Intra-Industry Spillovers of Profit Shifting and Tax Haven FDIs

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Abstract: Do firms replicate the tax avoidance schemes of their peers? The present paper provides systematic evidence along these lines. An event study shows that a US-listed enterprise is more likely to enter a specific tax haven if another US-listed enterprise operating in the same sector already owns subsidiaries in that tax haven. The inclusion of three-way fixed effects, the absence of pre-trends, and several robustness checks consolidate the results. Moreover, profit shifting spillovers vary over time, across sectors, and by tax haven. The findings suggest that aggressive tax planning strategies spread within industries and carry policy implications.

Keywords: Multinational enterprises, profit shifting, tax havens, foreign direct investments, spillovers.

JEL codes: F23, H26, L25, M21.

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1 Introduction

Many multinational enterprises (MNEs) are under public scrutiny in the wake of the last tax scandals. They are suspected of artificially shifting profits from high- to low-tax jurisdictions to decrease their average effective tax rate. The techniques designed to this end are now well identified and documented in the literature. They involve transfer mispricing, a tax-efficient use of intercompany debt, and a relocation of intellectual property (IP) rights in tax havens (Dharmapala, 2014; Riedel, 2018; Beer, de Mooij, and Liu, 2020). Less is known about the factors prompting MNEs to engage in large-scale tax avoidance and profit shifting. Tax rate differentials are key since they create incentives to move income across borders. Among others, Tørsløv, Wier, and Zucman (2021) show that countries [1] with high corporate income tax rates are exposed to base erosion and profit shifting. The lion's share of these profits is directed toward tax havens, where corporate income tax rates are on the opposite close to zero. Perhaps, a more challenging question is whether an MNE influences the income shifting behavior of other MNEs. Two streams of the literature point in this direction. An old body of research establishes the existence of technology spillovers. Research and development, innovation, exports, and foreign direct investment (FDI) activities conducted by some firms generate positive externalities and foster the performance of other firms, for instance through labor mobility. A more recent strand of research suggests that the same could apply to tax planning. Cen, Maydew, Zhang, and Zuo (2017), Lim, Shevlin, Wang, and Xu (2018), Gallemore, Gipper, and Maydew (2019), and Barrios and Gallemore (2021) observe that firms connected to low-tax firms via auditor, bank, employee, and supply ties have lower effective tax rates (ETRs). Moreover, Bauckloh, Hardeck, Wittenstein, and Zwergel (2021) notice that news about the tax avoidance practices of an MNE entails a negative stock price reaction among its peers. They claim that it is because investors expect similar firms to employ similar practices.

The present paper delves into the latter assertion and focuses on intra-industry spillovers, profit shifting, and tax haven FDIs. The first part of the paper collects data on the worldwide network of US-listed firms' subsidiaries between 1993 and 2013. The Securities and Exchange Commission (SEC) requires these companies to disclose every year a list of their subsidiaries and the reports are publicly available on its website. On this basis, I compile a unique database disaggregated at the firm-country-year level that gives the number of subsidiaries declared by each US-listed enterprise in each offshore financial center (OFC) [2] and each year. The second part of the paper proceeds with an event study. I examine the probability to report subsidiaries in a particular tax haven when at least one

1. "Jurisdiction" and "country" are used interchangeably for simplicity.
2. "Tax haven" and "offshore financial center" are also used interchangeably for simplicity. They refer to jurisdictions offering low corporate income tax rates, some sort of financial secrecy, and therefore an environment conducive to aggressive tax planning.

other company operating in the same 4-digit SIC sector also does. The granularity of the database allows inserting three-way fixed effects. Hence, the impact of peer entry into tax havens is quantified while controlling for numerous confounding factors. Among others, the firm-year, country-year, and firm-country fixed effects neutralize all firm-, sector-, and country-year causes of tax haven FDIs such as firm productivity and corporate tax rates. They greatly fine-tune the identification strategy and mitigate endogeneity concerns.

The benchmark results reveal that all other things being equal, the average probability to report a subsidiary in a specific OFC is 10 percent higher if a peer is already present in this OFC. The spillover effect is sizable and gradual. It slowly grows and reaches a peak four years post peer entry. The mere fact that the diffusion of profit shifting schemes is both OFC-specific and progressive suggests that it is more likely to be induced by a learning mechanism than by competitive pressures. The finding is corroborated by multiple sensitivity checks. First, it holds with various estimation methodologies. Linear probability models and binary estimators converge toward the same conclusion. The finding holds too when FDI persistence over time is taken care of via dynamic panel models à la Blundell and Bond (1998). Second, the conclusion is robust across tax haven classifications. The baseline equation leverages two lists commonly used in the field (Hines and Rice, 1994; Dyreng and Lindsey, 2009). Adopting only one list, using the intersection of the two lists, omitting one tax haven at a time, or incorporating the classification of Tørsløv et al. (2021) delivers concordant results. On the same note, I find consistent results after excluding the largest and most central tax havens. Workhorse international trade theories predict that FDIs should be directed toward large and central countries (e.g., Brainard, 1993; Head and Mayer, 2004; Helpman, Melitz, and Yeaple, 2004). As a consequence, subsidiaries in large and well-connected tax havens like Ireland might have nothing to do with aggressive tax planning in the first place. It is on the contrary reasonable to consider that FDIs in small and isolated jurisdictions such as the Marshall Islands have no or little economic substance and are purely attributable to profit shifting. Third, the results are validated by a couple of falsification tests. I assign companies to random industries and see whether profit shifting strategies disseminate within these fictitious industries. This is not the case. I do not find evidence of spatial spillovers either. Last but not least, no pre-existing trend emerges, i.e., firm presence in OFCs does not depend on future peer entry into OFCs. This rules out the possibility that the treatment variable picks the effect of past and unobserved firm- and sector-country-year shocks, lends credence to the parallel trend assumption, and more generally supports a causal interpretation of the results.

I also investigate the existence of heterogeneous spillover effects along three dimensions: over time, across sectors, and by tax haven. There is compelling evidence that profit shifting amplified in the last decades (Grubert, 2012; Klassen and Laplante, 2012) and that it is more prevalent in finance and services (Gumpert, Hines, and Schnitzer, 2016; Merz and

Overesch, 2016), something for which I provide additional support. I thus hypothesize that spillovers are more pronounced in the most recent subperiod and in services and financial sectors. The regression results confirm both assumptions. In addition, profit shifting spillovers differ by OFC. They are stronger for the most tax aggressive OFCs (e.g., Barbados, Luxembourg, and Switzerland), where corporate income tax rates are at very low levels.

The findings are new as they are to the best of my knowledge the first to uncover the existence of (intra-industry) profit shifting spillovers. As such, they contribute to the flourishing literature on the determinants of corporate tax avoidance and profit shifting (Alm, 2019; Beer et al., 2020; Wang, Xu, Sun, and Cullinan, 2020). They more notably resonate with the work of Cen et al. (2017), Lim et al. (2018), Gallemore et al. (2019), Barrios and Gallemore (2021), and Bauckloh et al. (2021). The aforementioned papers suggest that interactions between firms matter for tax avoidance. From a methodological perspective, they usually resort to firm-level data and look at firm-year-level ETRs. However, one shortcoming of ETRs is that they encompass diverse tax avoidance activities (Hanlon and Heitzman, 2010). They also are highly volatile and can fluctuate for a number of reasons unrelated to tax avoidance (Dyreng, Hanlon, and Maydew, 2008). The data used in this paper are much finer. They offer a clearer indication of corporate tax avoidance, make it possible to single out profit shifting, and highlight the OFCs involved. They make it possible to refine the statistical approach at the same time.

In a sense, the findings partly explain the rapid development of profit shifting activities witnessed in the 1990s-2000s. They have policy implications too. Profit shifting has become a topical issue in a decade of economic, political, and social turmoil. The successive data leaks, the rise of within-country income inequalities, the persistence of budget deficits in Europe and the US, and the COVID-19 pandemic have urged governments to implement anti profit shifting measures. Against this background, the results emphasize that firms tend to reproduce the profit shifting schemes of their peers. They indicate that when a firm undertakes tax dodging activities in a tax haven, there is a higher chance that other corporations operating in the same sector exploit this tax haven. Anti profit shifting reforms could thus be more efficient in the long term by concentrating efforts on some sectors and OFCs. The fact that spillovers are more salient in services and finance and for very aggressive OFCs reaffirms that policymakers might want to pay more attention to these industries and jurisdictions.

The remainder of the paper is structured as follows. First, section 2 introduces the data and outlines a set of facts on US-listed firms' presence in tax havens. Next, section 3 lays out the econometric exercise, the results, and the robustness checks. Section 4 briefly concludes and discusses avenues for subsequent research.

