Tax Compliance of Multinationals and Industry Concentration in the European Union*

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Abstract

We examine whether tax compliance of multinationals reduces industry concentration by exploiting a 2016 country-by-country reporting reform in a difference-in-differences approach. We find that increased tax compliance following the reform reduced the consolidated global sales of large multinationals subject to the reform. Specifically, a one percentage point rise in effective tax rates was associated with a 1.8% decrease in sales. We further find that the increased tax compliance was also associated with a decline in the sales of the affected multinationals' subsidiaries and a decrease in concentration in industries where the top firms were subject to the reform.

JEL codes: F23, H26, L11

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1 Introduction

Many industries have become more concentrated in recent decades, both in the United States (Autor et al., 2020; Furman and Orszag, 2018; Grullon et al., 2019) and in Europe (Affeldt et al., 2021; Bajgar et al., 2023; Bighelli et al., 2023). The explanations proposed for this trend include, for example, advances in information and communication technology (Bessen, 2020), the increasing importance of intangible assets (Crouzet and Eberly, 2019), weak antitrust enforcement (Gutiérrez and Philippon, 2018), a decline in technology diffusion (Akcigit and Ates, 2021), and low interest rates (Liu et al., 2022). A less explored possibility is that the industry concentration increases are at least partly associated with disproportionately low tax bills of large companies. Large multinationals often pay lower taxes than smaller competitors (Bilicka, 2019; Wier and Erasmus, 2023; Bachas et al., 2023), and their tax avoidance is sizable (Tørsløv et al., 2023) and has grown substantially over time (Wier and Zucman, 2022). If the resulting greater net profits allow large multinationals to increase their tangible and intangible investments and, ultimately, grow their shares in industry revenues, tax avoidance by large multinationals translates into greater concentration.

Understanding the link between industry concentration and corporate taxation is especially relevant in the context of recent and ongoing international efforts to increase tax compliance. For example, more than 130 countries have agreed on reforms requiring large multinationals to report their activities on a country-by-country basis from 2016 onwards (OECD, 2015; Clausing, 2020) and pay a global minimum tax of 15% from 2024 (Johannesen, 2022; Hugger et al., 2024). Could an important by-product of these reforms be a reduction in industry concentration?

In this paper, we investigate whether increased tax compliance leads to reductions in industry concentration. We exploit the 2016 country-by-country reporting reform in a difference-in-differences approach to study the causal effect of taxes on sales of large multinationals and industry concentration in the European Union. The reform required multinationals with over €750 million in revenue to report their profits and taxes on a country-by-country basis, allowing tax authorities to carry out better-informed tax evasion risk

assessments and increasing the detection risk perceived by multinationals with aggressive tax strategies (Joshi, 2020). This had, in turn, the effect of deterring these multinationals from such strategies and improving their tax compliance.

We conduct the analysis at three levels of aggregation. First, we compare the evolution of consolidated global effective tax rates and sales of the treated multinationals (revenues in excess of €750 million) to group-level sales of companies below the revenue threshold. This analysis has the advantage that the consolidated data abstracts from the relocation of sales, profits and taxes across countries in response to the reform. Second, we compare the evolution of effective tax rates and sales of the treated multinationals' subsidiaries to those of other firms within each country-industry. Analysis at this level represents an intermediate link between the group-level and industry-level analyses. Third, we compare the evolution of industry concentration in country-industries where some of the top 4 firms are multinationals treated by the reform to country-industries where this is not the case. The analysis is based on consolidated and unconsolidated financial data from the Orbis dabase. We focus on companies headquartered in the European Union; this is done mainly because Orbis offers better coverage in Europe than in other parts of the world (Bajgar et al., 2020), but it also helps ensure a more homogeneous institutional setting for the analysis.

We find that increased tax compliance following the country-by-country reporting reform is associated with reductions in the sales of large multinationals and in industry concentration. We begin by confirming the existing evidence on the reform's effect on tax compliance, which indicates that the effective tax rates of affected large multinationals rose by 1-2 percentage points as a result of the reform (Joshi, 2020; De Simone and Olbert, 2022; Tuinsma et al., 2023; Hugger, 2024). Moving to the core contribution of our paper, we estimate that business groups that had to report on the country-by-country basis saw a decrease in sales of 5% relative to the unaffected business groups, with the effect taking a few years to materialize but increasing over time. The findings are robust to different data and methodology choices and they are economically important: if we relate the estimated effect on sales to the that on effective tax rates, they indicate that a 1-percentage-point rise in consolidated effective tax rates is associated with a 1.8% decrease in consolidated sales. We further find

that the reform was also associated with sales declines within individual subsidiaries of the affected multinationals. This is not guaranteed by the findings for consolidated sales; for example, if the higher effective tax rates made the affected multinationals sell some subsidiaries, we could observe negative effects on group-level sales but not on sales of individual subsidiaries. On average, we estimate that treated subsidiaries' sales dropped by 2.1% due to the country-by-country reporting. Finally, we document a decrease in concentration in industries where the top firms belonged to multinational groups subject to the reform. Our main difference-in-differences results indicate a decrease in industry concentration due to country-by-country reporting of 2 percentage points in the case of the top 4 firms (significant at the 5% level), or 2.6 percentage points in the case of the top 8 (significant at the 1% level).

