Optimisation Frictions and the Fixed Cost of Profit Shifting

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Abstract

This paper studies the optimisation frictions that affect the cost of profit shifting for multinational companies. Using confidential UK corporate tax returns data for the years 2000 – 2015, we analyse the effects of foreign tax rate cuts on the extensive and intensive margins of profit reporting in the UK. We show that profits of multinational firms operating in the UK do not react to tax rate changes in their home countries at the intensive margin. Instead, our reduced form evidence shows large extensive margin responses, providing evidence for the presence of fixed costs related to profit shifting. We build a model which accounts for those fixed costs and we estimate the extent of shifting frictions alongside the intensive and extensive margin elasticities of taxable profit.

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1 Introduction

In recent years the public policy and academic interest in the issues of tax avoidance and profit shifting of multinational companies have increased. The revelations of Panama and Paradise papers have shown the extent to which companies and individuals shelter profits in tax havens and have sparked a series of investigations. In this paper we are interested in optimisation frictions that affect the allocation of profits across multinational subsidiaries. In particular, we show how to identify and estimate the friction function in the context of the profit shifting behaviour of multinational companies. It is commonly assumed that this function is convex in the amount of profit shifted. While this provides a convenient analytical solution for the structural estimation of profit shifting as a response to tax rate differentials between countries, it also leads to the conclusion that a firm would shift more profits to a lower tax jurisdiction the more profits it makes.

Using administrative data, we first show that companies do not gradually shift an increasing amount of profits as the tax rate differential increases marginally. Specifically, we show that the profits that firms report to the UK tax authorities do not change in response to tax rate changes in their foreign parents at the intensive margin. However, the foreign tax rate cut affects the likelihood of reporting any profits to tax authorities; the changes to taxable profit take place at the extensive margin. We develop a novel structural model where multinational enterprises (MNEs) maximize the present discounted value of all period cash flows in each subsidiary location, net of investments made by the multinational in a 'tax avoidance technology'. Multinationals accumulate tax avoidance capability by investing in this avoidance technology, which is subject to a decline in value depending on government changes to tax rules to combat tax avoidance. The value of the tax avoidance asset can therefore be thought of as depreciating at some exogenous rate in each period. Our conceptual framework therefore embeds the convex cost hypothesis within a more general framework. In particular, our proposed framework generates corner solutions which would imply that a multinational firm shifts all of its profits out of a particular subsidiary and would not alter the amount shifted in response to marginal changes in statutory tax rates.[1]

Hence, our model provides a consistent economic explanation for the lack of changes in profit shifting behaviour, at the margin, in response to tax cuts. There is heterogeneity in friction costs and we show how we can identify and estimate the parameters of shifting costs and the relevant elasticities.

[1] This is similar to Koethenbuerger et al. [2019] who allow for corner solutions in the choice of the optimal transfer price, just one particular type of profit shifting strategy that multinational firms use.

A change in the corporate tax rate may have a small effect at the intensive margin of profit reporting since companies have already borne the fixed cost of shifting profits to the extent that they report no taxable profits in the UK. In turn, a tax cut may incentivise a firm to switch from reporting zero to positive taxable profits or vice versa, if that firm is close to a fixed cost threshold. Empirically, a model with non-convex profit shifting costs would explain why a large proportion of subsidiaries of foreign multinational companies in the UK (60%) report zero taxable profits (Bilicka [2019]).

To identify the characteristics of shifting frictions, we use the variation in taxable profit reporting responses of multinational subsidiaries generated from changes in foreign tax rates and anti-tax avoidance regulations. Specifically, we consider multinational subsidiaries of foreign headquartered companies reporting their taxable profits in the UK. We compare foreign subsidiaries from countries that changed their statutory tax rates or introduced anti-tax avoidance regulations during the analysed period (2000 – 2015) to subsidiaries from countries that did not introduce those changes during the analysed time period. Intuitively, if the fixed costs of profit shifting hypothesis is true, we would expect to observe little to no change in the taxable profits of foreign multinationals' UK subsidiaries in response to the analyzed changes at the intensive margin. A small change in the tax rate or in anti-tax avoidance regulations should not alter non-marginal firms' reported profits significantly, provided that the multinationals are already shifting an optimal amount of profits out of, or into the UK. In turn, changes in reported taxable profits in response to foreign tax cuts or anti-avoidance regulations may occur at the extensive margin, at which point firms close to the fixed cost threshold switch from reporting positive taxable profits to reporting zero taxable profits or vice versa.

In the preliminary version of this paper we explore two foreign tax reforms: the effects of the German tax cut of 2008 and the effects of the 2002 Italian Controlled Foreign Company (CFC) reform. Germany has cut its main federal statutory tax rate by 10 percentage points, from 25% to 15%. We consider UK subsidiaries of multinational companies with headquarters in Germany and compare them to UK subsidiaries of multinational companies with headquarters in France and US. During the analysed time period neither France nor US have changed their statutory tax rates. This tax cut reduced the total tax burden of multinationals headquartered in Germany from above that of the UK to below that of the UK at the time it was introduced. Hence, this cut should have a large effect on profit reporting in the UK. At the same time, in 2008, UK has introduced a reform that was aimed at increasing its competitiveness and reduced the statutory corporate tax rate from 30% in 2008 to 28% in 2009 and then incrementally down to 20% in 2017. However, the UK reform has affected

all foreign subsidiaries reporting profits in the UK equally.

Consider a tax rate cut in Germany in 2008. We ask the following question: do subsidiaries of German headquartered multinationals in the UK following that reform change their profit-reporting behaviour? According to the traditional profit shifting literature (see e.g.Hines and Rice [1994], Grubert and Slemrod [1998], Desai et al. [2006], Slemrod and Wilson [2009], Egger et al. [2010], Dischinger and Riedel [2011], Dharmapala and Riedel [2013], Dischinger et al. [2014], Gumpert et al. [2016]) if the German company was shifting profits to the UK at the margin before 2008 because of the lower UK tax rate, then the incentive to do so is smaller now. This could induce the German company to report lower taxable profits in the UK. Under the fixed costs hypothesis, we would expect companies switching from reporting positive to no taxable profits in the UK following the German tax rate cut. At the same time, we would not expect to observe any intensive margin response, i.e. the ratio of taxable profits to total assets should not significantly change following the tax cut.

Alternatively, we look at a large CFC reform in Italy that took place in 2002. The CFC rules stipulate that income of foreign low-tax subsidiaries should be included in domestic tax base. Hence, they create incentives for multinationals to move income away from low-tax jurisdictions towards countries with tax rates just above the CFC threshold rule (Clifford [2019]). We consider UK subsidiaries of multinational companies with headquarters in Italy and compare them to UK subsidiaries of multinational companies headquartered in France and Spain. Neither of those two countries changed their tax rates or CFC rules in the years 2000 - 2005.[2] Consider tightening the CFC regime in Italy in 2002. Clifford [2019] shows that firms in Italy would have an incentive to move profits from low tax-jurisdictions, previously not falling under the CFC rules, to higher tax rate countries in which they operate. This could induce Italian headquartered multinationals to move profits to the UK. Similar to the case of German tax rate cuts, under the fixed costs hypothesis, we would expect to observe the adjustment at the extensive margin.