2 Data

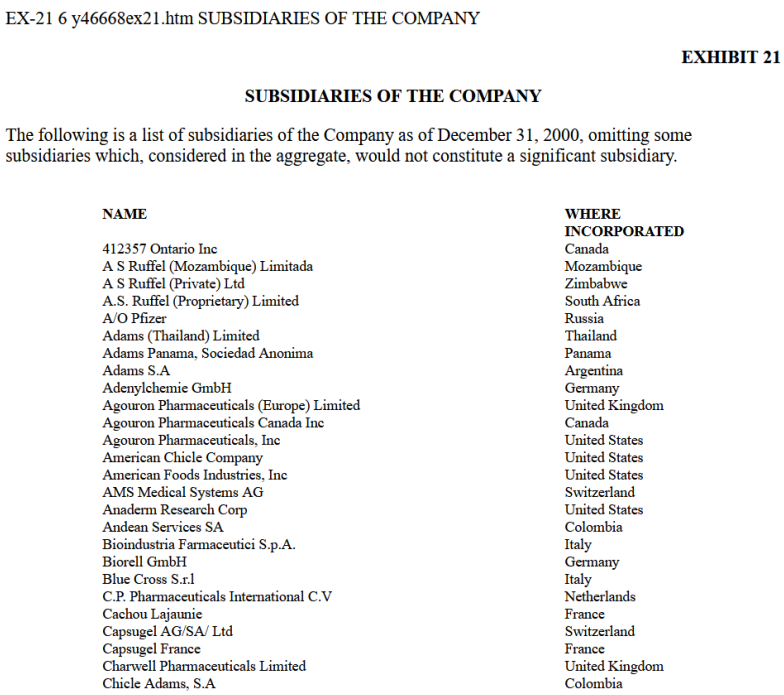
2.1 Sources

The data originate from two sources: Compustat and Exhibit 21 filings. Compustat contains extensive information on (consolidated) balance sheets, income statements, and cash flows of publicly listed firms in North America. These firms are the most productive ones. Albeit few in number, they account for a substantial share of overall sales, profits, and employment (e.g., Asker, Farre-Mensa, and Ljungqvist, 2014). Importantly, they are the most likely to engage in tax haven FDIs and profit shifting. Earlier work hints at the existence of a fixed cost of FDI. Foreign investments generally require completing market research ex ante, creating distribution networks, establishing facilities overseas, etc. Merely the largest and most productive firms can afford and find it profitable to pay these costs (Helpman et al., 2004). A similar logic applies to profit shifting (Krautheim and Schmidt-Eisenlohr, 2011; Langenmayr, 2015; Bilicka, Devereux, and Guceri, 2020). Avoiding taxes necessitates excellent knowledge of the tax code. MNEs must recruit expensive tax experts to take advantage of legal technicalities and artificially book their income in tax-friendly jurisdictions (Jones, Temouri, and Cobham, 2018). Anecdotal evidence for instance shows that PricewaterhouseCoopers received $55 million from Caterpillar for developing its international tax planning strategy (US Senate Permanent Subcommittee on Investigations, 2014). For these reasons, a very narrow circle of MNEs have the resources to engage in profit shifting (Gumpert et al., 2016). Compustat arguably includes these companies and not having a representative sample of the universe of firms should not be seen as a problem in this context. [3]

Compustat is merged with data extracted from Exhibit 21 filings. Every year, the SEC requires US-listed firms to disclose a list of their significant subsidiaries in Exhibit 21 of Form 10-K. A subsidiary is significant if its assets (or revenues) represent at least 10 percent of consolidated assets (or revenues). Moreover, any undisclosed subsidiary is treated as significant if by combining all undisclosed subsidiaries into one composite subsidiary, the latter accounts for at least 10 percent of global assets (or revenues). Hence, Exhibit 21 filings reflect where more than 90 percent of US-listed firms' assets and revenues are recorded. They allow observing where the vast majority of US-listed firms' subsidiaries are incorporated and how these networks evolve over time. An interesting feature of Exhibit 21 reports is that they are electronically filed since 1993 and are publicly available on the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) platform maintained by the SEC.

3. Small and medium enterprises (SMEs) have fewer resources, have a lower probability to be audited, and are less internationally oriented. They are therefore more inclined to *evade* taxes and to turn to informality. The key difference is that tax evasion is undoubtedly illegal, whereas tax avoidance is closer to the sharp line between legality and illegality.

Figure 1 – Subsidiaries reported by Pfizer Inc.



EX-21 6 y46668ex21.htm SUBSIDIARIES OF THE COMPANY

EXHIBIT 21

SUBSIDIARIES OF THE COMPANY

The following is a list of subsidiaries of the Company as of December 31, 2000, omitting some subsidiaries which, considered in the aggregate, would not constitute a significant subsidiary.

NAME	WHERE INCORPORATED
412357 Ontario Inc	Canada
A S Ruffel (Mozambique) Limitada	Mozambique
A S Ruffel (Private) Ltd	Zimbabwe
A.S. Ruffel (Proprietary) Limited	South Africa
A/O Pfizer	Russia
Adams (Thailand) Limited	Thailand
Adams Panama, Sociedad Anonima	Panama
Adams S.A	Argentina
Adenylchemie GmbH	Germany
Agouron Pharmaceuticals (Europe) Limited	United Kingdom
Agouron Pharmaceuticals Canada Inc	Canada
Agouron Pharmaceuticals, Inc	United States
American Chicle Company	United States
American Foods Industries, Inc	United States
AMS Medical Systems AG	Switzerland
Anaderm Research Corp	United States
Andean Services SA	Colombia
Bioindustria Farmaceutici S.p.A.	Italy
Biorell GmbH	Germany
Blue Cross S.r.l	Italy
C.P. Pharmaceuticals International C.V	Netherlands
Cachou Lajaunie	France
Capsugel AG/SA/ Ltd	Switzerland
Capsugel France	France
Charwell Pharmaceuticals Limited	United Kingdom
Chicle Adams, S.A	Colombia

Notes: This snapshot is a non-exhaustive list of the significant subsidiaries reported by Pfizer Inc. in Exhibit 21 in December 2000.

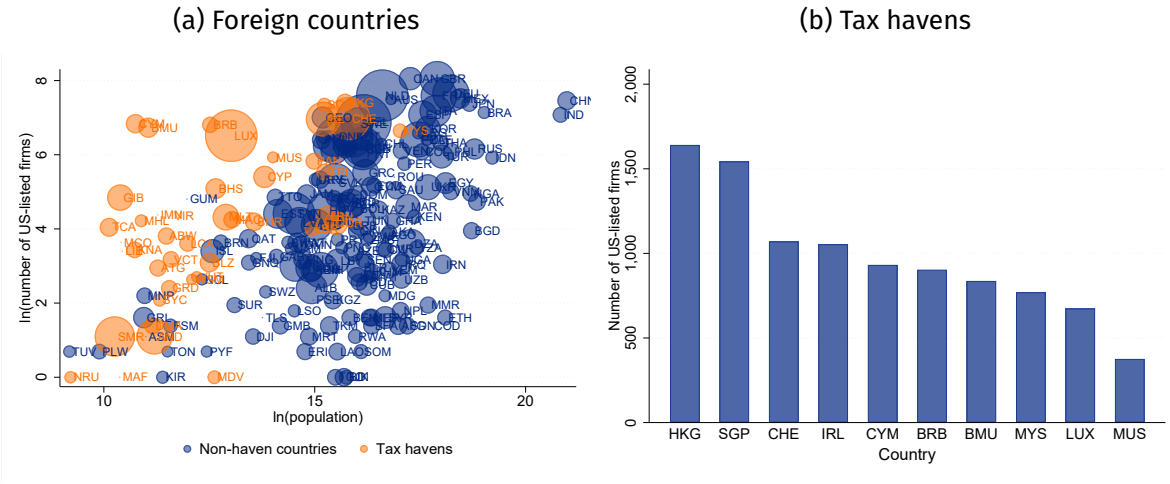
Table 1 – List of tax havens (Hines and Rice, 1994; Dyreng and Lindsey, 2009)

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

Figure 1 gives an example. It displays (a part of) the list of subsidiaries reported by Pfizer Inc. in the US and abroad in December 2000. In what follows, I exploit an updated version of the database constructed by Dyreng and Lindsey (2009) covering the 1993-2013 period.

One potential caveat is that firms might be tempted to under-report tax haven subsidiaries. Dyreng, Hoopes, Langetieg, and Wilde (2020) argue however that most disclosures are accurate, even when it comes to tax havens. Another caveat is that subsidiaries incorporated in tax havens are not automatically involved in profit shifting. Disentangling both types of tax haven subsidiaries is challenging. Information at the subsidiary level is sparse since US-listed companies are not obliged to convey financial information at this level. Neverthe-

Figure 2 – Firm presence overseas



Notes: Graph (a) shows the relationship between US-listed firms' presence in foreign countries (*y*-axis), population size (*x*-axis), and centrality (bubble size). Population data are from 2003 and come from the World Bank. Centrality of country *c* is calculated as $\sum_j GDP_{j,2003}/dist_{jc}$. GDP and bilateral distance data are standardized and retrieved from CEPII. Graph (b) shows the top 10 OFCs where US-listed firms were implanted over the period 1993-2013.

less, note that tax havens are essentially small jurisdictions (see table 1 and stylized fact 1 below). Therefore, tax haven subsidiaries not used for profit shifting purposes are unlikely to reach the 10 percent threshold. We will see that entry into OFCs is systematically associated with a decrease in US-listed firms' ETRs (see stylized fact 4 below), and we will also abstract from the largest tax havens in one of the robustness checks to better address this concern.