Our work contributes to the literature on the consequences of tax avoidance and compliance. While the determinants of tax avoidance have been intensively studied, research on its consequences constitutes a small but growing body of work (Bruehne and Jacob, 2019). Some documented firm-level consequences of tax avoidance include decreasing firm transparency (Ayers et al., 2009; Chen et al., 2018), higher cost of capital (Heitzman and Ogneva, 2018), and higher cost of debt (Hasan et al., 2014; Platikanova, 2017). Other studies show links between tax avoidance and firm value (Desai and Dharmapala, 2009; Hanlon and Slemrod, 2009). Li et al. (2021) additionally find that an anti-tax avoidance measure in the US decreased firm innovation. Our study contributes to this literature by highlighting that, besides the previously studied consequences, increased tax compliance of large multinationals is associated with a reduction in industry concentration.

Our work is also related to studies analysing the drivers of the concentration increases observed in the United States and other parts of the world (e.g. Aghion et al., 2023; Crouzet and Eberly, 2019; Autor et al., 2020; Gutiérrez and Philippon, 2018; Akcigit and Ates, 2021; Liu et al., 2022). We complement these studies by analysing tax avoidance as a novel potential driver of the concentration increases.

Two of the most closely related papers are those by Martin et al. (2023, henceforth MPT) and Gauß et al. (2024). MPT show a causal impact of corporate tax avoidance on sales of

US firms. Their results suggest that changes in tax avoidance of large relative to small firms can explain about 15% of the variation of concentration across U.S. industries between 1994 and 2017. Our study and MPT reach similar conclusions but they differ in several important aspects: (i) we focus on taxation of large multinational companies, whereas the sample of MPT contains a more general set of firms; (ii) we analyse an international taxation reform whereas MPT focus on national tax policies in the US; (iii) we directly link tax compliance to industry concentration, whereas MPT show the causal link between tax avoidance and sales and provide a quantitative exercise to further link it with industry concentration; (iv) we investigate the effects of strengthened tax compliance, whereas MPT mostly capture decreases in effective tax rates; (v) we use data from the European Union, whereas MPT focus on the United States; and (vi) we analyse a relatively recent reform implemented in 2016 while MPT exploit a more historical variation, namely changes in audit probabilities between 1994 and 2017 and two reforms implemented around year 1998. Gauß et al. (2024) document that tighter transfer pricing regulations in the European Union increased the effective taxation and lowered the sales of multinationals and fostered the profits and sales of domestic firms. Like our paper, they use EU data and analyse an instance of *strengthened* tax compliance, but they study a different reform and time period and, most importantly, they do not link tax compliance to industry concentration. Overall, our paper and the papers by Martin et al. (2023) and Gauß et al. (2024) study a similar subject from different angles, and their findings can be seen as consistent and mutually reinforcing.

Our findings highlight the potential of tax compliance reforms in reducing industry concentration. For example, the European Union has agreed to require large multinationals to make most of the information in their country-by-country reports publicly available, starting from year 2024.[1] The publication of the reports is likely to further deter multinationals from aggressive tax strategies and support tax compliance.[2] Perhaps even more consequentially, 135 countries have agreed to require large multinationals to pay a global minimum tax of 15% from 2024 (Johannesen, 2022; Hugger et al., 2024). Existing studies suggest that these

[1] Previously the reports were only shared with national tax authorities.

[2] There is evidence that publishing such reports in the banking sector (Overesch and Wolff, 2021; Joshi et al., 2020) and in the extractive and logging sectors (Johannesen and Larsen, 2016) in 2010s affected tax compliance.

reforms will contribute to tax compliance of large multinationals. This paper additionally argues that the reforms can be expected to also result in reduced industry concentration.

The remainder of this paper is structured as follows. In Sections 2 and 3, we respectively describe the data and our methodology. We present our results in Section 4, and Section 5 concludes.

2 Data

We obtain yearly consolidated and unconsolidated financial data and ownership data from the Orbis Historical database, provided by Bureau van Dijk. We restrict the sample to firms in the EU28 because Orbis offers a much better coverage of firms in Europe than elsewhere (Bajgar et al., 2020) and because the country-by-country reform was implemented in a homogenous way across all member states of the European Union.[3]

We download all firms located in the EU with sales of at least €1 million, either consolidated or unconsolidated. As the treatment status of each business group (and its subsidiaries) is based on consolidated revenues, we further restrict the sample to business groups with a consolidated revenue between €10 million and €10 billion to prevent comparing the very smallest with the very largest groups.[4] Groups that switch treatment status during our post-reform period are dropped since the timing of treatment effects is inconsistent with the rest of the treated group.[5]

To determine which firms belong to each business group, we identify the global ultimate owner (GUO) of each firm and define business groups as collections of firms with the same global ultimate owner. Specifically, we use the Orbis GUO50 link which identifies the global ultimate owner with over 50% ownership of the subsidiary, hence ensuring unique GUOs for each subsidiary. Where we do not identify a GUO, we assume the firm is independent, i.e. it is its own GUO. To clearly distinguish between the different levels of analysis, we

[3] We include firms in the 28 countries that were EU members before Brexit, since nearly our full sample period is pre-Brexit and the UK implemented country-by-country reporting simultaneously with the rest of the EU.

[4] We test the robustness of our results to further reducing this interval, with the results in Figure 3 in the Appendix.

[5] This drops 4% of our observations. In a robustness test presented in Figure 3 in the Appendix, we show that our results are the same when treatment switchers are not excluded.

henceforth use the term 'group' to refer to collections of firms with the same GUO and the term 'subsidiary' for unconsolidated firms, although both also include independent firms, provided these meet the size threshold.