We first present reduced form evidence using a simple difference-in-difference setting with two types of outcome variables: continuous ratio of taxable profits to total assets and a binary variable indicating whether taxable profits reported by a given subsidiary are positive or zero. The former will show us the intensive margin adjustments, the latter, the extensive margin adjustments. We further look at the two outcome variables jointly using a Heckman selection type model. We find that a German subsidiary is unlikely to change the amount of taxable profits reported in the UK, i.e. the ratio of its taxable profits to total assets after

[2]Note that Italy has strengthened their CFC rules in 2006. Italy has also cut its statutory tax rate from 33% in 2007 to 27.5% in 2008. Hence, we stop the comparison in 2005.

the reform. On the other hand, the likelihood of reporting zero taxable profits declines with the effect being particularly strong for subsidiaries directly owned by the headquarter and for multinational companies that have no tax havens as part of their ownership structure. Further, we find that ownership of an Italian subsidiary significantly reduces the likelihood of reporting zero taxable profits in the UK, while there is no change in the ratio of its taxable profits to total assets. Combining the results from the continuous and binary outcome models, using the Heckman selection model, we show that these results carry over through to that framework. This evidence is consistent with the optimisation frictions in the profit shifting behaviour.

Our results address a long-standing puzzle in the literature where the aggregate and firm level elasticities of taxable profits with respect to tax rate changes diverge dramatically. The firm level elasticities have been shown to be small, while aggregate elasticities are large (Dharmapala [2014]). If the response of firms to tax rate changes at the extensive margin is much larger than that at the intensive margin, for instance, due to fixed costs of profit shifting, we would expect the aggregate elasticities to be much larger than firm-level elasticities. This analysis is also related to the comparisons of labour supply macro and micro level elasticities in Chetty [2012]. He finds that that frictions can account for the gap in micro and macro level elasticities on the intensive margin. On the other hand, at the extensive margin both elasticities are very similar and frictions play minor role. We argue that in the context of profit shifting the frictions would have large effects at the extensive margin, where the hypothesis of non-convex cost of profit shifting would allow reconciliation of large disparities between micro and macro level elasticities. The channel that we propose to be at play here is the large cost of setting up a profit shifting strategy, which results in large propensity of foreign multinational subsidiaries to report zero taxable profits in the UK.

2 Reduced form evidence

2.1 Data and sample construction

To examine the effects of the tax rate cut in Germany and the CFC reform in Italy on profit reporting in the UK, we use the confidential universe of unconsolidated corporation tax returns in the UK for the years 2000 - 2014 provided by the UK tax authorities (HMRC). The dataset comprises all items that are submitted on the corporation tax return form (CT600 form) and the unit of observation is an unconsolidated statement in each of the years, i.e. each subsidiary of a company operating in the UK files a separate tax return. We use this

data to obtain information on the taxable profits variable. The HMRC data does not include any firm level characteristics, apart from trading turnover. Therefore we merge the HMRC data with the accounting data from the FAME dataset. FAME dataset, collected by Bureau van Dijk, provides balance sheet information for most of the UK companies. For instance, it gives us information on total assets, accounting profits, age of firms, number of employees, industry and leverage.[3]

We use the FAME ownership information to identify firms as UK subsidiaries of foreign multinational companies which are subsidiaries of multinational companies that have headquarters outside of the UK. In particular, we select firms for which we can identify the headquarter to be in Germany, Italy (for our treatment groups) and Spain, France and US (for our control groups).

In additional robustness checks, we limit the sample of multinational firms to subsidiaries that have direct links between the UK subsidiary and given headquarter. Thus, we only include UK subsidiaries that report to be owned directly 100% by the headquarter. We do this, because we think that the direct link between headquarter and subsidiary might strengthen the profit shifting incentives. In addition, we also conduct a robustness check in which we limit the sample to include only multinational groups that report to have no tax haven subsidiaries as part of their group structure. We hypothesise that these multinationals may have larger incentives to shift profits between higher tax jurisdictions that we consider in this paper, rather than shift most of their profits to tax havens (Dowd et al. [2017]).

When we consider the effects of German tax rate cut, our sample contains 3,870 unique German subsidiaries, 2,910 unique French subsidiaries and 16,724 unique US subsidiaries. There are 8,123 US subsidiaries with direct links, 1,248 French ones and 1,454 German ones. There are 3,726 German subsidiaries that belong to multinationals with no links to tax havens, 2,814 French ones and 15,791 US ones. This analysis is conducted using years 2006 - 2010, i.e 2 years before the reform and 2 years after the reform.

When we consider the effects of Italian CFC reform, our sample contains 1,278 unique Italian subsidiaries, 736 unique Spanish subsidiaries and 2,910 unique French ones. There are 1,248 Italian subsidiaries that belong to multinationals with no links to tax havens, 2,814 French ones and 711 Spanish ones. This analysis is conducted using years 2000 - 2005, i.e 2 years before the reform and 2 years after the reform.

[3]Matching the HMRC data with accounting data restricts the sample size. We find a matched unconsolidated accounting statement in FAME for 76 percent of unconsolidated tax returns from the HMRC data, which includes 89 percent of the total tax liability and 92 percent of total trading turnover in the UK. We further ensure that we have non-missing total assets information and full 12 months accounting period for each matched HMRC-FAME observation.

2.2 Reduced form models

We use the difference-in-difference approach to investigate the profit reporting behaviour of multinational firms in the UK in response to the two reforms. Subsidiaries of multinational firms reporting in the UK that are headquartered in Germany and in Italy are in our treated groups. Subsidiaries of multinational firms reporting in the UK that are headquartered in France, US and Spain are in our control groups. We run two sets of difference-in-difference models using two reforms separately. Further, within each reform, we run two sets of difference-in-difference models using two types of dependent variables. We use the following general specifications:

$$ROA_{i,t} = \alpha + \beta_1 treated_i \times post_t + \sigma_1 X_{it}^{'} + \theta_i + \eta_t + \epsilon_{it} \quad (1)$$

$$ztp_{i,t} = \alpha + \beta_2 treated_i \times post_t + \sigma_2 X_{it}^{'} + \theta_i + \eta_t + \epsilon_{it} \quad (2)$$

where $ROA_{i,t}$ is the ratio of taxable profits to total assets for each UK subsidiary belonging to a foreign multinational and $ztp_{i,t}$ is a dummy equal to one when a firm reports zero taxable profits in a given year. $treated_i$ is a dummy variable that equals one, if a subsidiary is headquartered in either Germany or Italy and zero otherwise; $post_t$ is a dummy variable that equals one from 2009 onward for the German tax cut reform and from 2003 onward for the Italian CFC reform. $X_{it}^{'}$ is a set of firm-level control variables, such as group size and UK size; θ_i is a firm-specific fixed effect, η_t is a time fixed effect, and ϵ_{it} is the error term.