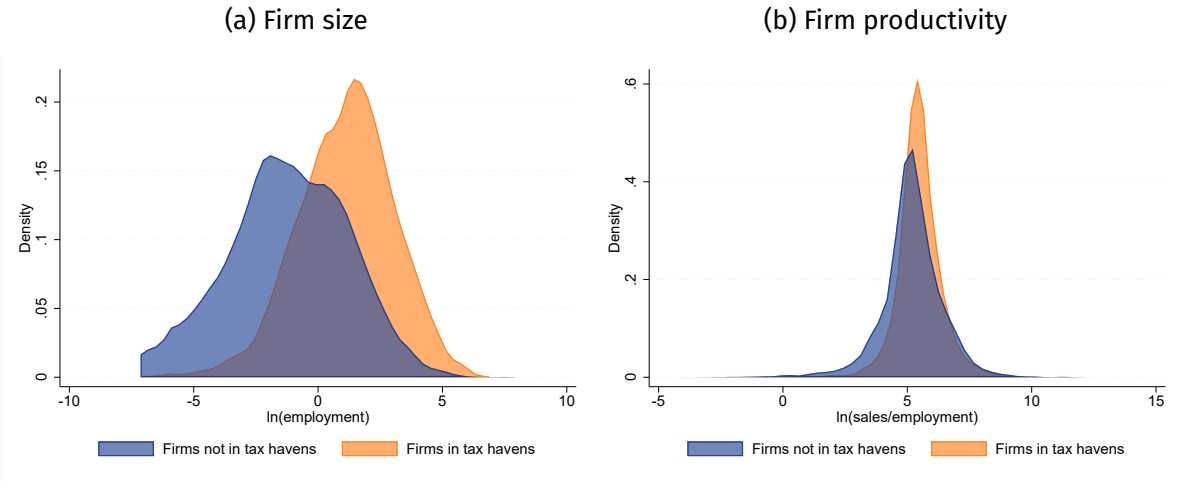
2.2 Sample

The final sample consists of 14,070 firms active in 436 4-digit SIC sectors, all of which reported one or several subsidiaries at some point inside or outside the US. The database is arranged at the firm-OFC-year level. The OFC list draws on Hines and Rice (1994) and Dyreng and Lindsey (2009). These classifications are typical in the corporate tax avoidance literature and a country is qualified as a tax haven if it figures in at least one of the two lists. In total, 50 foreign countries are marked as tax havens (see table 1).

2.3 Stylized facts

Stylized fact 1: Tax havens attract a disproportionately high number of firms given their small size and remoteness.

Figure 3 – Firm size and productivity (distribution)



Notes: In Compustat, employment is given by the variable denoted *EMP* and sales are given by the variable labeled *SALE*. Employment is expressed in thousands and sales are measured in million US dollars.

Figure 2a illustrates the relationship between countries' attractiveness (number of US-listed companies, *y*-axis), size (population, *x*-axis), and centrality (proximity to large markets, bubble size). Tax havens (in orange) are separated from non-haven countries (in blue). The orange point cloud is higher than the blue one. Tax havens thus concentrate more US-listed companies on average than non-haven countries of the same size. The proposition holds for centrality. This pattern is worth noticing because it re-questions the empirical validity of old international trade models according to which small and isolated countries receive less FDIs than their counterparts (e.g., Brainard, 1993; Head and Mayer, 2004; Helpman et al., 2004). It suggests that corporate income taxation partly shapes the geography of FDIs and that investments in OFCs are principally motivated by tax considerations. Among OFCs, Hong Kong appears as the most attractive one. 11.66 percent of the US-listed firms in the sample disclosed at least one subsidiary in this jurisdiction (see figure 2b). Singapore (10.97 percent), Switzerland (7.60 percent), Ireland (7.49 percent), and the Cayman Islands (6.62 percent) join the top 5.

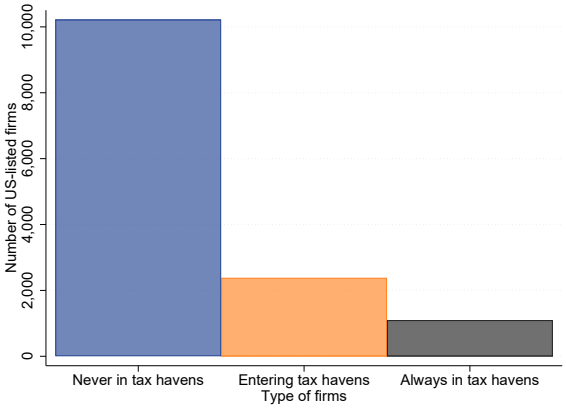
Stylized fact 2: US-listed firms in tax havens are few, but their number is rising over time. They also are larger and more productive than their peers.

10,220 companies out of 14,070 (73 percent) never divulged any tax haven subsidiary between 1993 and 2013. Among MNEs linked with OFCs, 2,387 firms (17 percent) entered at least one tax haven for the first time during this period, while 1,097 firms (8 percent) always reported at least one tax haven subsidiary (see also Appendix figure AF1). [4] It means that a

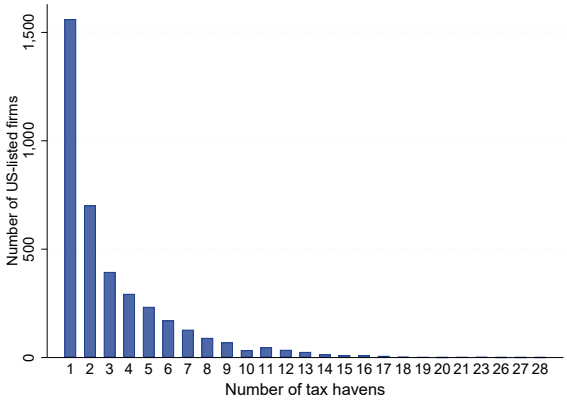
4. The remaining 366 corporations (2 percent) were in tax havens in the first year of observation and exited

Figure 4 – Firm presence in OFCs

(a) Extensive margin



(b) Intensive margin



handful of firms were in OFCs and that the 1993-2013 period is well suited for the analysis insofar as operations in OFCs soared over the time span. An industry decomposition attached in Appendix table AT1 shows that the upward trend is most striking in finance (SIC 60-67) and services (SIC 70-89). Moreover, figure 3 highlights a mapping between firm presence in tax havens, firm size, and firm productivity.[5] The fact that not all US-listed companies were in tax havens and those who did were larger and more productive concurs with the view that profit shifters form a club of superstar MNEs.

Stylized fact 3: US-listed firms implanted in tax havens are mostly located in one or two tax havens.

On average, profit shifting MNEs[6] were located in three distinct tax havens. 40 (18) percent of these companies were implanted in one (two) tax haven(s), so a fistful of companies declared subsidiaries in many tax havens (see figure 4b). Nine companies were for example active in more than 20 OFCs. Again, the skewness of the distribution reinforces the idea that the subgroup of MNEs that massively shift profits across borders comprises the most performing corporations.

at a later stage. By the same token, among the 2,387 companies entering for the first time between 1993 and 2013, 182 companies left tax havens after a few years. No information at hand allows us to identify the reason(s) for such exits. The 10 percent threshold requirement could be part of the story. All the same, these firms have very limited influence and do not affect the results. More details are available upon request.

5. See Appendix figure AF2 for alternative metrics: assets, turnover, and profits.

6. It is worth recalling that the profit shifting metric used in this paper (having a significant subsidiary in tax havens) is conservative. As discussed in section 2, some subsidiaries used for tax saving purposes might be unobserved due to the reporting threshold. Moreover, although profits are essentially directed toward OFCs (Dowd, Landefeld, and Moore, 2017; Garcia-Bernardo and Janskỳ, 2022), firms can shift profits between non-havens to lighten their tax burden.

Stylized fact 4: US-listed firms implanted in tax havens exhibit lower ETRs.

If presence in OFCs fulfills tax saving purposes, then ETRs should decrease when US-listed firms enter tax havens. The regression attached in Appendix table AT2 examines this. Firm-year-level ETRs are regressed on the number of tax havens with which US-listed corporations are connected, controlling for firm size and tax loss carryforward. Firm and year fixed effects correct for systematic heterogeneity across firms and over time. The objective is to compare the tax liability of companies with a similar profile but different exposure to OFCs. The results reveal that entry into a tax haven is indeed associated with a decline in ETRs. The drop amounts to 0.4 percentage point. This coefficient means that tax haven subsidiaries allow the most tax aggressive US-listed firms to diminish their global average ETR by nearly 10 percentage points.

3 Econometric analysis

I now turn to the econometric analysis and prove that US-listed corporations replicate the profit shifting schemes of their peers. The first part of the analysis computes an average spillover effect and gauges its robustness. The second part tests for heterogeneous effects to gain further insight into the diffusion of tax avoidance practices.

3.1 Average spillover effect

3.1.1 Identification strategy

The baseline approach consists of a linear probability model (LPM) with ordinary least squares:

$$FDI_{i,c,t} = \alpha TREAT_{i,c,t} + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t} \quad (1)$$

The dependent variable $FDI_{i,c,t}$ is a dummy variable equal to 1 if firm *i* has at least one subsidiary in tax haven *c* in year *t*. On the right-hand side, $TREAT_{i,c,t}$ is a dichotomous variable equal to 1 if another firm from the same 4-digit SIC sector discloses in year *t* a subsidiary in tax haven *c*. Three-way fixed effects purge the treatment effect of confounding factors and thereby reduce endogeneity. Firm-year fixed effects $\mu_{i,t}$ absorb sector- and firm-year determinants of FDIs and aggressive tax planning. They incorporate, among other things, sector trends in tax haven FDIs as well as firm-level determinants highlighted in the literature such as productivity and intangible assets. Country-year fixed effects $\upsilon_{c,t}$ encompass country-year factors influencing inward FDIs from US-listed firms. These factors include (but are not limited to) corporate tax rates and financial opacity. Firm-country fixed effects $\gamma_{i,c}$ neutralize firm-country time-invariant causes of tax haven

FDIs, inclusive of the distance between headquarters and OFCs.

The coefficient α captures the average profit shifting spillover. In other words, it captures the effect of peer presence in a tax haven on the firm's probability to own subsidiaries in that tax haven. Take two firms i and i' active in two different sectors denoted s_i and $s_{i'}$ respectively. Assume that they have comparable global trends in tax haven FDIs, i.e., $\mu_{i,t} - \mu_{i,t-1} \approx \mu_{i',t} - \mu_{i',t-1}$, and that no firm was established in tax haven c in year $t-1$. Further assume that at least one firm in s_i starts operating in tax haven c in year t but no company in $s_{i'}$ penetrates tax haven c in year t. The identification of α relies on the hypothesis that FDIs of i and i' in jurisdiction c would have evolved similarly between $t-1$ and t without any entry in s_i. In the same spirit, take two OFCs c and c' such that $\upsilon_{c,t} - \upsilon_{c,t-1} \approx \upsilon_{c',t} - \upsilon_{c',t-1}$. Assume that no firm in s_i had subsidiaries in c and c' in year $t-1$ and that at least one company enters tax haven c in year t. The conjecture is that FDIs of firm i in tax havens c and c' would have moved in parallel had there not been any entry into tax haven c in year t among s_i companies.