We use the Orbis microdata to build datasets on three different levels: the business group level, the subsidiary level, and the industry level. In the group-level analysis, our main outcome variable is consolidated group sales. The advantage of this variable is that it is not directly affected by re-location of sales between different parts of the group. In the subsidiary-level analysis, we focus on unconsolidated sales of each group's subsidiaries. This allows us to test whether the increased tax compliance reduced within-firm sales in the subsidiaries of the affected multinationals, as opposed to, for example, just making the multinationals divest some of these subsidiaries.

In the industry-level analysis, the outcome variable is industry concentration, defined as the share of the top 1, 4 or 8 groups in the total sales in each country-industry. Following Bajgar et al. (2023), the numerator of the concentration ratios is calculated aggregating sales across all subsidiaries of each group within each country-industry, and the denominator is based on country-industry sales, sourced from Eurostat Structural Business Statistics data.[6] As a baseline, we use 2-digit NACE industries, but, we also test the robustness of the results to using 1-digit and 3-digit industries.

Effective tax rates at the group level are calculated as a ratio of consolidated taxes paid to consolidated profits before taxes of each business group.[7] Additional variables used as covariates in robustness tests include the number of employees, return on assets, leverage, and intangibles share.[8]

The country-by-country reporting requirements apply to multinational groups with consolidated revenues in excess of €750 million. Which business groups are considered treated in our diff-in-diff analysis is thus determined by interacting an indicator of whether a group

[6]The coverage of smaller firms in Orbis tends to increase over time (Bajgar et al., 2020), so calculating the denominator of the concentration ratios by simply summing up across all firms observed in Orbis would create a spurious upward trend in such denominator and, consequently, a spurious downward trend in industry concentration. Denominators based on country-industry sales from Eurostat are not subject to a similar bias.

[7]Loss-making groups are dropped, consistent with most of the tax avoidance literature (Hanlon and Heitzman, 2010; Henry and Sansing, 2018).

[8]For variable definitions, see the note accompanying Table 1.

exceeds the revenue threshold with an indicator of its multinational status, which we set to one if a given GUO owns at least one foreign subsidiary. At the subsidiary level, treatment is determined by the treatment status of its GUO. At the industry level, the treatment variable is given by the share of the top 1, 4 or 8 firms in a given country-industry that belong to groups affected by the reform. Hence, it can attain several values between 0 and 1.

Since Orbis historical ownership coverage starts in 2007 and the latest information available to us is from 2021, our sample period is 2007–2021,[9] allowing us to include 9 pre-reform and 6 post-reform years. The descriptive statistics for our data are shown in Table 1, and they are complemented with descriptive graphs in Figure 1.

At the group level, we observe 28,651 unique corporate groups and 164,209 group-year observations, which are summarised in Panel A of Table 1. Average sales and revenue in our sample are just over €200 million, and the average effective tax rate is 25%. The time trend of effective tax rates within our sample is shown in Panel A of Figure 1: it declines from 27% at the start of our sample period to 23% at the end. Nearly 45% of observations correspond to groups with a multinational status, but most of these remain below the country-by-country reporting threshold of €750 million, so only about 3% of all observations correspond to treated groups. Panel B of Figure 1 shows the relationship between effective tax rates and group size within a country-industry-year. Effective tax rates are initially clearly progressive in group size. However, for larger groups, rates remain constant and, at the top end of the size distribution, they even become slightly regressive. Although this figure does not prove that large groups avoid more taxes, it motivates our research question by illustrating suggestive evidence for this phenomenon, in line with evidence of lower effective tax rates for the largest firms found by Bachas et al. (2023) and Wier and Erasmus (2023).

Panel B in Table 1 presents the summary statistics on the subsidiary level. Our panel dataset here includes 130,604 unique subsidiaries and 707,658 yearly observations. Average unconsolidated sales is €44 million. Over 70% of observations are subsidiaries owned by a multinational group, of which 31% have a consolidated revenue exceeding the revenue

[9]The coverage of the Eurostat data restricts the industry-level analysis to years 2008–2020.