The parameters of interest are βs. β_1 captures the effect of the reform on the ratio of taxable profits to total assets, i.e. the intensive margin. β_2 captures the effect of the reform on the propensity of the firm to report zero taxable profits, i.e. the extensive margin. Under the fixed cost hypothesis, we should observe β_2 to be positive and significant for the case of the German tax reform. German subsidiaries should report less profits in the UK now that the German tax rate is lower than the UK one, since they may have larger incentive to report these profits back home. β_2 should be negative and significant for the case of the Italian anti-tax avoidance reform. Italian subsidiaries should report higher profits in the UK now that Italy is taxing profits located in lower tax jurisdictions in Italy anyway. In both cases, under the fixed cost hypothesis, β_1 should be close to zero or statistically not significant.

2.2.1 Dynamic model

The results using the difference-in-difference approach present causal estimates of the effects of the analysed reform on reported profits for the treated group under the assumption that absent each reform, reported profits would have evolved in a similar way to the control group. To test this assumption, we further expand the simple difference-in-difference approach to event study methodology. This allows us to evaluate the pre-reform trends to confirm the validity of our difference-in-difference approach. Further, we consider the dynamic effects of the reforms. Thus, we estimate the following specifications that correspond to (1) and (2) directly:

$$ROA_{i,t} = \alpha + \beta_1 treated_i \times \sum_{\kappa=-2}^{2} \delta_t \mathbb{1}[t = \kappa] + \sigma_1 X_{it}^{'} + \theta_i + \eta_t + \epsilon_{it} \tag{3}$$

$$ztp_{i,t} = \alpha + \beta_2 treated_i \times \sum_{\kappa=-2}^{2} \delta_t \mathbb{1}[t = \kappa] + \sigma - 2X_{it}^{'} + \theta_i + \eta_t + \epsilon_{it} \tag{4}$$

where $\mathbb{1}[t = \kappa]$ is a series of year dummies that equal one when the tax reform was κ years away. Each of the δ_t coefficients measures a change in reported profits (3) or in the propensity to report zero taxable profits (4) for a treated firm relative to a control firm in the κ year before or after the reform. We omit $\kappa = -1$ year, which means that we estimate the effect δ_t relative to the year before each reform came into effect.

2.2.2 Selection model

Finally, we combine the results from equations (1) and (2) for $ROA_{i,t}$ and $ztp_{i,t}$ in a Heckman style model. The importance of the extensive margin for taxable profit reporting in response to the analyzed reforms suggests that there may be a selection of companies into zero and positive taxable profit reporting groups. Hence, the OLS estimates from pooling all observations together may be inconsistent and downward biased. Further, Heckman selection model would help to disentangle whether our results are driven by the extensive or intensive margin. We assume that the variables determining whether the company reports a positive profit are separate from variables determining how much profit the company is reporting, once it decides to do so at all. Therefore, the first equation we estimate will determine why companies report positive profits. This involves regressing dummy equal to 1 when a firm reports positive profits and 0 otherwise on determinants of reporting positive profits. The

second equation involves estimating a regression of taxable profits divided by total assets conditional on reporting positive taxable profits. This is equivalent to equation (1) but on a restricted sample of positive taxable profits only. We estimate those two equations jointly using the maximum likelihood technique, with error terms from both equations assumed to be bivariate normal.

For identification purposes estimating Heckman selection model requires at least one variable in the first stage that is not a determinant in second stage. In our case we need a variable that determines whether a firm chooses to report any profits at all that is not a determinant of how much profits a firm is going to report. We use the following selection of variables in the first stage: dummies for reporting zero taxable profits in at least 2 of the last 3 years, lagged zero table profit dummies, presence of a tax haven parent, last years losses carried forward, and average industry turnover.

A firm that reports no taxable profits in at least 2 out of the last 3 years or that reports zero taxable consistently each year prior to the reform may be doing this not because it made no profits, but because it may be signalling 'aggressive tax avoidance' behaviour. Similarly, having a tax haven parent may determine whether a company is an aggressive tax avoider. These two determinants may affect whether a company decides to report any profits in the UK or whether it shifts everything to, for example, its tax haven headquarter. The presence of the tax haven parent per se does not affect the profitability of the company in the UK, i.e. its ROA. Further, each company filing a tax return in the UK has to report whether is has any losses from previous periods that it wants to use to offset against taxable profits in this period. They affect whether the company reports zero taxable profits as it can use those losses to reduce its taxable profits, but they may not affect how much profit the company made this year. Finally, we use the average industry turnover, which approximates the business cycle fluctuations that would affect the proportion of companies reporting zero taxable profits in a particular year. Average industry turnover is calculated for each year and each 2 digit industry code using mean trading turnover from the tax returns data. We use combinations of those five variables together with total assets in the first stage equation that determines whether a company reports zero or positive profits. In the second stage equation we use the following determinants of the reported profits: total assets, leverage ratio, statutory tax rate in the location of the parent firm, whether a firm made losses in the previous year, whether a firm owns a tax haven subsidiary, logarithm of trading turnover.

2.3 Reduced form results

In Table 1 and Table 2 we present the baseline difference-in-difference results. Table 1 summarizes the results using the German tax rate reform, comparing the UK subsidiaries of multinationals headquartered in Germany to those headquartered in the US (column 1-3) and to those headquartered in France (columns 4-6). We find that the German tax rate cut significantly increases the likelihood of reporting zero taxable profits for German multinationals in the UK relative to both US and French ones. Specifically, German multinationals are 2.3% more likely to report zero taxable profits relative to US ones and 3.5% more likely relative to French ones. The effect of the reform on the reported ratios of taxable profits to total assets is small and negative when we compare German firms to the US ones and close to zero and insignificant when we compare them to French ones. These effects are larger when we consider only the sub-sample of firms that are directly owned by parents in respective countries (Table 5) and similar in magnitudes when we consider the sample of multinational firms which have no links to tax havens listed in FAME dataset (Table 6).

This result is consistent with our hypothesis that when German tax rate drops below the UK one, German firms might choose to report lower profits in the UK. This may occur for two reasons, which we cannot distinguish. First, before the tax cut German firms were using UK as a low tax destination and shifting profits towards the UK from Germany. After the reform, they choose not to shift. Second, before the reform German firms were using UK as a low tax hub, where some profits were shifted to and from tax havens. After the reform, they do not use UK hub at all, but directly do their operations using the German headquarter. We show that the majority of this adjustment happens at the extensive margin, where firms choose to stop reporting taxable profits all together. Since our fixed cost hypothesis embeds the convex cost hypothesis, it is entirely possible that there is some small adjustment along the intensive margin. This is what we observe when we compare German multinational subsidiaries to the US ones.