3.1.2 Results

The benchmark result is outlined in table 2. $\hat{\alpha}$ is equal to 0.14 percent and is statistically significant at the 1 percent level. Other things held constant, the average probability to own a subsidiary in a particular OFC is 0.14 percentage point (equivalently, 10 percent) higher if another firm from the same sector also does.[7]

Supplementary regressions displayed in Appendix table AT3 replace the dichotomous treatment variable $TREAT_{i,c,t}$ with $TREAT^{C}_{i,c,t}$ (number of peers in tax haven c in year t, column (1)) or $TREAT^{S}_{i,c,t}$ (share of peers in tax haven c in year t, column (2)). The coefficient remains positive and statistically significant at the 1 percent level in the two configurations. The probability to disclose subsidiaries in a given OFC increases by 1 percentage point if the share of peers implanted in this OFC rises by 10 percentage points. Appendix figure AF3 zooms in and measures the level of peer presence in OFCs above which spillovers become statistically significant. Interestingly, the graph reveals that profit shifting spillovers kick in when more than 10 percent of peers have ownership ties with tax havens. There does not seem to be any "snowball effect," however.

3.1.3 Robustness

Dynamics A battery of tests assess the robustness of the finding. The first robustness check thoroughly scrutinizes how the probability to disclose a subsidiary in a tax haven

7. Note that removing non-MNEs from the regression mechanically leads to higher point estimates ($\hat{\alpha}$ = 1.78e-3) since (i) non-MNEs have no foreign subsidiaries and (ii) only the largest MNEs engage in profit shifting and tax haven FDIs. I thank a referee for drawing my attention to this sample selection issue.

Table 2 – Profit shifting spillovers: baseline results

Dependent variable	$FDI_{i,c,t}$
$TREAT_{i,c,t}$	1.35e-3[a]
	(2.74e-4)
Firm-year FEs	Yes
Country-year FEs	Yes
Firm-country FEs	Yes
R^2	0.69
No. of obs.	5,514,400
Mean value of the dependent variable	1.33e-2

Notes: Results of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. The standard error, in parentheses, is clustered at the sector-year level. [b] $p < 0.05$, [a] $p < 0.01$. See section 3 for more details.

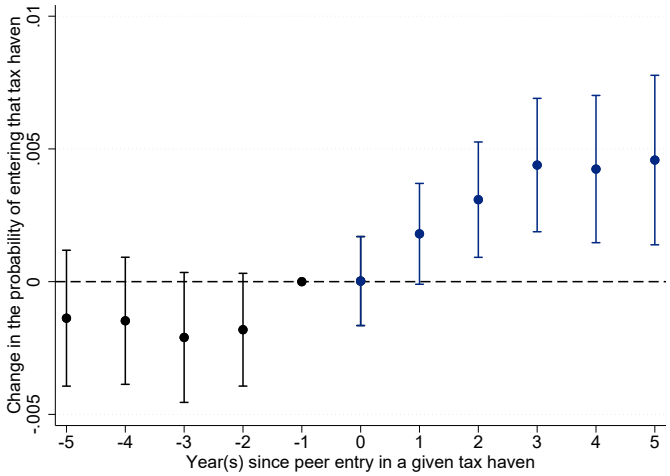
varies before and after peer entry into this tax haven. Equation (1) is enriched with lagged and leading values of $TREAT_{i,c,t}$ denoted $TREAT^{t-k}_{i,c,t}$ and $TREAT^{t+k}_{i,c,t}$ respectively. I select a 10-year window around the treatment and estimate equation (2) below:

$$FDI_{i,c,t} = \alpha TREAT_{i,c,t} + \sum_{k=1}^{5} \beta_k TREAT^{t+k}_{i,c,t} + \sum_{k=1}^{5} \zeta_k TREAT^{t-k}_{i,c,t} + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t} \quad (2)$$

Two comments emerge from figure 5. First, there is little evidence of pre-trends. The $\hat{\beta}$ are not significantly different from zero, i.e., firm presence in OFCs does not significantly vary before peer entry into OFCs. This pattern supports the common trend assumption, implies that the treatment variable is unlikely to be correlated with unobserved firm- or sector-country-year shocks (e.g., technology shocks), and reduces endogeneity concerns. Second, the spillover effect intensifies and persists over time. It becomes significant after one or two years and stabilizes after four years.

The graduality sheds some light on the mechanism. In principle, entry decisions could be either simultaneous (e.g., due to competitive pressures) or sequential (e.g., due to knowledge diffusion). Disentangling the two cases is not straightforward but two elements are reminiscent of a sequential game. First, spillovers are OFC-specific. If entry into OFCs were triggered by competitive pressures, then it is unclear why US-listed firms would enter the same OFCs as their peers. They would penetrate any OFC with the aim of saving taxes. Notice that the firm-year fixed effects nest global trends in tax haven FDIs at the industry-year level. In this respect, the impact of competition on firm entry into OFCs is more likely to pass through the firm-year fixed effects than through the treatment variable $TREAT_{i,c,t}$. Second, profit shifting spillovers grow over time. It suggests that firms progressively learn from the

Figure 5 – Profit shifting spillovers: dynamics



Notes: Results of equation (2). $FDI_{i,c,t}$ is a dummy equal to 1 if firm *i* has at least one subsidiary in tax haven *c* in year *t*. On the *x*-axis, the left part represents the $\hat{\beta}_k$, i.e., how $FDI_{i,c,t}$ varies before peer entry. The coefficient for "-3" for instance represents $\hat{\beta}_3$, i.e, how $FDI_{i,c,t}$ varies 3 years before peer entry into OFC *c*. The right part represents the $\hat{\alpha} + \sum_k \hat{\zeta}_k$, $k = \{0, ..., 5\}$, i.e., how $FDI_{i,c,t}$ varies post peer entry into OFC *c*. The coefficient for "3" for instance represents $\hat{\alpha} + \sum_{k=1}^{3} \hat{\zeta}_k$, i.e., how $FDI_{i,c,t}$ varies 3 years after peer entry into OFC *c*. Point estimates with 95 percent confidence intervals, normalized at "-1" for a better visualization. Standard errors are clustered at the sector-year level. See section 3 for more details and Appendix table AT4 for a full table.

experience of their peers.

Estimation method Other tests question the relevance of the baseline estimation technique. There is to the best of my knowledge no consensus in the literature on the estimator one should use when the dependent variable is binary (e.g., Horrace and Oaxaca, 2006; Angrist and Pischke, 2009; Battey, Cox, and Jackson, 2019; Gomila, 2021). On the one hand, LPMs are easier to interpret and more transparent, but they might deliver inconsistent estimates under some conditions. On the other hand, binary models guarantee that the predicted probabilities lie on the unit interval, but they may suffer from the so-called incidental parameters problem. Estimating binary models with high-dimensional fixed effects is not trivial. Groups for which the dependent variable stays constant should be excluded and this omission biases the point estimates. In Appendix table AT5 column (1), I build on recent advances in the econometric literature. Hinz, Stammann, and Wanner (2020) design a correction procedure for binary models with three-way fixed effects akin to equation (1). I estimate a logit model with three-way fixed effects and apply their guidelines. Reassuringly, the average partial effect is positive, statistically significant at standard levels, and close to the benchmark $\hat{\alpha}$.

An alternative empirical strategy to investigate profit shifting spillovers involves dynamic panel models. As discussed in section 2, tax haven FDIs entail fixed costs. Firm *i*'s presence in tax haven *c* and period *t* thus crucially depends on its presence there in period $t-1$, which is precisely something equation (1) does not account for. To address this issue of persistence, the lagged value of the dependent variable is inserted into equation (1) in a supplementary sensitivity check:

$$FDI_{i,c,t} = \alpha TREAT_{i,c,t} + \kappa FDI_{i,c,t-1} + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t} \quad (3)$$

OLS estimations of equation (3) are reported in Appendix table AT5 column (2). They give a positive and significant $\hat{\kappa}$. The value of the autoregressive parameter is not far from 1 and attests that tax haven FDIs are highly persistent. As for the main coefficient of interest, $\hat{\alpha}$ drops but remains sizable and close to its benchmark value. Additional regressions proceed with two-stage least squares (2SLS) and generalized method of moments (GMM) to tackle the endogeneity inherent to dynamic models. Instrumenting $FDI_{i,c,t-1}$ with $FDI_{i,c,t-3}$ mitigates the issue generated by an autocorrelation of residuals in equation (3). The results are outlined in column (3) and align with the rest. System-GMM estimators à la Blundell and Bond (1998) are the most popular in dynamic panel modeling – at least among international business studies (Li, Ding, Hu, and Wan, 2021) – and also lead to similar results (column (4)). [8]

Tax haven classification Appendix table AT6 reflects upon the tax haven classification. Tax havens are traditionally defined as jurisdictions where corporate income tax rates are low and where operations are opaque. The first criterion is relatively easy to evaluate. The second one, however, is more difficult to assess. Secrecy is multidimensional and some facets are hardly quantifiable (e.g., exchange of information). Hence, characterizing a country as a tax haven might turn out to be arbitrary. I rerun equation (1) by using the classifications of Hines and Rice (1994) and Dyreng and Lindsey (2009) separately (HR, column (1); DL, column (2)) or by forming a restricted list composed of the jurisdictions found in the two lists (DL ∩ HR, column (3)). [9] Appendix figure AF4 replicates the results after omitting one OFC at a time. A complementary regression puts six tax havens aside: Hong Kong, Ireland, Luxembourg, Malaysia, Singapore, and Switzerland (EX6, column (4)). The rationale is the following. Since

8. Assumptions and applications to international business studies are extensively discussed in Li et al. (2021). Here, system-GMM estimators (Blundell and Bond, 1998) are preferred to difference-GMM estimators (Arellano and Bond, 1991) since the dependent variable *FDI* is highly persistent, and system-GMM are known to perform better in such cases. One lag of *FDI* is included and *TREAT* is treated as a predetermined variable. As expected, note that the Arellano-Bond test for zero autocorrelation in first-differenced errors rejects the null hypothesis of no autocorrelation for the first lag but not for the second one (p-value = 0.00 for the lag of order 1, p-value = 0.64 for the lag of order 2).