Table 1: Descriptive statistics

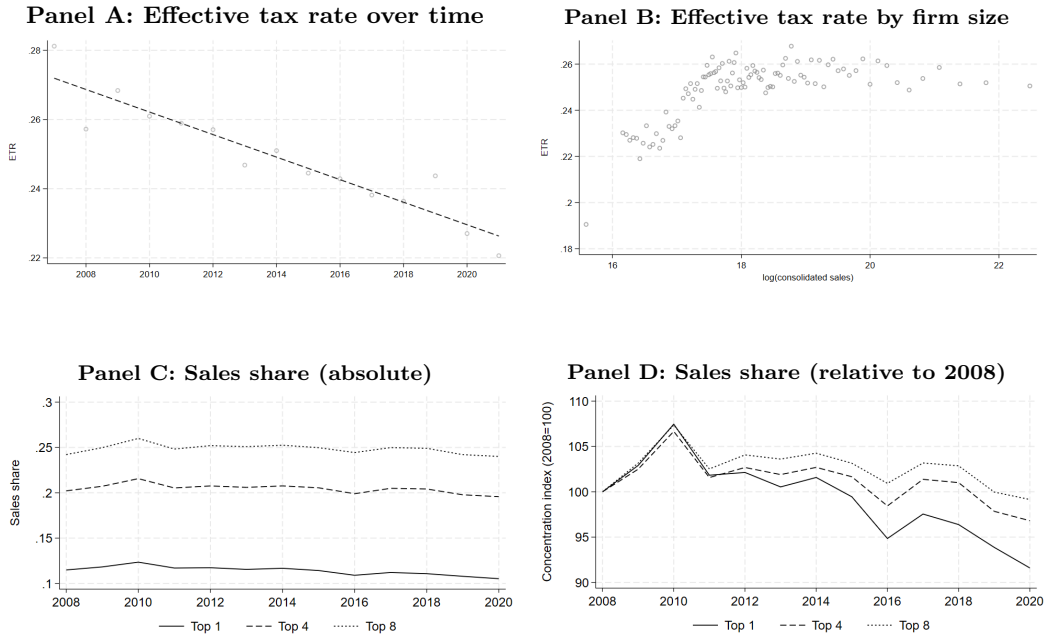
	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
Panel A. Group-level dataset					
Sales (consolidated, € million)	164,209	204.0	711.6	1.076	86,966
Revenue (consolidated, € million)	164,209	208.1	658.9	10.00	10,000
Effective tax rate (consolidated)	164,209	0.250	0.189	0	1
Revenue > € 750 million	164,209	0.042	0.200	0	1
Multinational	164,209	0.447	0.497	0	1
Treated	164,209	0.032	0.176	0	1
Post-reform	164,209	0.403	0.490	0	1
Treated x post-reform	164,209	0.013	0.113	0	1
Panel B. Subsidiary-level dataset					
Sales (unconsolidated, € million)	707,658	44.28	179.6	1	17,399
GUO with revenue > € 750 million	707,658	0.323	0.468	0	1
Multinational GUO	707,658	0.717	0.450	0	1
Treated	707,658	0.314	0.464	0	1
Post-reform	707,658	0.432	0.495	0	1
Treated x post-reform	707,658	0.134	0.340	0	1
Panel C. Country-industry-level dataset					
Turnover (million €, top 8)	10,688	25,302.2	70,717.6	501.1	1,251,471.8
Turnover (million €, top 4)	12,590	22,034.7	65,671.6	500.6	1,251,471.8
Turnover (million €, top 1)	14,083	19,937.5	62,408.3	500.6	1,251,471.8
Concentration (top 8)	10,688	0.248	0.213	0.003	1
Concentration (top 4)	12,590	0.208	0.205	0.001	1
Concentration (top 1)	14,083	0.118	0.158	0	1
Treated share (top 8)	10,688	0.626	0.261	0	1
Treated share (top 4)	12,590	0.671	0.299	0	1
Treated share (top 1)	14,083	0.740	0.439	0	1

Note: This table shows descriptive statistics for the datasets on three levels. Panel A describes the group-level dataset, with all financials on consolidated basis. We observe 28,651 unique corporate groups. Panel B describes the subsidiary-level dataset, with sales on unconsolidated basis. We observe 130,604 unique subsidiaries. Panel C describes the country-industry-level dataset. We observe 1,216 unique country-industry pairs.

threshold for country-by-country reporting.

Finally, Panel C shows the descriptive statistics for the country-industry level. We selected only industries with an aggregate sales of at least € 500 million to avoid our results being driven by very small industries in the control group. Our data includes observations

Figure 1: Motivating figures



Note: Panel A shows the time trend in average consolidated effective tax rates on the group level over time. All groups with positive profits are selected, yearly bins are plotted together with a linear fit. Panel B shows the relationship between effective tax rates and the natural logarithm of consolidated sales for the same sample. 100 equally-sized bins are plotted. Panels C and D show the time trend in industry concentration, respectively in absolute terms and relative to 2008 levels. Concentration is measured as the sales share of the top 1, top 4, or top 8 firms within a country and a 2-digit NACE industry. The sample is balanced and only country-industries with at least 8 firms in each year are included. Outlier country-industries for which the difference between the lowest and highest recorded concentration exceeds 75 percentage points are excluded from the sample.

on 1,216 unique country-industries, divided between 27 EU countries and 68 industries.[10] The average industry size is between 20 and 25 billion euros. On average, the top 8 firms account for 25% of these sales, with the top 4 accounting for just over 20% and the largest firm alone for nearly 12%. Most firms entering the concentration ratios form part of the affected multinationals, as the average share of treated firms is 62% within the top 8, 67% within the top 4 and 74% for the largest firm.[11]

[10] Our data unfortunately does not contain unconsolidated financials for Ireland, hence Ireland is not included in the industry-level (and subsidiary-level) analysis.

[11] These figures may seem large at first. Note that treatment status is determined by consolidated group revenue, also taking into account revenue of the business group outside the country-industry unit. For example, the treated share of a country-industry with total turnover of €500 million may still be strictly positive if its largest business group with €250 million of sales *within* that country-industry additionally

The evolution of industry concentration during our sample period is shown in Panels C and D of Figure 1. Panel C confirms the averages in the summary statistics, which appear relatively stable over time. Panel D shows the evolution of concentration relative to 2008 levels. It suggests that concentration rose during the financial crisis, which might be partly due to recessions hitting smaller firms more and larger firms recovering faster after the financial crisis (Crouzet and Mehrotra, 2020; Sahin et al., 2011). After 2010, concentration drops back nearly to 2008 levels and remains flat until 2015. From 2016 onwards, concentration starts decreasing. While many factors might explain this decrease, it is also consistent with our hypothesis that increased tax compliance due to the 2016 country-by-country reporting reform reduced industry concentration.

3 Methodology

To infer causal effects of country-by-country reporting on tax compliance, sales, and industry concentration, we use a difference-in-differences approach. Additionally, we use event study estimates to test the plausibility of the identifying parallel trends assumption and to explore the time dynamics of the policy effect.