Table 2 summarizes the results using the Italian anti-tax avoidance reform, i.e. an introduction of tighter CFC regulations. We compare the UK subsidiaries of multinationals headquartered in Italy to those headquartered in France (column 1-3) and those headquartered in Spain (columns 4-6). We find that Italian CFC reform has significantly reduced the likelihood of reporting zero taxable profits for Italian multinationals in the UK relative to both French and Spanish ones. Specifically, Italian multinationals are 7.8% less likely to report zero taxable profits relative to French ones and 6.1% less likely relative to Spanish ones. Here, the effect of the reform on the reported ratios of taxable profits to total assets in

almost zero and insignificant in both comparison cases. These effects are similar in magnitude when we consider the sample of multinational firms which have no links to tax havens listed in FAME dataset (Table 7).

Table 1: The effects of German tax reform.

	(1) ztp ols	(2) ztp probit	(3) ROA	(4) ztp ols	(5) ztp probit	(6) ROA
$treated_i \times post_t$	0.023**	0.124**	-0.013***	0.035**	0.088**	-0.009
	(0.009)	(0.049)	(0.004)	(0.015)	(0.038)	(0.008)
Constant	0.492***	-0.038	0.113***	0.558***	0.144***	0.102***
	(0.006)	(0.030)	(0.006)	(0.021)	(0.054)	(0.011)
Observations	32,620	32,620	32,525	12,321	12,317	12,298
Number of firms	9,816	9,816	9,789	9,816	9,816	9,789

Note: These are regression results from considering the effects of German tax rate change in 2008 on the reported taxable profits of UK subsidiaries of German HQ companies relative to French HQ ones - columns 4-6 and US HQ ones - column 1-3. ztp ols refers to OLS specification results using zero taxable profits as a dependant variable, ztp probit refers to probit specification results using zero taxable profits as a dependant variable, ROA refers to OLS results using the ratio of taxable profits to total assets as a dependant variable. The data contains 3870 unique German subsidiaries, 2910 unique French subsidiaries and 16724 unique US subsidiaries. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In all specifications we control for the subsidiary size by including log of total assets and for multinational size by including number of subsidiaries that multinational report in FAME data. All subsidiaries are included here. Source: matched HMRC and FAME data.

2.4 Selection model results

The results from Heckman selection model confirm our baseline findings. In Table 3 we show that the effect of the German tax rate reform on reported profits is entirely driven by the extensive margin. The results from first stage regressions on the determinants of reporting positive profits are statistically significant across specifications. The negative coefficients on the interaction term between $treated_i \times post_t$ suggest that after the German tax rate cut, firms in our treated groups were less likely to report positive taxable profits in the UK. This is exactly the same results as presented in columns (1) and (2) in Table 1. The magnitude of the effect is larger here than in the simple OLS estimations, suggesting that after the German tax rate cut, German firms in the UK are 8-10% less likely to report positive taxable profits

Table 2: The effects of Italian anti-avoidance reform.

	(1) ztp ols	(2) ztp probit	(3) ROA	(4) ztp ols	(5) ztp probit	(6) ROA
$treated_i \times post_t$	-0.078***	-0.387***	-0.007	-0.061**	-0.302**	0.000
	(0.019)	(0.098)	(0.007)	(0.028)	(0.134)	(0.010)
Constant	0.531***	0.146**	0.083***	0.456***	-0.219**	0.099***
	(0.014)	(0.071)	(0.007)	(0.022)	(0.102)	(0.012)
Observations	8,062	8,062	8,047	3,650	3,650	3,638
Number of firms	1,902	1,902	1,900	864	864	863

Note: These are regression results from considering the effects the Italian CFC refrom in 2002 on the reported taxable profits of UK subsidiaries of Italian HQ companies relative to French HQ ones - columns 1-3 and Spanish HQ ones - column 4-6. ztp ols refers to OLS specification results using zero taxable profits as a dependant variable, ztp probit refers to probit specification results using zero taxable profits as a dependant variable, ROA refers to OLS results using the ratio of taxable profits to total assets as a dependant variable. Our sample contains 1,278 unique Italian subsidiaries, 736 unique Spanish subsidiaries and 2,910 unique French ones. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In all specifications we control for the subsidiary size by including log of total assets and for multinational size by including number of subsidiaries that multinational report in FAME data. All subsidiaries are included here. Source: matched HMRC and FAME data.

relative to French multinational subsidiaries. This results holds in terms of both significance and magnitude irrespective of the first stage determinants of positive taxable profit reporting we use. The second stage coefficients are insignificant and very close to zero in magnitudes in all specifications.[4]

In Table 4 we show similar results using the Italian CFC reform. Here, the results from the first stage regressions on the determinants of reporting positive profits are statistically significant with very large magnitudes. They suggest that after the CFC reform, Italian firms in the UK are 52-57% less likely to report positive taxable profits relative to French multinational subsidiaries. This results holds in terms of both significance and magnitude irrespective of the first stage determinants of positive taxable profit reporting we use. Here, we observe a significant effect in second stage regression too. However, the magnitude of the effect is much smaller than the one in first stage regressions. Again, this is consistent with our approach that allows adjustment on intensive margin by embedding the convex cost hypothesis into the fixed cost of profit shifting model.

Taken together, The results from Tables 1, 2, 3 and 4 suggest that the effects of foreign tax rate cuts and foreign anti-tax avoidance reforms that result in changes in incentives to shift profits to the UK affect the extensive margin of profit reporting with little to no effect on the intensive margin. It is important to note here that we do not observe the same patterns when we use profit and loss from the accounting statement and the likelihood of reporting losses in the financial statements.

[4]In unreported exercises we perform Heckman selection estimations on the restricted models that only include subsidiaries directly owned by the parent and subsidiaries belonging to multinational groups that do not report to have any tax haven subsidiaries. The results hold in both cases, with very similar coefficient magnitudes. We also run the same estimation using the US multinationals as a comparison group to obtain very similar effects.

Table 3: The effects of German tax rate cut: Heckman selection model.