9. The two lists share 37 OFCs. The classification of Dyreng and Lindsey (2009) is the only one to enumerate Aruba, Costa Rica, Malaysia, Mauritius, Nauru, Niue, Samoa, San Marino, and Seychelles. Conversely, Hines and Rice (1994) retain the British Virgin Islands, Jordan, Maldives, and Saint Martin, unlike Dyreng and Lindsey (2009).

these countries are relatively large and well connected with the rest of the world, FDIs of US-listed firms in these countries could very well be unrelated to tax avoidance. Notice in this regard that all six countries are in figure 2b. FDIs in remote and small jurisdictions like Jersey and Mauritius, on the contrary, more certainly fall within the sole scope of profit shifting. Last but not least, I leverage the classification used in a newly influential contribution in the field: Tørsløv et al. (2021). A major advantage of this list is that it covers some major OFCs absent from both Hines and Rice (1994) and Dyreng and Lindsey (2009) like the Netherlands and Puerto Rico. Column (5) introduces these additional OFCs into equation (1).[10] Overall, the results are stable and coincide with the baseline estimate. They should therefore hold for a wide range of classifications.

Industry definition Along the same lines, Appendix table AT7 adjusts the industry definition. A shortcoming not addressed thus far is that $\hat{\alpha}$ might be essentially driven by small sectors, where firms could for instance interact more via alliances or mergers and acquisitions (M&A). To verify that it is not the case, I reproduce the results by keeping only 4-digit SIC sectors with more than 15 enterprises ($TREAT^{>15}_{i,c,t}$, column (1)) or by extending sectors at the 3-digit SIC level ($TREAT^{3-digit}_{i,c,t}$, column (2)). The estimates are not surprisingly of lower magnitude but stay statistically significant. They confirm that profit shifting spillovers are quite pervasive. To cope with the particular issue of M&A operations, a regression retains only companies recording no acquisitions between 1993 and 2013 ($TREAT^{acq}_{i,c,t}$, column (3))[11] and one regression re-performs the analysis with firms appearing in the database throughout the period ($TREAT^{1993-2013}_{i,c,t}$, column (4)). The results are still positive and significant, meaning that they should not be mechanical and imputable to M&A deals made with corporations already present in OFCs.

Falsification tests Appendix table AT8 finally performs a couple of falsification tests. The test in column (1) mixes all firms together and forms 436 random sectors ($TREAT^{random}_{i,c,t}$). If the estimates exposed until now truly reflect intra-industry spillovers, then we should observe no changes in FDIs in tax haven c when another random company enters c. In the same spirit, column (2) verifies that the profit shifting spillovers are not spatial. There might be some overlap between industry peers and geographic neighbors, in which case the results displayed throughout the paper could be induced by *spatial* profit shifting spillovers (Grieser, LeSage, and Zekhnini, 2021). I retrieve information about US-listed companies' state of incorporation (from Compustat) and US subsidiaries (from Exhibit 21, when possible[12]).

10. These OFCs are: Belgium, Bonaire, Curacao, the Netherlands, and Puerto Rico.

11. Compustat provides very few details on M&A transactions. Here, firms recording no acquisitions are identified thanks to the *ACQMETH* Compustat variable.

12. Many US-listed companies do not spell out the state of incorporation/organization of their US subsidiaries. This is for example the case for JPMorgan Chase & Co., Microsoft Corporation, and Pfizer Inc. (see figure 1).

Next, I replace $TREAT_{i,c,t}$ with an analogous variable $TREAT^{spatial}_{i,c,t}$ that is equal to 1 if another US-listed company implanted in the same US state(s) as firm *i* has subsidiaries in OFC *c* in year *t*. The two exercises bear out the benchmark results insofar as $\hat{\alpha}$ is not statistically different from zero. All in all, the robustness checks substantiate the existence of intra-industry profit shifting spillovers.

3.2 Heterogeneous spillover effects

Before concluding, I explore the existence of heterogeneous effects over time, across industries, and between OFCs.

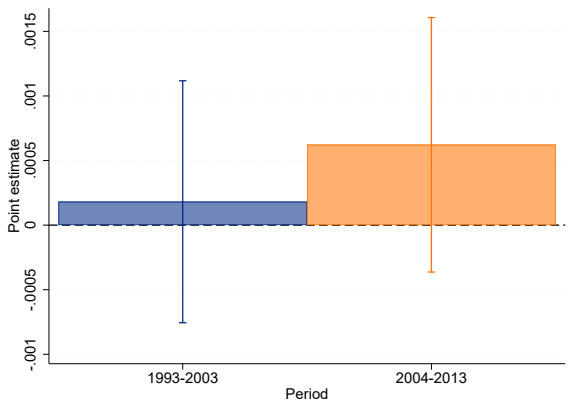
Disparities over time and across sectors Equation (1) estimates an average profit shifting spillover effect. Yet, there are reasons to expect disparities over time and across sectors. Grubert (2012) and Klassen and Laplante (2012) find that profit shifting of US MNEs escalated in previous decades, notably thanks to declining audit rates and the implementation of the "check-the-box" rules in 1997 (see also Appendix figure AF1). The latter originally aimed at simplifying tax procedures by granting firms the right to select themselves their organizational form and tax treatment (corporation, partnership, etc). They had the unintended consequence of facilitating tax dodging of US MNEs through hybrid entities, i.e., entities that are recognized as corporations by one jurisdiction but not by another one.

Another stream of research emphasizes industry-specific heterogeneity in profit shifting. Gumpert et al. (2016) and Merz and Overesch (2016) show that profit shifting is more prevalent in services and finance. This is because intangible assets remarkably ease tax-motivated income transfers across borders (see also Beer and Loeprick, 2015; Barrios and d'Andria, 2020, and Appendix table AT1). Intangible assets are highly mobile in essence. They can be developed in a particular country, and their property rights can then be transferred to a tax-friendly jurisdiction. Besides being mobile, intangibles make transfer pricing regulations hard to enforce. It is difficult for the regulator to define an arm's length price for an IP-related transaction because there is generally no comparable transaction between unrelated parties that can serve as a reference.

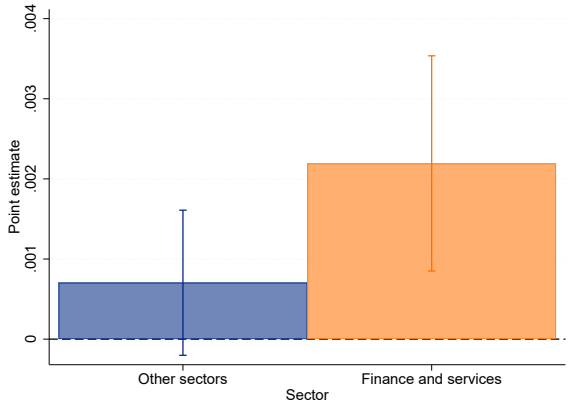
Therefore, I posit that spillover effects are larger between 2004 and 2013, and in services and financial sectors (SIC 60-67, SIC 70-89). To confront these hypotheses with data, regression (1) is run on the four corresponding subsamples. Figures 6a and 6b depict the regression results and globally support both hypotheses. The diffusion of tax dodging practices is stronger in the second subperiod (figure 6a, second coefficient statistically significant at the 15 percent level) and in services and financial industries (figure 6b).

Figure 6 – Profit shifting spillovers over time and across sectors

(a) 1993-2003 versus 2004-2013



(b) Finance and services versus other sectors



Notes: Results of equation (1) for four subsamples. The bars represent the point estimates $\hat{\alpha}$. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the sector-year level. See section 3 for more details and Appendix table AT9 for a full table.

Table 3 – Profit shifting spillovers (by OFCs)

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$
THs_c	0.29^b							
	(0.14)							
$LACIT_c$		0.46^b					0.42^b	
		(0.21)					(0.18)	
LG_c			0.24				-0.19	
			(0.17)				(0.53)	
$TRSP_c$				-0.19			-0.20	
				(0.14)			(0.16)	
AA_c					-6.46e-4		-0.04	
					(0.10)		(0.12)	
$DTTA_c$						0.25^b	0.34	
						(0.12)	(0.50)	
ETR_c^{CBCR}								-0.22^b
								(0.10)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.12	0.30	0.08	0.05	0.00	0.09	0.38	0.06
No. of obs.	27	27	27	27	27	27	27	37

Notes: Results of equation (5) with different specifications. $\hat{\alpha}_c$ is the profit shifting spillover effect for tax haven *c*. THS_c is the tax haven score computed by the Tax Justice Network for tax haven *c*. The five other explanatory variables in columns (2)-(7) refer to the components of THS_c. ETR_c^{CbCR} is the average ETR in OFC *c*, as calculated via CbCR reports. All variables are defined in section 3 and standardized. Standard errors, in parentheses, are heteroskedasticity-robust. $^b p < 0.05$, $^a p < 0.01$. See section 3 for more details.