In the group level analysis, the treatment group are multinationals with a revenue above the threshold of €750 million, which have to report on the country-by-country basis from 2016 onwards (our post-treatment period). Non-multinationals (i.e. business groups operating only in a single country) and multinationals below the revenue threshold constitute the control group.[12] To enable us to compare effects within country-industries, country-industry-year fixed effects are included. To avoid picking up the effects of different starting productivity levels of group and other unobservable time-invariant group characteristics, we

has €600 million of revenue in other country-industries.

[12] In a robustness test, we exclude non-multinationals with a revenue over €750 million from our sample. These are groups for which we cannot observe a foreign subsidiary, hence their multinational status is zero. However, if some ownership links are missing in Orbis, we could incorrectly identify some groups as non-multinationals because of a missing link to a foreign subsidiary. Our results are robust to dropping these groups (see Figure 3). Restricting our sample further to only include multinational groups, i.e. also excluding non-multinationals below the revenue threshold, does not alter our main results either (see Figure 3). The former sampling decision is the most similar to the one used by Hugger (2024), while the latter sample excluding non-multinationals from both treatment and control groups is used by Joshi (2020).

also include group fixed effects. Formally, we estimate the following equations:

$$ETR_{g,c,s,t} = \alpha Treatment_g \cdot Post2016_t + FE_g + FE_{c,s,t} + \epsilon_{g,c,s,t}, \tag{1}$$

and

$$\log Sales_{g,c,s,t} = \beta_1 Treatment_g \cdot Post2016_t + FE_g + FE_{c,s,t} + \mu_{g,c,s,t}, \tag{2}$$

where $ETR_{g,c,s,t}$ and $\log Sales_{g,c,s,t}$ respectively denote the consolidated effective tax rates and the natural logarithm of consolidated sales of business group g headquartered in country c and operating in industry s in year t. α is the estimate for the effect of country-by-country reporting on effective tax rates and β_1 estimates its effect on consolidated sales. Standard errors are clustered at the group level.

Similar to Martin et al. (2023), we also employ two-stage least squares to obtain a semi-elasticity of sales with respect to effective tax rates, using $Treatment_g \cdot Post2016_t$ as an instrument exogenously affecting effective tax rates. We also provide several robustness checks to show that our results hold using different sampling decisions, methodologies, or definitions.

At the subsidiary level, we estimate equation (3), which is similar to equation (2) but with the outcome variable consisting of unconsolidated sales of subsidiary i of group g:

$$\log Sales_{i,g,c,s,t} = \beta_2 Treatment_g \cdot Post2016_t + FE_i + FE_{c,s,t} + \mu_{i,g,c,s,t}. \tag{3}$$

Here, the subsidiary i operates in country c and industry s. The fixed effects are now defined at the subsidiary level to remove any confounding time-invariant differences between subsidiaries. Standard errors are also clustered at the subsidiary level.

Finally, at the industry level, the outcome variable is the top 1, 4 or 8 concentration ratio for country c, industry s and year t and we estimate the following equation:

$$Concentration_{c,s,t} = \beta_3 TreatedShare_{c,s,t} \cdot Post2016_t + FE_{c,s} + FE_t + \nu_{c,s,t}, \tag{4}$$

Here, standard errors are clustered at the country-industry level. Country-industry-year fixed effects would be perfectly collinear with our explanatory and outcome variables, hence we now control for separate country-industry fixed effects and the overall time trend in concentration.

4 Results

In this section, we first describe our results on the group level. Next, we show our results on the subsidiary level. Finally, we present our industry-level results.

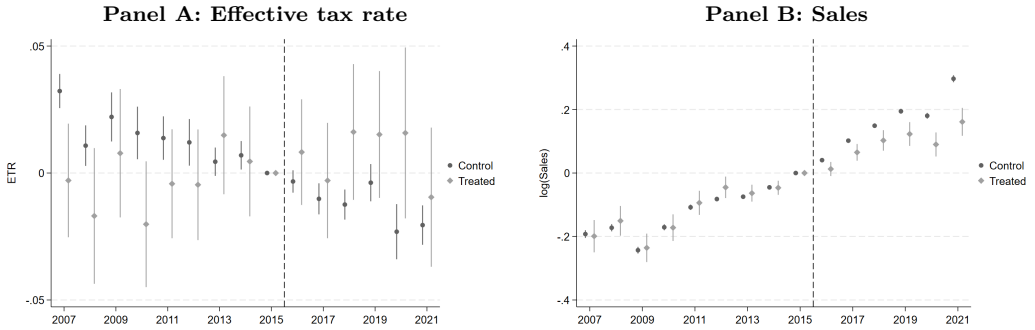
4.1 Group level

We treat the introduction of country-by-country reporting as a quasi-experiment, exogenously changing tax compliance behaviour of treated firms, i.e. multinationals with a revenue of at least €750 million. The control group consists of non-multinational firms and multinationals with a revenue below the threshold.[13] Figure 2 shows the trends in terms of effective tax rates and sales of the control and treatment groups separately, relative to their 2015 levels. Until 2015, before the reform was implemented, both groups' effective tax rates and sales trend similarly. The treatment group's effective tax rate is a little volatile before the introduction of country-by-country reporting due to the smaller sample this group constitutes, but is overall not significantly different from the control group's effective tax rate trend. However, from 2016 onwards, treated firms' effective tax rates rise slightly compared to its previous trend, and diverge even more significantly from the control group's effective tax rates which continues its downward trend. Similarly, from 2016 onwards the sales growth of treated firms is significantly lower relative to the control group. This is a first visual indication of the effect of country-by-country reporting on sales through tax compliance effects.