	(1)	(2)	(3)	(4)
First stage results				
$treated_i \times post_t$	-0.092***	-0.080**	-0.099***	-0.083**
	(0.032)	(0.034)	(0.031)	(0.034)
Constant	0.573***	0.580***	0.380***	0.637***
	(0.082)	(0.086)	(0.078)	(0.083)
Second stage results				
$treated_i \times post_t$	-0.003	-0.005	-0.003	-0.005
	(0.019)	(0.019)	(0.019)	(0.019)
Constant	0.317***	0.282***	0.306***	0.284***
	(0.019)	(0.018)	(0.020)	(0.018)
Observations	12,213	12,213	12,213	12,213
No of firms	3,605	3,605	3,605	3,605
Control variables: First Stage				
Size	x	x	x	x
Losses in last 2 out of 3 years	x	x	x	
Industry turnover	x	x		
Previous loss	x	x		
Tax haven sub	x	x		
Previous loss	x	x		
Lagged ztp		x		x

Note: These are Heckman selection results from considering the effects of German tax rate change in 2008 on the reported taxable profits of UK subsidiaries of German HQ companies relative to French HQ ones. In all specifications lambda is significant and negative at 1% level. First stage results show the result from regression of the likelihood of reporting positive taxable profits on determinants of reporting positive taxable profits. First stage controls are listed in the Table under each corresponding column. Second stage results show the results from OLS specification using the ratio of taxable profits divided by total assets as a dependant variable on the restricted sample of positive taxable profits only. The data contains 3870 unique German subsidiaries and 2910 unique French subsidiaries. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In the second stage equation we use the following determinants of the reported profits: leverage ratio, statutory tax rate in the location of the parent firm, whether a firm made losses in the previous year, whether a firm owns a tax haven subsidiary, logarithm of trading turnover. All subsidiaries are included here. Source: matched HMRC and FAME data.

Table 4: The effects of Italian anti-avoidance reform: Heckman selection model.

	(1)	(2)	(3)	(4)
First stage results				
$treated_i \times post_t$	0.559***	0.527***	0.568***	0.521***
	(0.058)	(0.063)	(0.057)	(0.063)
Constant	0.624***	0.641***	0.521***	0.750***
	(0.163)	(0.167)	(0.153)	(0.160)
Second stage results				
$treated_i \times post_t$	-0.098***	-0.089***	-0.102***	-0.091***
	(0.027)	(0.027)	(0.027)	(0.027)
Constant	0.242***	0.225***	0.257***	0.229***
	(0.027)	(0.026)	(0.029)	(0.026)
Observations	3,613	3,613	3,613	3,613
Control variables: First Stage				
Size	x	x	x	x
Losses in last 2 out of 3 years	x	x	x	
Industry turnover	x	x		
Previous loss	x	x		
Tax haven sub	x	x		
Previous loss	x	x		
Lagged ztp		x		x

Note: These are Heckman selection results from considering the effects of Italian CFC reform in 2002 on the reported taxable profits of UK subsidiaries of Italian HQ companies relative to Spanish HQ ones. In all specifications lambda is significant and negative at 1% level. First stage results show the result from regression of the likelihood of reporting positive taxable profits on determinants of reporting positive taxable profits. First stage controls are listed in the Table under each corresponding column. Second stage results show the results from OLS specification using the ratio of taxable profits divided by total assets as a dependant variable on the restricted sample of positive taxable profits only. Our sample contains 1,278 unique Italian subsidiaries and 736 unique Spanish subsidiaries In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In the second stage equation we use the following determinants of the reported profits: leverage ratio, statutory tax rate in the location of the parent firm, whether a firm made losses in the previous year, whether a firm owns a tax haven subsidiary, logarithm of trading turnover. All subsidiaries are included here. Source: matched HMRC and FAME data.

3 The model

The MNE has N subsidiaries, in separate jurisdictions. It aims to maximise its end-of period t value, V_t:

$$V_t = E_t \sum_{j=0}^{\infty} \beta_j \{[\sum_{i=1}^{N} \Pi_{it+j}] - y_{t+j}\} \tag{5}$$

where Π_{it+j} is the net cash flow generated in subsidiary i in period $t+j$; y_{t+j} is the investment by the MNE in the tax avoidance asset, Y_{t+j}), in period $t+j$; and $\beta_j = \frac{1}{(1+r)^j}$ is the discount factor.

The total expected value of the tax avoidance asset at the end of period t is

$$E(Y_t) = Y_{t-1}[1 - E(g_t)] + y_t$$

where $E(g_t)$ is the expected decline in its value to the MNE in period t , which depends solely on changes in the international tax regime (and where $g_t \leq 1$). So governments can change tax rules to reduce the value of the tax avoidance asset, in effect by increasing g_t. The expenditure y_t is assumed to be incurred outside country i, e.g. in the tax haven, or the parent country, so does not affect tax in country i. The tax avoidance asset is specific to the MNE and cannot be sold. Hence $y_t \geq 0$.

Each subsidiary uses tangible capital, K_{it-1} (available at the beginning of the period) to produce net revenue in period t of $F(K_{it-1})$. It invests I_{it} in tangible capital (which increases revenue the following period). The value of tangible capital at the end of period t is

$$K_{it} = K_{it-1}(1 - \delta) + I_{it}$$

where δ is the true economic depreciation rate.

We assume for simplicity that this is also the tax depreciation rate. The "true" tax base in subsidiary i is therefore

$$B_{it} = F(K_{it-1}) - \delta K_{it-1}$$ [5]

The subsidiary shifts a proportion α_{it} of the tax base to a tax haven where it pays no tax. So the "observed" tax base in country i is

[5] The investment in the intangible is not deductible.

$$B^*_{it} = (1 - \alpha_{it})B_{it}$$

At a tax rate of τ_i, tax paid in subsidiary i is therefore

$$T_{it} = \tau_i B^*_{it} = \tau_i(1 - \alpha_{it})B_{it}$$

There are variable costs of shifting profit. These depend on the size and proportion of the tax base to be shifted. They also depend negatively on the beginning of period tax avoidance asset, Y_{t-1}. Specifically, let the variable costs in subsidiary i be

$$c_{it} = c(\alpha_{it}, Y_{t-1})B_{it}$$

with

$$c_\alpha > 0, c_{\alpha\alpha} > 0$$

$$c_Y < 0, c_{YY} > 0, c_{\alpha Y} < 0$$

(where these are all for subsidiary i). So the key cost function is convex in α_{it} and in Y_{t-1}. And a rise in Y_{t-1} reduces costs, and also reduces c_α.

We may use a quadratic form of variable costs, for example:

$$c_{it} = \frac{\gamma}{2}\frac{B_{it}}{Y_{t-1}}\alpha^2_{it}$$

Assume for now that these variable costs are not tax deductible. Values of α_{it} must lie between zero and 100%, i.e. $\alpha_{it} \geq 0$ and $\alpha_{it} \leq 1$. We do not consider shifting profits into the subsidiary in i.