Country-specific spillovers Spillover effects could also differ by tax haven. Appendix figure AF5 confirms this and, in fact, reveals considerable disparities across jurisdictions. The figure plots the results obtained after adding a series of variables that interact the treatment term $TREAT_{i,c,t}$ with tax haven dummies $\mathbb{1}_c$:

$$FDI_{i,c,t} = \sum_c \alpha_c TREAT_{i,c,t} \times \mathbb{1}_c + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t} \quad (4)$$

Famous OFCs such as Barbados, Luxembourg, and Switzerland, already visible in figure 2b, stand out and feature in the top 10. A plausible explanation is that spillovers depend on tax havens' aggressiveness:

$$\hat{\alpha}_c = \delta + \eta THS_c + \zeta_c \quad (5)$$

In equation (5), THS_c denotes the tax haven score computed by the Tax Justice Network (Ateş, Cobham, Harari, Janskỳ, Meinzer, Millán, and Palanskỳ, 2021).[13] $\hat{\alpha}_c$ and THS_c are standardized for the ease of interpretation. The results of equation (5) are provided in table 3 column (1) and uncover a positive correlation between profit shifting spillovers and tax havens' aggressiveness. A one standard deviation increase in the tax haven score is associated with a 0.29 standard deviation increase in income shifting spillovers. Columns (2)-(6) supplement column (1). They focus on the five components of the index, namely: lowest available corporate income tax rate (LACIT), loopholes and gaps (LG), transparency (TRSP), anti-avoidance (AA), and double tax treaty aggressiveness (DTTA). Higher values are associated with higher tax aggressiveness. The results highlight the prominent role of corporate income tax rates applicable in tax havens (columns (2) and (7)).

Capitalizing on OECD Country-by-Country Reports (CbCRs) strengthens this last point (column (8)). CbCRs emerged as a result of Base Erosion and Profit Shifting (BEPS) Action 13 and under the initiative of the OECD and G20. MNEs headquartered in the countries that have adopted the regulation and recording group revenues over €750 million are required to document their activities where they operate: sales, profits, number of employees, corporate income taxes paid, etc. The information is then aggregated at the parent-host country level and made publicly available by the OECD. CbCR-based ETRs offer the best indication of the tax rates faced by MNEs in OFCs for various reasons (Casella and Souillard, 2022). First, ETRs better describe corporate tax liability than statutory tax rates (STRs) as they take into account numerous tax breaks (e.g., credits and exemptions). The gap between STRs and ETRs is especially striking in OFCs due to greater resort to fiscal incentives and preferential tax treatments. Second, among ETRs, those based on CbCRs are the most

13. Owing to data limitations, the data are from 2019. Given that OFCs' characteristics are quite persistent over time, this should not constitute a major problem. Moreover, note that the tax haven score is not defined for all 50 tax havens.

likely to mirror the taxes paid by MNEs since only MNEs fill CbCRs. Replacing THS_c with tax havens' ETR (ETR_c^{CbCR}) in equation (5) yields an estimate that is negative, significant at the 5 percent level, and coherent with columns (2) and (7). [14]

4 Conclusion

Using information on the tax haven subsidiaries of US-listed companies, I unveil in this paper the existence of intra-industry spillovers of profit shifting. A firm is more prone to establish a physical presence in a tax haven if another firm from the same industry owns subsidiaries in that tax haven. The profit shifting spillover effects are sizable. Moreover, they are heterogeneous. They are more intense in the most recent subperiod. The pattern echoes with prior work showing that profit shifting soared during the 2000s (Grubert, 2012; Klassen and Laplante, 2012). Furthermore, they are bigger in finance and services, which coincides with the idea that intangible-intensive industries are more inclined to undertake profit shifting activities (Gumpert et al., 2016; Merz and Overesch, 2016; Barrios and d'Andria, 2020). Last but not least, profit shifting spillovers are more pronounced for the most aggressive OFCs. The results pass several robustness checks, suggest that firms learn the profit shifting techniques of their peers, and help grasp the surge of profit shifting activities witnessed in the last decades.

More work is now needed in this direction. Although many US-listed firms are multinational and thus likely to appear in alternative databases, it would be valuable to ascertain the external validity of the findings through triangulation of data sources. Unraveling the exact channels whereby tax haven knowledge disseminates across MNEs is another promising task for future research.

14. Several comments are in order. (i) CbCR-based ETRs are also less likely to be contaminated by double counting of income and profits (compared to other series of ETRs), and loss-making companies can be ruled out to polish the computation of ETRs (Casella and Souillard, 2022). (ii) The first year of OECD CbCR data is 2016 but reporting at that time was not mandatory. I thus exploit data from 2017 and take simple averages across parent countries. ETR_c^{CbCR} is computed for 37 distinct tax havens. Its average is 7 percent. By contrast, the average STR is 17 percent (data from the Tax Foundation).

References

Alm, J. (2019): "What motivates tax compliance?" *Journal of Economic Surveys*, 33, 353–388.

Angrist, J. D. and J.-S. Pischke (2009): *Mostly harmless econometrics: An empiricist's companion*, Princeton University Press.

Arellano, M. and S. Bond (1991): "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations," *Review of Economic Studies*, 58, 277–297.

Asker, J., J. Farre-Mensa, and A. Ljungqvist (2014): "Corporate investment and stock market listing: A puzzle?" *Review of Financial Studies*, 28, 342–390.

Ateş, L., A. Cobham, M. Harari, P. Janskỳ, M. Meinzer, L. Millán, and M. Palanskỳ (2021): "The corporate tax haven index: A new geography of profit shifting," in *Combatting Fiscal Fraud and Empowering Regulators*, ed. by B. Unger, L. Russel, and J. Ferwerda, Oxford University Press.

Barrios, J. M. and J. Gallemore (2021): "Tax-related human capital: Evidence from employee movements," *NBER Working Papers*, 28775.

Barrios, S. and D. d'Andria (2020): "Profit shifting and industrial heterogeneity," *CESifo Economic Studies*, 66, 134–156.

Battey, H., D. Cox, and M. Jackson (2019): "On the linear in probability model for binary data," *Royal Society Open Science*, 6, 190067.

Bauckloh, T., I. Hardeck, P. U. Wittenstein, and B. Zwergel (2021): "Spillover effects of tax avoidance on peers' firm value," *Accounting Review*, 96, 51–79.

Beer, S., R. de Mooij, and L. Liu (2020): "International corporate tax avoidance: A review of the channels, magnitudes, and blind spots," *Journal of Economic Surveys*, 34, 660–688.

Beer, S. and J. Loeprick (2015): "Profit shifting: Drivers of transfer (mis) pricing and the potential of countermeasures," *International Tax and Public Finance*, 22, 426–451.

Bilicka, K. R., M. Devereux, and I. Guceri (2020): "Optimization frictions and fixed costs of profit shifting," *mimeo*.

Blundell, R. and S. Bond (1998): "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, 87, 115–143.

Brainard, S. L. (1993): "A simple theory of multinational corporations and trade with a trade-off between proximity and concentration," *NBER working Papers*, 4269.

Casella, B. and B. Souillard (2022): "A new framework to assess the fiscal impact of a global minimum tax on FDI," *Transnational Corporations*, forthcoming.

Cen, L., E. L. Maydew, L. Zhang, and L. Zuo (2017): "Customer-supplier relationships and corporate tax avoidance," *Journal of Financial Economics*, 123, 377–394.

Dharmapala, D. (2014): "What do we know about base erosion and profit shifting? A review of the empirical literature," *Fiscal Studies*, 35, 421–448.

Dowd, T., P. Landefeld, and A. Moore (2017): "Profit shifting of US multinationals," *Journal of Public Economics*, 148, 1–13.

Dyreng, S., J. L. Hoopes, P. Langetieg, and J. H. Wilde (2020): "Strategic subsidiary disclosure," *Journal of Accounting Research*, 58, 643–692.

Dyreng, S. D., M. Hanlon, and E. L. Maydew (2008): "Long-run corporate tax avoidance," *Accounting Review*, 83, 61–82.

Dyreng, S. D. and B. P. Lindsey (2009): "Using financial accounting data to examine the effect of foreign operations located in tax havens and other countries on US multinational firms' tax rates," *Journal of Accounting Research*, 47, 1283–1316.

Gallemore, J., B. Gipper, and E. Maydew (2019): "Banks as tax planning intermediaries," *Journal of Accounting Research*, 57, 169–209.

Garcia-Bernardo, J. and P. Janskỳ (2022): "Profit shifting of multinational corporations worldwide," *mimeo*.

Gomila, R. (2021): "Logistic or linear? Estimating causal effects of experimental treatments on binary outcomes using regression analysis," *Journal of Experimental Psychology: General*, 150, 700–709.

Grieser, W., J. LeSage, and M. Zekhnini (2021): "Industry networks and the geography of firm behavior," *Management Science*.

Grubert, H. (2012): "Foreign taxes and the growing share of US multinational company income abroad: Profits, not sales, are being globalized," *National Tax Journal*, 65, 247–282.

Gumpert, A., J. R. Hines, and M. Schnitzer (2016): "Multinational firms and tax havens," *Review of Economics and Statistics*, 98, 713–727.

Hanlon, M. and S. Heitzman (2010): "A review of tax research," *Journal of Accounting and Economics*, 50, 127–178.

Head, K. and T. Mayer (2004): "Market potential and the location of Japanese investment in the European Union," *Review of Economics and Statistics*, 86, 959–972.