We continue with a causal inference analysis using a difference-in-differences approach. For this strategy to be valid, we must ensure the pre-reform trends of our treatment and

[13] In robustness tests, we show that conclusions remain the same when non-multinationals are excluded from the control group.

Figure 2: Consolidated effective tax rate and sales – parallel trends



Note: This figure shows the time trend in consolidated effective tax rates and sales for the treatment group, i.e., firms with country-by-country reporting obligations, and control group separately. Both trends are relative to 2015 base levels. Firm fixed effects are taken into account. 95% confidence intervals are depicted. The dotted vertical line represents the introduction of country-by-country reporting in 2016.

control group, in both effective tax rates and sales, run parallel. Columns (1) and (2) of Online Appendix Table A.1 present event study estimates. These results confirm that until 2015, the year before country-by-country reporting became mandatory for our treated group, those firms' effective tax rates and sales trends did not significantly differ to that of our control group.[14] Hence, the necessary parallel trends assumption for our difference-in-differences approach to be valid is not rejected.

Continuing with our main difference-in-differences estimates, column (1) in Table 2 shows that country-by-country reporting did increase tax compliance. We estimate a highly significant 2.8 percentage point increase in an effective tax rate, an effect size similar to but slightly larger than found in the literature (Hugger, 2024; Joshi et al., 2020). Specifically, the literature estimates an increase in effective tax rates between 1 and 2 percentage points; our slightly larger treatment effect may be attributed to the fact that our data includes more and later post-reform years, in which the effect has increased, as seen in column (1) of Online Appendix Table A.1. Column (3) in Table 2 shows that not only effective tax rate was affected, but sales were as well. Firms that had to report on the country-by-country basis saw a decrease in sales of 5% relative to the control group, statistically significant at

[14] 2012 appears to be a small outlier within the parallel sales trends, when sales were significantly higher in the treatment group. There is no clear explanation for this phenomenon in this specific year, but the overall picture of the 2007–2015 trend remains such that we are still confident in our parallel trends assumption.

Table 2: Main results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	Effective tax rate	log(Sales, consolidated)	log(Sales, consolidated)	log(Sales, unconsolidated)	Concentration (top 8)	Concentration (top 4)	Concentration (top 1)
Analysis level	Shareholder	Shareholder	Shareholder	Subsidiary	Industry	Industry	Industry
		2SLS					
	1st stage	2nd stage					
Effective tax rate		-1.783**					
		(0.797)					
Country-by-country reporting	0.028***		-0.050***	-0.021***			
	(0.007)		(0.018)	(0.006)			
Treated share					0.059***	0.042***	0.013***
					(0.010)	(0.008)	(0.004)
Post × treated share					-0.026***	-0.020**	-0.005
					(0.010)	(0.008)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	-	-	-
Country × industry × year FE	Yes	Yes	Yes	Yes			
Country × industry FE	-	-	-	-	Yes	Yes	Yes
Observations	164,209	164,209	164,209	707,658	10,688	12,590	14,083
Adjusted R^2	0.398		0.953	0.939	0.875	0.866	0.852
F-statistic		13.94					

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: this table summarises the effects of country-by-country reporting on shareholder-level consolidated effective tax rates and consolidated sales in columns (1)–(3), on subsidiary-level unconsolidated sales in column (4), and on industry concentration in columns (5)–(7). Standard errors are clustered on the shareholder level (columns (1)–(3)), subsidiary level (column (4)), and country-industry level (columns (5)–(7)). Country-by-country reporting is the interaction of post-CbCR and treatment. Treated share is the share of the top 8, top 4, or top 1 firm(s) that are treated. Industry classification is at the 2-digit level. In column (2), the Kleibergen-Paap Wald rk F-statistic is reported.

the 1% level. We can observe the timing of this effect in our event study results in column (2) of Online Appendix Table A.1. It is clear that the tax compliance effect materialises slowly and only becomes significant from the third year after implementation. It is relatively constant (the larger estimate found in 2020 may be due to the coronavirus pandemic). The sales effect takes a year longer to become significant but increases over time.

In column (2) in Table 2 we decompose the effect of country-by-country reporting on sales to obtain the semi-elasticity of sales with respect to effective tax rates. We estimate that a one percentage point increase in effective tax rates decreases sales by 1.8%. The Kleibergen-Paap Wald rk F-statistic is 13.94, well above the commonly accepted benchmark of 10, indicating the strength of our instrument.