Net cash flow generated in subsidiary i in period t is therefore

$$\begin{aligned}\Pi_{it} &= F(K_{it-1}) - I_{it} - T_{it} - c(\alpha_{it}, Y_{t-1})B_{it} \\ &= [1 - \tau_i(1 - \alpha_{it}) - c(\alpha_{it}, Y_{t-1})](F(K_{it-1}) - \delta K_{it-1}) - K_{it} + K_{it-1}\end{aligned}$$

In period t the MNE chooses y_t (in effect $E(Y_t)$), as well as K_{it} and α_{it} in each subsidiary i to maximise V_t, subject to constraints

$$y_t = E_t(Y_t) - Y_{t-1}[1 - E(g_t)] = Y_t - Y_{t-1}[1 - g_t] \geq 0$$
$$\alpha_{it} \geq 0$$
$$\alpha_{it} \leq 1$$

which are associated with multipliers λ_t, μ_{it} and η_{it}, respectively.

3.1 First order conditions

The following are the first order conditions for this problem:

$$K_{it} : -1 + \beta + \beta[1 - \tau_i(1 - \alpha_{it+1}) - c(\alpha_{it+1}, Y_t)](F_{Kt+1} - \delta) = 0$$
$$E(Y_t) : -1 + \beta[1 - E_t(g_t + 1) - \beta[\sum_{\imath=1}^{N} B_{it+1} c_{Yit+1}] + \lambda_t - \beta\lambda_{t+1}[1 - E_t(g_{t+1})] = 0$$
$$\alpha_{it} : \{\tau_i - c_\alpha\}B_{it} + \mu_{it} - \eta_{it} = 0$$
$$\lambda_t y_t = 0; \mu_{it}\alpha_{it} = 0; \eta_{it}(_{it} - 1) = 0$$

Rearranging the condition for K_{it} (and substituting for $\beta = \frac{1}{(1+r)}$) we get a broadly conventional expression for the cost of capital:

$$F_{Kt+1} = \frac{r}{1 - \tau_i(1 - _{it+1}) - c(\alpha_{it+1}, Y_t)} + \delta$$

In a simple model, r would be divided by $1 - \tau_i$. Here that is adjusted for profit shifting, and the costs of profit shifting.

Define $C_{Yt+1} = \sum_{i=1}^{N} B_{it+1} c_{Yit+1}$ as the total weighted change in variable costs arising from a marginal change in Y_t. Then the first order condition for $E(Y_t)$ is

$$-C_{Yt+1} = (r + E_t(g_{t+1})) - \lambda_t(1 + r) + \lambda_{t+1}[1 - E(g_{t+1})]$$

Assuming that the firm is not at $y_t = 0$, then $\lambda_t = \lambda_{t+1} = 0$, and we have a simple formulation for investment in that asset:

$$-C_{Yt+1} = r + E_t(g_{t+1})$$

Here the (positive) benefit of a higher Y_t ($-C_{Yt+1}$) is set equal to the user cost ($r +$

$E_t(g_{t+1})$). This mirrors the condition for tangible capital but applies to the MNE group as a whole. Note here that there are no adjustment costs or frictions in the choice of y_t - or Y_t. Given the timing in the model, and unexpected change in g_t can leave the MNE at a suboptimal level of Y_t, but if there is no further unexpected effect, the MNE can revert to the optimal position a period later with Y_{t+1}.

The condition for α_{it} is also straightforward. There are three possible regimes, depending the value of Y_t:

1. $0 < \alpha_{it} < 1$ which implies that $\mu_{it} = \eta_{it} = 0$; in this case the firm balances the marginal benefits and costs of profit shifting, up to the point at which

$$c_\alpha(\alpha_{it+1}, Y_t) = \tau_i$$

2. $\alpha_{it} = 0$ which implies that $\mu_{it} = \{c_\alpha - \tau_i\}B_{it}; \eta_{it} = 0$: in this case the marginal cost of shifting even the first unit of the tax base exceeds the benefit through reduced taxation, and so the firm does not shift any profit. μ_{it} is the shadow value of being able to relax the constraint that α_{it} cannot be negative.

3. $\alpha_{it} = 1$ which implies that $\mu_{it} = 0; \eta_{it} = \{\tau_i - c_\alpha\}B_{it}$: in this case the marginal cost of shifting even the last unit of the tax base is lower than the benefit of reduced taxation, and so the firm shifts all of its profit. η_{it} is the shadow value of being able to relax the constraint, to shift more than 100% of its profit.

3.2 Effects of policy changes

In this model, governments can make two policy choices. They can change international tax rules, which can change g_t, and hence reduce the value of the tax avoidance capital. That has the effect of changing the variable costs of profit shifting. In turn, that can have an intensive margin effect if the firm is in case (1) above, or an extensive margin effect, moving it from (3) - or possibly (2) - to (1). Second, the local government it can change the tax rate. This can also have extensive and intensive margin effects.

Combating tax avoidance Governments can increase g_t and $E_t(g_{t+1})$. This increases the user cost of investment in the tax avoidance asset. Start with the first order condition for Y_t (assuming $\lambda_t = \lambda_{t+1} = 0$), but writing it out in full:

$$-C_{Yt+1} = -\sum_{i=1}^{N} B_{it+1} c_Y(\alpha_{it+1}, Y_t) = r + E_t(g_{t+1})$$

Totally differentiating with respect to g_t:

$$-\sum_{i=1}^{N}\{\frac{\partial B_{it+1}}{\partial K_{it}}\frac{\partial K_{it}}{\partial(g_t)}c_Y(\alpha_{it+1}, Y_t) + B_{it+1}[\frac{\partial c_{Yit+1}}{\partial \alpha_{it+1}}\frac{\partial \alpha_{it+1}}{\partial(g_t)} + \frac{\partial c_{Yit+1}}{\partial Y_t}\frac{\partial Y_t}{\partial(g_t)}]\} = 1$$

Totally differentiating with respect to $E_t(g_{t+1})$

$$-\sum_{i=1}^{N}\{\frac{\partial B_{it+1}}{\partial K_{it}}\frac{\partial K_{it}}{\partial E_t(g_t+1)}c_Y(\alpha_{it+1}, Y_t) + B_{it+1}[\frac{\partial c_{Yit+1}}{\partial \alpha_{it+1}}\frac{\partial \alpha_{it+1}}{\partial E_t(g_t+)} + \frac{\partial c_{Yit+1}}{\partial Y_t}\frac{\partial Y_t}{\partial E_t(g_t+1)}]\} = 1$$

Which we can also write as

$$-C_{YY}\frac{\partial Y_t}{\partial E(g_t)} - \sum_{i=1}^{N}\{(F(K_{it}) - \delta)c_Y(\alpha_{it+1}, Y_t)\frac{\partial K_{it}}{\partial E(g_t)} + B_{it+1}c_{Y\alpha i}\frac{\partial \alpha_{it+1}}{\partial E(g_t)}\} = 1$$

