and Eastern European countries, closely relates to the sample of firms considered (i.e. manufacturing firms). It would be nice to go further into specific issues and in particular the relative importance of tangible vs. intangible assets, and the importance of intra-firm trade. In the end when linking assets and employment to profits, one implicitly assume that productivity levels are homogenous across countries and sectors of activity. But this is certainly not the case. All this blurs very much in my view the interpretation of the results based on this approach. However, I also believe that by going further into sector and country-specific analysis one may be more able to exploit the potential offered by the same approach."

I agree that unobserved differences in productivity across countries or industries might explain an important part of the misaligned profits in high-tax countries. Part of this might better be captured when operationalising labour input as headcount instead of compensation of employees which is unfortunately not available. It is plausible that German MNEs shift profits out of Spain and Eastern European countries to tax havens. It is also plausible that power relations along the value chain allow the headquarters to absorb a greater share of value added. This might be an interesting avenue for further research but touches on the fundamental theoretical question of how value is created.

In response to the comment, I have added a new section to the second chapter ("2.7 Are misaligned profits shifted profits?") where I add additional co-variates at country-level and discuss their potential contribution to the unexplained residual of "misaligned profits" a bit further. These co-variates include GDP per capita or average wage, population, and the share of high-tech exports in total exports. I show that for some countries, the residual profits are quite sensitive to the model specification but for the majority of countries adjustments are more gradual. I add some comments on potential unobserved covariates. I illustrate that misalignment correlates with effective tax rates but state clearly that the descriptive framework does not allow for an identification of profit shifting.

Third chapter

The third paper analyses tax payments across countries by MNEs using CBCR data. The findings are interesting and suggest that MNEs that voluntarily published their CBCR are more likely to pay higher ETRs than MNEs from the aggregate CBCR data. The author highlight the importance of extractive industries in this dataset: in absolute terms, the excess profits booked in tax havens are smaller than the MNEs' excess profits in resources-rich countries. The findings suggest a negative relationship between reported profits with the ETR, although elasticities are low. I have only limited comments on this paper as I believe it is just a first attempt, with limited data, to assess the determinant of profit reporting by MNEs, although I think this type of exercise offers promising venues for future research.

My first comment concerns the use of asset values for measuring real activities, which might be biased if assets and, let me insist.., reported intangible assets prices, are biased because of tax avoidance. The measure of ETR used is unlikely to be exogenous to profit shifting activities in particular. I would tend to think that statutory tax rates are in principle a better variable to be used in this type of exercise. In addition, I find that the interpretation made of the non-linear relationship between reported profits and ETR largely unexploited (e.g. is there a certain penalty level beyond which profit shifting becomes under specific scrutiny? Is this possibility correlated with the level of ETR?), although here again, a larger sample would be needed in order to derive more conclusive evidence.

One must admit that the paper represents only a first attempt with limited number of data for MNEs reporting profits voluntarily and the results obtained should be interpreted with caution, and the authors are particularly careful in this respect. However, I think that, whenever data will become more abundant, it would be nice to analyse specifically why some companies chose to disclose such data and others not. I think that trying to uncover regularities in this respect, e.g. by analysing the determinants (which can be country, sector or firm-specific) of profit reporting, would be interesting in order to better understand the mechanisms of global profit shifting.

I have revised the third paper substantially. I share the concern of the reviewer that the small sample size impedes a meaningful econometric analysis. For this reason, I have adapted the research question and methodology to make it more suitable for the sample and to make better use of the available information. Improvements of the revised version include:

- A slightly better sample: Exclusion of AXA and BT Group which did not report proper CbCR data; inclusion of BP and Telefonica and more years for each company as more CbCR data has become available.
- Comparison of micro CbCR to consolidated accounts and aggregate CbCR to illustrate benefits and shortcomings of CbCR, including an assessment of double-counting of dividends (section 3.3.1.) and associate and joint venture profits (section 3.3.2.)
- An analysis of individual MNEs' functions in tax havens to make better use of the qualitative information included in micro CbCR
- Discussion of results by company to better account for heterogeneity in the sample
- I have rewritten the whole chapter from scratch, which is also reflected in a new structure and several new analytical sections

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