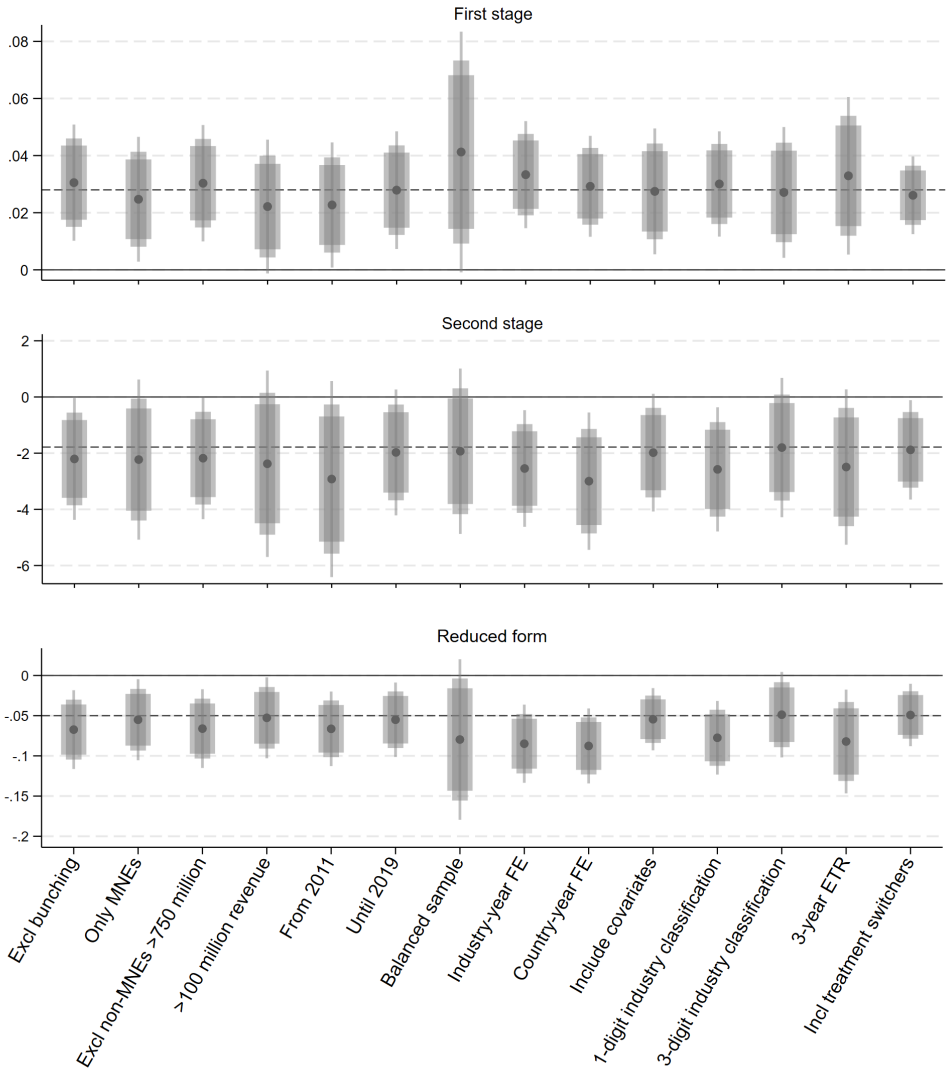
4.1.1 Robustness

We show with a myriad of robustness tests that these results are robust to most alternative specifications and sample definitions. The results of these robustness tests, for the first stage, the second stage, and the reduced form, are summarised in Figure 3.

In the first robustness test, we drop firms that potentially manipulated their revenue to remain below the country-by-country reporting threshold and avoid the regulation. Although Joshi (2020) and Tuinsma et al. (2023) do not find evidence for bunching below the threshold, Hugger (2024) and De Simone and Olbert (2022) do find such evidence. Following Hugger (2024), we exclude firms in the bunching region of 90%-100% of the reporting threshold. Estimates are robust to this exclusion and remain significant, with all three point estimates slightly larger in size compared to our baseline estimates.

Next, we present results for three alternative sampling decisions. We exclude non-multinational firms, either from the full sample or only those exceeding the reporting threshold, and we exclude firms with a revenue below €100 million. Removing all non-multinationals improves the comparability of the treatment and control group at the cost of decreasing sample size and precision, resulting in a slightly larger second-stage point estimate but a drop in its statistical significance. Removing non-multinationals only when their revenue exceeds the reporting threshold similarly does not significantly alter results.

Figure 3: Robustness tests – group level



Note: These figures summarise the point estimates along with their confidence intervals at the 90%, 95%, and 99% level for our robustness tests at the group level. In the first stage, we estimate the effect of country-by-country reporting on effective tax rates. In the second stage, we estimate the effect of effective tax rates on sales. In the reduced form, we estimate the effect of country-by-country reporting on sales. In all three figures, the solid horizontal line indicates zero and the dashed horizontal line indicates our baseline estimates displayed in Table 2.

Excluding firms with a revenue below €100 million further ensures comparability between the control and treatment group. Again, point estimates are robust, however the first stage

estimate is slightly smaller compared to our baseline estimate and is significant at the 5% level. The second stage estimate is in this case only significant at the 10% level.

Since Figure 2 shows significant sales drops after 2008 due to the financial crisis and from 2020 due to the COVID-19 outbreak, we want to exclude the possibility that these crises affected the control and treatment group differently and bias our results. Hence, we exclude 2007–2010 and 2020–2021 from our sample in the following robustness tests. Results are robust, although the second stage loses some statistical significance due to smaller sample size and lower precision.

Coverage of large firms in Orbis is generally good, but for small firms this is less the case (Bajgar et al., 2020). To alleviate concerns about the consistency of the treatment and control groups, we also perform our analyses on the balanced sample of firms for which all 15 years are observed. Although the results lose some statistical significance due to lower power, they are consistent with our baseline results and point estimates exceed our main estimates.

We also perform several robustness checks related to regression specifications and the definition of industries. First, we treat the EU as a single market, hence industries in which firms operate are only determined by their industry classification (country-industry-year fixed effects are dropped in favour of industry-year fixed effects). We also show results when using country-year fixed effects instead. Results and conclusions are robust to these specifications. We also add potential determinants of our outcomes and independent variables as covariates. Control variables included are size in terms of assets and employees (both in natural logarithms), return on assets, and leverage. Finally, we vary the granularity of our industry classification (1-digit and 3-digit) and our effective tax rate definition (3-year average effective tax rate). Results from these specifications confirm the robustness of our main findings.