Where all the derivatives that follow (e.g. c_{YY}) are dated in period $t+1$. To respond to a change in $E(g_t)$, the MNE must therefore in principle take into account the choices it makes over Y_t, but also for K_{it} and α_{it+1} in each subsidiary, i. If there were no changes to K_{it} and α_{it+1}, then this expression would simplify to:

$$\frac{\partial Y_t}{\partial E(g_t)} = -\frac{1}{c_{YY}}$$

Expecting higher combating of avoidance to reduce Y_t therefore requires the cost function to be convex in Y_t: $c_{YY} > 0$. Let us assume that K_{it} is fixed. Then the condition reduces to:

$$\frac{\partial Y_t}{\partial E(g_t)} = -\frac{1 + \sum_{i=1}^{N} B_{it+1}c_{Y\alpha i}\frac{\partial \alpha_{it+1}}{\partial E(g_t)}}{C_{YY}}$$

So here the MNE must consider the impact of changing $E(g_t)$ on Y_t, but also α_{it+1} in each

subsidiary, and on the effects of these on the weighted sum of marginal costs of profit shifting. Assuming that $c_{Y\alpha} < 0$ in all countries, and that $C_{YY} > 0$, then this is consistent with a rise in $E(g_t)$ having a negative impact on both Y_t and α_{it+1} in each subsidiary. An interpretation of what happens here is that the increase in $E(g_t)$ first reduces Y_t. This raises the variable costs of profit shifting, which will induce subsidiaries also to reduce the proportion of the tax base shifted.

To see this further, consider the first order condition for profit shifting in subsidiary i. For the intensive margin regime (1) case, we have

$$c_\alpha(\alpha_{it+1}, Y_t) = \tau_i$$

Totally differentiating again, with respect to $E(g_t)$

$$\frac{\partial c_\alpha}{\partial \alpha_{it+1}} \frac{\partial \alpha_{it+1}}{\partial E(g_t)} + \frac{\partial c_\alpha}{\partial Y_t} \frac{\partial Y_t}{\partial E(g_t)} = 0$$

or

$$\frac{\partial \alpha_{it+1}}{\partial E(g_t)} = -\frac{c_{\alpha Y}}{c_{\alpha\alpha}} \frac{\partial Y_t}{\partial E(g_t)}$$

Assuming that $c_{\alpha Y} < 0$ and $c_{\alpha\alpha} > 0$, then an increase in $E(g_t)$ is likely to reduce both Y_t and α_{it+1}. The reduction in Y_t increases c_α and the reduction in α_{it+1} raises c_α, so that overall c_α is unchanged and still equal to τ_i. But less profit is shifted. Note that this condition applies to the subsidiary in country i. We could in principle aggregate this over all countries and combine these two expressions to solve for $\frac{\partial Y_y}{\partial E(g_t)}$ and $\frac{\partial \alpha_{it+1}}{\partial E(g_t)}$ independently of each other.

In regime (3), the reduction in Y_t as a result of the rise in $E(g_t)$ will induce a rise in c_α, assuming again that $c_{\alpha Y} < 0$. But in this regime we start with $\tau_i - c_\alpha$. So the rise in c_α may or may not reverse the sign of $\tau_i - c_\alpha$ for the last unit of profit shifted.

If it does not, then the rise in Y_t will have no effect on the profit shifting of that subsidiary (since it continues to shift all profit), so α_{it+1} remains equal to 1. If it does, then there will also be an extensive margin effect, as the subsidiary switches to regime (1). In this case, we also have the case in which α_{it+1} is reduced, and we get to $\tau_i = c_\alpha$. Subsidiaries in regime (2) should be unaffected by a rise in Y_t; they will continue not to shift any profit, so α_{it+1} remains equal to 0.

Increasing the tax rate Suppose the government in i increases τ_i. We start again with considering the first order condition for Y_t. Totally differentiating with respect to to τ_i yields:

$$-\sum_{j=1}^{N}\{\frac{\partial B_{jt+1}}{\partial K_{jt}}\frac{\partial K_{jt}}{\partial \tau_i}c_Y(\alpha_{jt+1},Y_t)+B_{jt+1}[\frac{\partial c_{Yjt+1}}{\partial \alpha_{jt+1}}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}+\frac{\partial c_{Yjt+1}}{\partial Y_y}\frac{\partial Y_t}{\partial \tau_i}]\}=0$$

Again, let us assume that K_{it} is unaffected. Then we have

$$\frac{\partial Y_t}{\partial \tau_i}\sum_{j=1}^{N}\{B_{jt+1}c_{YYj}\}=-\sum_{j=1}^{N}\{B_{jt+1}[\frac{\partial c_{Yjt+1}}{\partial \alpha_{jt+1}}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}]\}$$

Define $C_{YY}=\sum_{j=1}^{N}\{B_{jt+1}c_{YYj}\}$ to be the weighted sum of all the marginal c_{YYj}. Then

$$\frac{\partial Y_t}{\partial \tau_i}=-\frac{\sum_{j=1}^{N}B_{jt+1}c_{Y\alpha j}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}}{C_{YY}}$$

Note that here we allow for α_{it+1} to change in all subsidiaries, which may arise because of an indirect effect through Y_t. That in turn would be induced by a change in profit shifting in country i. So let us turn next to the profit shifting response in subsidiary i regime (1).

$$c_{\alpha\alpha i}\frac{\partial \alpha_{it+1}}{\partial \tau_i}+c_{\alpha Yi}\frac{\partial Y_t}{\partial \tau_i}=1$$

And so

$$\frac{\partial \alpha_{it+1}}{\partial \tau_i}=\frac{1-c_{\alpha Yi}\frac{\partial Y_t}{\partial \tau_i}}{c_{\alpha\alpha i}}$$

For $\frac{\partial Y_t}{\partial \tau_i}=0$, this is a straightforward case in which a higher tax rate induces more profit shifting, with $c_{\alpha\alpha i}>0$. This would be a reasonable approximation if i is like a small open economy within the MNE. But there may also be a change in Y_t (even if it is a small effect) because the benefits of shifting profit are greater with a higher τ_i. So we might expect $\frac{\partial Y_t}{\partial \tau_i}>0$. That would reduce c_α at a given level of profit shifting, so that would make the impact on α_{it+1} larger - which is reflected in the equation since $c_{\alpha Yi}<0$.