Helpman, E., M. J. Melitz, and S. R. Yeaple (2004): "Export versus FDI with heterogeneous firms," *American Economic Review*, 94, 300–316.

Hines, J. R. and E. M. Rice (1994): "Fiscal paradise: Foreign tax havens and American business," *Quarterly Journal of Economics*, 109, 149–182.

Hinz, J., A. Stammann, and J. Wanner (2020): "State dependence and unobserved heterogeneity in the extensive margin of trade," *mimeo*.

Horrace, W. C. and R. L. Oaxaca (2006): "Results on the bias and inconsistency of ordinary least squares for the linear probability model," *Economics Letters*, 90, 321–327.

Jones, C., Y. Temouri, and A. Cobham (2018): "Tax haven networks and the role of the Big 4 accountancy firms," *Journal of World Business*, 53, 177–193.

Klassen, K. J. and S. K. Laplante (2012): "Are US multinational corporations becoming more aggressive income shifters?" *Journal of Accounting Research*, 50, 1245–1285.

Krautheim, S. and T. Schmidt-Eisenlohr (2011): "Heterogeneous firms, 'profit shifting' FDI and international tax competition," *Journal of Public Economics*, 95, 122–133.

Langenmayr, D. (2015): "Limiting profit shifting in a model with heterogeneous firm productivity," *BE Journal of Economic Analysis & Policy*, 15, 1657–1677.

Li, J., H. Ding, Y. Hu, and G. Wan (2021): "Dealing with dynamic endogeneity in international business research," *Journal of International Business Studies*, 52, 339–362.

Lim, C. Y., T. J. Shevlin, K. Wang, and Y. Xu (2018): "Tax knowledge diffusion through individual auditor network ties: Evidence from China," *SSRN Working Papers*, 3229564.

Merz, J. and M. Overesch (2016): "Profit shifting and tax response of multinational banks," *Journal of Banking & Finance*, 68, 57–68.

Riedel, N. (2018): "Quantifying international tax avoidance: A review of the academic literature," *Review of Economics*, 69, 169–181.

Tørsløv, T. R., L. S. Wier, and G. Zucman (2021): "The missing profits of nations," *NBER Working Papers*, 24701.

US Senate Permanent Subcommittee on Investigations (2014): "Caterpillar's offshore tax strategy," *technical report*.

Wang, F., S. Xu, J. Sun, and C. P. Cullinan (2020): "Corporate tax avoidance: A literature review and research agenda," *Journal of Economic Surveys*, 34, 793–811.

Appendix

Figure AF1 – Firm presence in OFCs over time

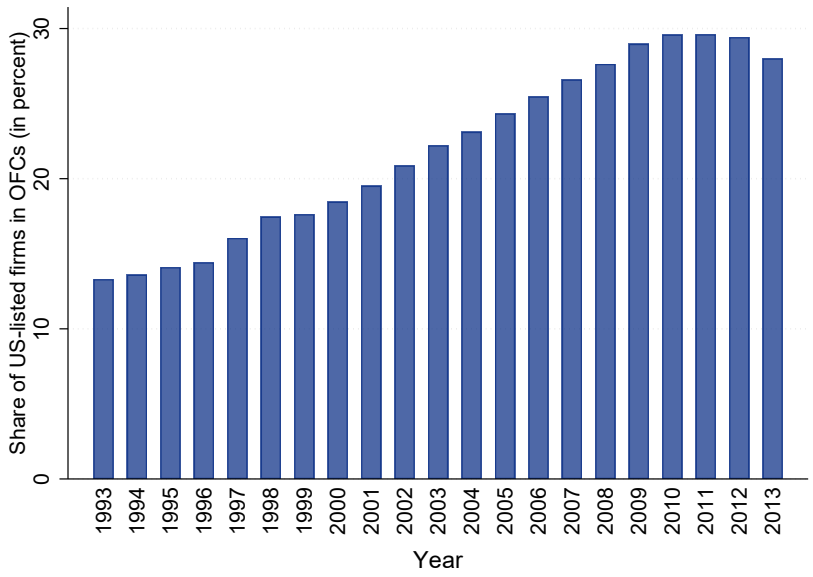
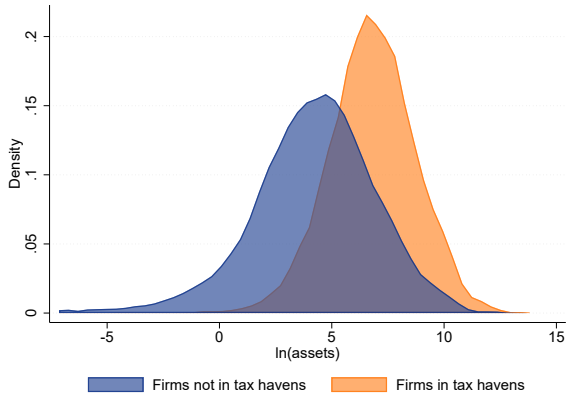
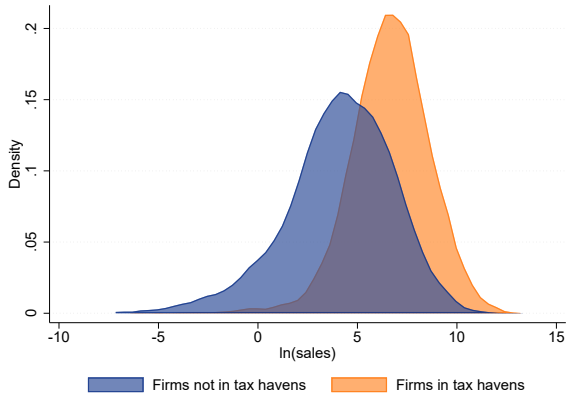


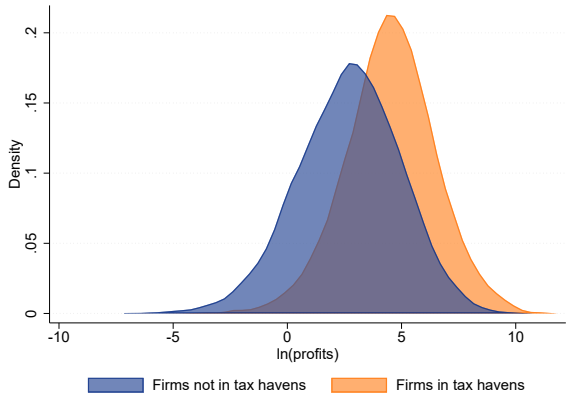
Table AT1 – Firm presence in OFCs over time (by industry)

SIC sectors	Share of firms in OFCs in 2013 (in percent)	Change between 1993 and 2013 (in percent)
Services (SIC 70-89)	34.13	243.19
Finance, real estate, insurance (SIC 60-67)	33.44	276.43
Manufacturing (SIC 20-39)	28.13	199.52
Retail & wholesale trade (SIC 50-59)	24.27	203.57
Mining (SIC 10-14)	19.82	31.41
Transportation & public utilities (SIC 40-49)	16.76	81.25
Public administration (SIC 91-99)	12.94	40.00

Figure AF2 – Assets, turnover, and profits (distribution)







Notes: In Compustat, assets are given by the variable denoted *AT*, sales by the variable labeled *SALE*, and profits by the variable *PI – SPI*. All three are measured in million US dollars.

Table AT2 – Firm presence in OFCs and effective tax rates

Dependent variable	$ETR_{i,t}$
$TH_{i,t}$	-0.004[a]
	(0.001)
Firm FEs	Yes
Year FEs	Yes
Controls	Yes
R^2	0.64
No. of obs.	76,559

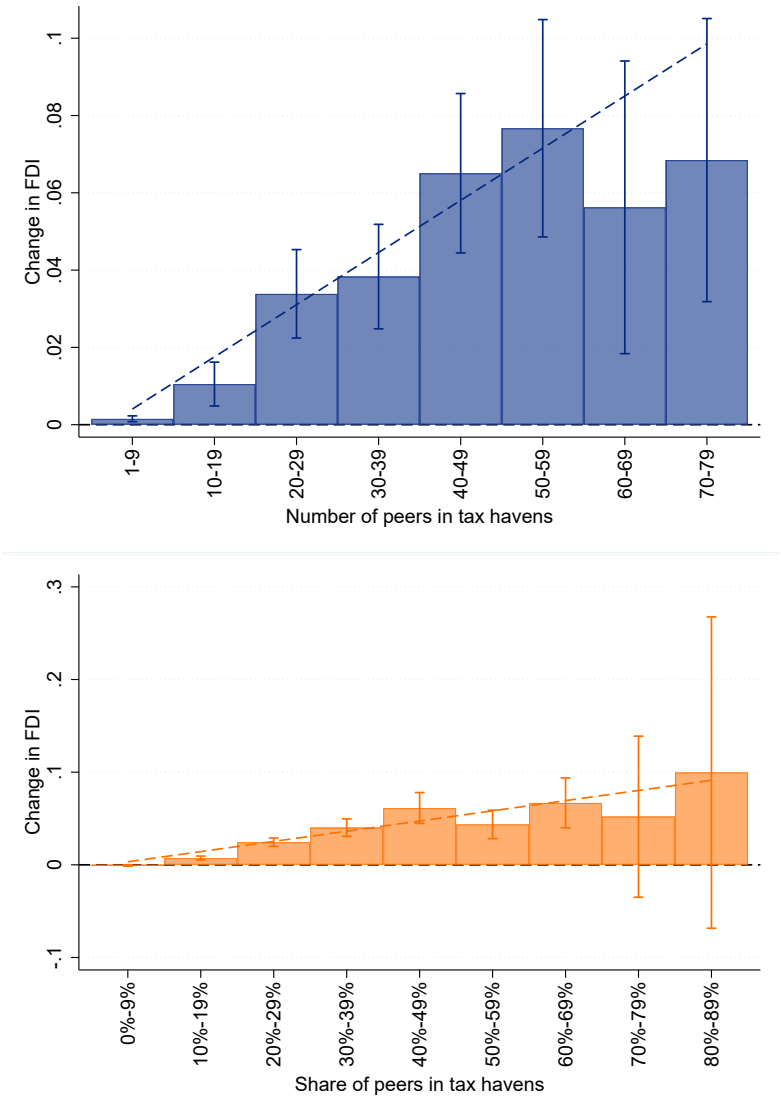
Notes: Results of the regression: $ETR_{i,t} = \alpha TH_{i,t} + \beta X_{i,t} + \mu_i + \upsilon_t + \epsilon_{i,t}$. $ETR_{i,t}$ is the effective tax rate of firm *i* in year *t*. The variable is constructed using the variables *TXT*, *PI*, and *SPI* in Compustat. It is equal to $TXT/(PI - SPI)$. For interpretability, and as is customary in the corporate tax avoidance literature, values outside the [0,1] interval are omitted. $TH_{i,t}$ is a count variable that represents the number of tax havens where firm *i* discloses subsidiaries in year *t*. $X_{i,t}$ is an array of controls: tax loss carryfoward (dummy whose construction is based on the variable labeled *TLCF* in Compustat), employment (whose construction is based on the variable labeled *EMP* in Compustat), sales (whose construction is based on the variable labeled *SALE* in Compustat), and assets (whose construction is based on the variable labeled *AT* in Compustat). Employment (in thousands), sales, and assets (in million US dollars) are in logarithm. μ_i are firm-level fixed effects. υ_t are year-level fixed effects. The standard error, in parentheses, is clustered at the firm level. $^b p < 0.05$, $^a p < 0.01$. See section 2 for more details.