4.2 Subsidiary level

In column (4) of Table 2, we provide difference-in-differences results of our analysis on the subsidiary level. Treatment is determined by the treatment status of the global ultimate

owner of the subsidiary, the outcome is unconsolidated sales on the subsidiary level. Using country-industry-year fixed effects on the subsidiary level allows us to compare unconsolidated sales with other subsidiaries in the same country-industry at the same time. Including subsidiary fixed effects accounts for pre-existing differences in subsidiary characteristics. On average, we estimate that treated subsidiaries' sales dropped by 2.1% due to country-by-country reporting. This shows that our estimate on consolidated group sales is not due to affected multinationals simply divesting their subsidiaries, but rather the decline in size of those subsidiaries relative to untreated firms.

Event study results in column (3) of Online Appendix Table A.1 do not give reason to reject the parallel trends assumption on the subsidiary level. In 2007 and 2008, control subsidiaries may have been affected more by the financial crisis leading to statistically significant differences in sales with the treatment group in those years. Excluding these years from the main diff-in-diff analysis does not significantly alter the estimate in column (4) of Table 2, see the result of this robustness test in Online Appendix Figure A.1. The yearly estimates further show that subsidiaries of firms with country-by-country reporting obligations started losing sales relative to control subsidiaries directly after the policy was implemented. This effect appears to grow over time, but this observation is coincident with the coronavirus pandemic which may confound this finding. Our main estimate is also robust to excluding the pandemic years from 2020 onwards, although the effect size is slightly smaller and statistically significant only at the 5% level (see Online Appendix Figure A.1).

Further results of robustness tests on the subsidiary level are also summarised in Online Appendix Figure A.1. Our main result is robust to the exclusion of subsidiaries that are not owned by multinational firms, and to the exclusion of non-multinational owners with a revenue over the treatment threshold. Excluding self-owned subsidiaries increases our point estimate slightly but otherwise confirms the robustness of our main estimate, as do regressions using 1-digit or 3-digit industry classifications.

4.3 Industry level

In this section, we investigate whether country-by-country reporting had a direct effect on industry concentration. We measure concentration by the unconsolidated sales share of the top firms within every country-industry combination (2-digit industries). The treatment variable is the share of the top $N \in \{8, 4, 1\}$ firms with treated status. In the case of the top 8 and top 4, our treatment variable is multi-valued discrete but can be thought of as continuous and ranges between 0 and 1; in the case of the top 1, this simplifies to a classic difference-in-differences with binary treatment. Results are presented, for the top 8, top 4, and top 1 respectively, in columns (5)–(7) of Table 2. The (continuous) difference-in-differences estimates indicate that an industry in which all of the top 8 firms are treated, experienced a 2.6 percentage points drop in concentration due to country-by-country reporting relative to completely untreated industries (significant at the 10% level). Hence, assuming this effect is linear, every additional top 8 firm with reporting obligations leads to a decrease in concentration of $\frac{1}{8} \cdot 2.6 = 0.325$ percentage points. For the top 4, this effect is $\frac{1}{4} \cdot 2 = 0.5$ percentage point, statistically significant at the 5% level. For the top 1 firm, we do not find a statistically significant effect.

We additionally present yearly event study estimates in Online Appendix Table A.2. The event study results show mostly parallel trends pre-reform, however, some estimates indicate potentially divergent trends before 2011. In robustness tests presented in Online Appendix Figure A.2, we drop these years and show that although the estimate size slightly decreases, our overall conclusions are robust. In an additional test, we drop 2020 due to potential distorting effects of the coronavirus pandemic, again confirming the robustness of our main results.

Unfortunately, we only have availability of Eurostat's aggregate industry data on the two-digit level, so we cannot perform a robustness test using the three-digit industry level. The one-digit industry classification does not provide enough information to allow for meaningful estimation of concentration on this level. We do provide results of further robustness tests in Online Appendix Figure A.2, in which we control for the size of industries and in which we use balanced samples. Our main industry-level estimates are robust to these specifications.

5 Conclusion

In this paper, we show that the 2016 introduction of country-by-country reporting decreased the sales of the largest multinationals in the EU by around 5%, relative to smaller business groups in the same country-industry. Our two-stage least squares analysis implies that a one percentage point increase in effective tax rates leads to a 1.8% decrease in sales. We also show that country-by-country reporting decreased the sales of subsidiaries of the affected multinationals, thereby showing that our estimate on consolidated group sales is not driven by divestment of subsidiaries but due to actual decline in size of the group's subsidiaries. Finally, we provide evidence for a reduction in industry concentration in country-industries where a larger share of the top firms have the country-by-country reporting obligation. Industries in which the top eight firms had this obligation became 2.6 percentage points less concentrated relative to industries in which no firms had the reporting obligation. Measuring industry concentration as the sales share of the four largest firms, we estimate the effect at a decrease of 2 percentage points. As far as we are aware, these are the first estimates in the academic literature of the direct effect of multinational tax compliance on industry concentration.

Our findings suggest that, beyond boosting tax revenues, more effective corporate tax policy can have the additional benefits of leveling the playing field for competition among firms of different size and reducing industry concentration. The findings are particularly important in the context of ongoing debates about the causes and consequences of recent industry concentration trends, and in the context of recent advances in international corporate taxation, especially the publication of country-by-country reports in the EU from 2024 onwards and the implementation of a global minimum corporate tax rate of 15% implemented by over 135 countries at the same time.

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