We now have 2 expressions for the effects of a rise in τ_i on α_{it+1} and Y_t, from two of the first order conditions. To explore this, let us continue to assume that K_{it} is fixed. Then we have

$$\frac{\partial Y_t}{\partial \tau_i}=-\frac{\sum_{i=1}^{N}B_{jt+1}c_{Y\alpha j}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}}{C_{YY}}=-\frac{B_{it+1}c_{Y\alpha i}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}}{C_{YY}}-\frac{\sum_{j\neq i}^{N}c_{Y\alpha j}\frac{\partial \alpha_{jt+1}}{\partial \tau_i}}{C_{YY}}$$

and

$$\frac{\partial \alpha_{jt+1}}{\partial \tau_i} = \frac{1 - c_{\alpha Y i} \dfrac{\partial Y_t}{\partial \tau_i}}{c_{\alpha \alpha i}}$$

Combining these, we have

$$\frac{\partial \alpha_{jt+1}}{\partial \tau_i} = \frac{1 + c_{\alpha Y i} \dfrac{B_{it+1} c_{Y \alpha i} \dfrac{\partial \alpha_{jt+1}}{\partial \tau_i} + A}{C_{YY}}}{c_{\alpha \alpha i}}$$

where A is the weighted impact on the proportion of profit shifted in other countries. Rearranging, we have:

$$\frac{\partial \alpha_{jt+1}}{\partial \tau_i} = \frac{C_{YY} + A}{c_{\alpha \alpha i} C_{YY} - B_{it+1} c_{\alpha Y i} c_{Y \alpha i}}$$

Assuming that A is small, then $\frac{\partial \alpha_{jt+1}}{\partial \tau_i} > 0$ if $c_{\alpha \alpha i} C_{YY} > B_{it+1} c_{\alpha Y i} c_{Y \alpha i}$ or

$$c_{\alpha \alpha i}(\{B_{it+1} c_{YYi}\} + \sum_{j \neq i}^{N} \{_{jt+1} c_{YYj}\}) > B_{it+1} c_{\alpha Y i} c_{Y \alpha i}$$

or

$$(c_{\alpha \alpha i} c_{YYi} - c_{\alpha Y i} c_{Y \alpha i}) B_{it+1} + c_{\alpha \alpha i} \sum_{j \neq i}^{N} \{B_{jt+1} c_{YYj}\} > 0$$

4 Structural Estimation

In the paper, we will present structural estimates for the parameters of the distribution of the fixed cost F and the variable cost γ of this model, using an indirect inference approach [Gallant and Tauchen, 1996, Gourieroux et al., 1993]. In our method of simulated moments (MSM) procedure, we simulate firms over unobserved productivity draws and use the existing allocation of ownership patterns of firms in the population of UK corporations to assign available tax rates and allowances to firms of different sizes. Our structural estimates minimize the MSM criterion function, which takes the form:

$$L(\Theta) = h(\Theta)' W_N h(\Theta) \tag{6}$$

where Θ is the vector of structural parameters of interest. $h(\Theta)$ is the vector of M moment conditions constructed as the difference between simulated moments computed over S simulated firms and empirical moments computed over the population of corporation tax returns composed of N companies. As the weight matrix, we use the diagonal elements of the inverse variance-covariance matrix of empirical moments.

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Appendices

Table 5: The effects of German tax reform: direct subsidiaries only.

	(1) ztp ols	(2) ztp probit	(3) ROA	(4) ztp ols	(5) ztp probit	(6) ROA
$treated_i \times post_t$	0.033*	0.089**	-0.012	0.047**	0.125**	-0.019*
	(0.017)	(0.045)	(0.008)	(0.022)	(0.060)	(0.011)
Constant	0.476***	-0.062	0.106***	0.527***	0.059	0.091***
	(0.017)	(0.043)	(0.007)	(0.034)	(0.088)	(0.013)
Observations	15,390	15,378	15,344	4,696	4,696	4,693
Number of firms	4,636	4,636	4,623	1,386	1,386	1,385

Note: These are regression results from considering the effects of German tax rate change in 2008 on the reported taxable profits of UK subsidiaries of German HQ companies relative to French HQ ones - columns 4-6 and US HQ ones - column 1-3. ztp ols refers to OLS specification results using zero taxable profits as a dependant variable, ztp probit refers to probit specification results using zero taxable profits as a dependant variable, ROA refers to OLS results using the ratio of taxable profits to total assets as a dependant variable. The data contains 1454 unique German subsidiaries, 1248 unique French subsidiaries and 8123 unique US subsidiaries. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In all specifications we control for the subsidiary size by including log of total assets and for multinational size by including number of subsidiaries that multinational report in FAME data. Only subsidiaries which are directly - 100% owned by the headquarter are included here. Source: matched HMRC and FAME data.

Table 6: The effects of German tax reform: no tax havens.

	(1) ztp ols	(2) ztp probit	(3) ROA	(4) ztp ols	(5) ztp probit	(6) ROA
$treated_i \times post_t$	0.022**	0.113**	-0.014***	0.038**	0.095**	-0.010
	(0.009)	(0.050)	(0.004)	(0.015)	(0.038)	(0.008)
Constant	0.497***	-0.043	0.113***	0.561***	0.151***	0.102***
	(0.012)	(0.031)	(0.006)	(0.021)	(0.055)	(0.011)
Observations	31,833	31,833	31,738	12,138	12,134	12,115
Number of firms	9,587	9,587	9,560	3,561	3,561	3,554

Note: These are regression results from considering the effects of German tax rate change in 2008 on the reported taxable profits of UK subsidiaries of German HQ companies relative to French HQ ones - columns 4-6 and US HQ ones - column 1-3. ztp ols refers to OLS specification results using zero taxable profits as a dependant variable, ztp probit refers to probit specification results using zero taxable profits as a dependant variable, ROA refers to OLS results using the ratio of taxable profits to total assets as a dependant variable. The data contains 3726 unique German subsidiaries, 2814 unique French subsidiaries and 15791 unique US subsidiaries. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In all specifications we control for the subsidiary size by including log of total assets and for multinational size by including number of subsidiaries that multinational report in FAME data. Only subsidiaries that are part of multinational groups that did not report to have any tax haven links are included here. Source: matched HMRC and FAME data.

Table 7: The effects of Italian anti-avoidance reform: no tax havens

(1)	(2) ztp ols	(3) ztp probit	ROA
$treated_i \times post_t$	-0.060**	-0.302**	0.001
	(0.028)	(0.135)	(0.010)
Constant	0.454***	-0.225**	0.095***
	(0.022)	(0.103)	(0.012)
Observations	3,590	3,590	3,578
Number of firms	850	850	849

Note: These are regression results from considering the effects the Italian CFC refrom in 2002 on the reported taxable profits of UK subsidiaries of Italian HQ companies relative to French HQ ones - columns 1-3 and Spanish HQ ones - column 4-6. ztp ols refers to OLS specification results using zero taxable profits as a dependant variable, ztp probit refers to probit specification results using zero taxable profits as a dependant variable, ROA refers to OLS results using the ratio of taxable profits to total assets as a dependant variable. Our sample contains 1,248 unique Italian subsidiaries, 711 unique Spanish subsidiaries and 2,814 unique French ones. In all specifications we control for firm fixed effects and year fixed effects. Standard errors are clustered at the firm level. In all specifications we control for the subsidiary size by including log of total assets and for multinational size by including number of subsidiaries that multinational report in FAME data. Only subsidiaries that are part of multinational groups that did not report to have any tax haven links are included here. Source: matched HMRC and FAME data.