Table AT3 – Profit shifting spillovers: supplementary results

Column	(1)	(2)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT^{C}_{i,c,t}$	1.95e-3^{a}	
	(2.45e-4)	
$TREAT^{S}_{i,c,t}$		0.11^{a}
		(7.66e-3)
Firm-year FEs	Yes	Yes
Country-year FEs	Yes	Yes
Firm-country FEs	Yes	Yes
No. of obs.	5,514,400	5,514,400

Notes: Results of two slightly modified versions of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT^{C}_{i,c,t}$ represents the number of companies operating in the same sector as firm i with at least one subsidiary in tax haven c in year t. $TREAT^{S}_{i,c,t}$ represents the share of companies operating in the same sector as firm i with at least one subsidiary in tax haven c in year t. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Figure AF3 – Profit shifting spillovers: supplementary results (ctd)



Notes: These figures are generated after replacing $TREAT_{i,c,t}$ in equation (1) with $TREAT^{C}_{i,c,t}$ (number of peers in tax haven c in year t, first subfigure) or $TREAT^{S}_{i,c,t}$ (share of peers in tax haven c in year t, second subfigure). $TREAT^{C}_{i,c,t}$ and $TREAT^{S}_{i,c,t}$ are first categorized and then inserted through a set of dummy variables. For instance, $TREAT^{C}_{1-9,i,c,t}$ is a dummy equal to 1 if firm i has between 1 and 9 peers present in OFC c in year t. Two equations are estimated: $FDI_{i,c,t} = \sum_k \alpha_k x_{k,i,c,t} + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t}$. $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $x = \{TREAT^{C}, TREAT^{S}\}$ and k denotes the category. The bars represent the point estimates $\hat{\alpha}_k$. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the sector-year level. The dashed lines correspond to $\hat{\alpha}$ in $FDI_{i,c,t} = \alpha x_{i,c,t} + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t}$. $x = \{TREAT^{C}, TREAT^{S}\}$. The two $\hat{\alpha}$ directly come from Appendix table AT3. See section 3 for more details.

Table AT4 – Profit shifting spillovers: dynamics (full table)

Dependent variable	$FDI_{i,c,t}$
$TREAT^{t+5}_{i,c,t}$	6.59e-4
	(7.54e-4)
$TREAT^{t+4}_{i,c,t}$	-7.38e-4
	(7.78e-4)
$TREAT^{t+3}_{i,c,t}$	-7.28e-4
	(7.85e-4)
$TREAT^{t+2}_{i,c,t}$	1.27e-3
	(7.98e-4)
$TREAT^{t+1}_{i,c,t}$	1.34e-3
	(8.26e-4)
$TREAT_{i,c,t}$	-0.34e-4
	(9.40e-4)
$TREAT^{t-1}_{i,c,t}$	2.18e-3^{a}
	(8.11e-4)
$TREAT^{t-2}_{i,c,t}$	1.70e-3^{b}
	(7.55e-4)
$TREAT^{t-3}_{i,c,t}$	9.51e-4
	(7.45e-4)
$TREAT^{t-4}_{i,c,t}$	2.34e-4
	(7.63e-4)
$TREAT^{t-5}_{i,c,t}$	-4.58e-5
	(7.98e-4)
Firm-year FEs	Yes
Country-year FEs	Yes
Firm-country FEs	Yes
No. of obs.	1,238,800

Notes: Results of equation (2). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. $TREAT^{t-k}_{i,c,t}$ and $TREAT^{t+k}_{i,c,t}$ are lagged and lead values of $TREAT_{i,c,t}$ Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Table AT5 – Profit shifting spillovers: alternative estimation techniques

Column	(1)	(2)	(3)	(4)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT_{i,c,t}$	1.63e-3^{b*}	1.02e-3^{b}	9.88e-4^{b}	1.29e-3^{a}
	(8.15e-4)	(4.85e-4)	(4.80e-4)	(2.36e-4)
$FDI_{i,c,t-1}$		0.85^{a}	0.82^{a}	0.87^{a}
		(2.12e-3)	(9.54e-3)	(3.01e-3)
Firm-year FEs	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes
No. of obs.	82,736	4,799,150	3,605,350	4,474,100
Method	Logit	OLS	2SLS	System-GMM

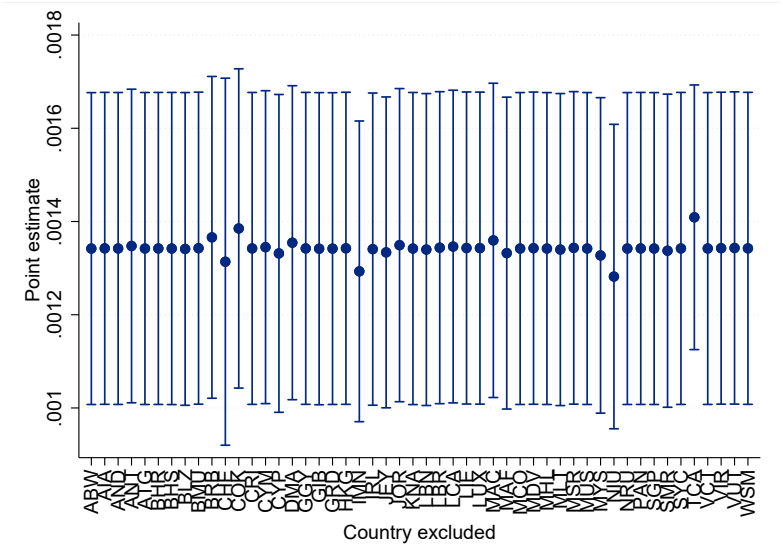
Notes: Results of four slightly modified versions of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. *The reported coefficient corresponds to an average marginal effect. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Table AT6 – Profit shifting spillovers: alternative tax haven classifications

Column	(1)	(2)	(3)	(4)	(5)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT_{i,c,t}$	9.33e-4^{b}	1.32e-3^{a}	8.95e-4^{b}	1.53e-3^{a}	8.69e-4^{b}
	(4.27e-4)	(3.98e-4)	(4.49e-4)	(3.33e-4)	(3.82e-4)
Firm-year FEs	Yes	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes	Yes
No. of obs.	4,301,232	5,073,248	3,860,080	4,852,672	5,845,264
OFC list	HR	DL	HL∩DL	EX6	DL+HR+TWZ

Notes: Results of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Figure AF4 – Profit shifting spillovers: alternative tax haven classifications (ctd)



Notes: Results of fifty slightly modified versions of equation (1). This figure shows how the point estimate $\hat{\alpha}$ varies after excluding one tax haven at a time from regression (1). Point estimates with 95 percent confidence intervals. Standard errors are clustered at the sector-year level. See section 3 for more details.

Table AT7 – Profit shifting spillovers: changing industry definition

Column	(1)	(2)	(3)	(4)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT^{>15}_{i,c,t}$	6.77e-4^{b}			
	(3.32e-4)			
$TREAT^{3-digit}_{i,c,t}$		1.23e-3^{a}		
		(1.09e-4)		
$TREAT^{acq}_{i,c,t}$			5.91e-4^{b}	
			(2.94e-4)	
$TREAT^{1993-2013}_{i,c,t}$				1.36e-3^{b}
				(5.67e-4)
Firm-year FEs	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes
No. of obs.	3,646,650	5,514,400	1,741,200	305,550

Notes: Results of four slightly modified versions of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. $TREAT^{>15}_{i,c,t}$, $TREAT^{3-digit}_{i,c,t}$, $TREAT^{acq}_{i,c,t}$, and $TREAT^{1993-2013}_{i,c,t}$ are very similar to $TREAT_{i,c,t}$ and defined in section 3. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Table AT8 – Profit shifting spillovers: falsification tests

Column	(1)	(2)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT^{random}_{i,c,t}$	-2.80e-4	
	(3.41e-4)	
$TREAT^{spatial}_{i,c,t}$		-3.24e-4
		(2.01e-4)
Firm-year FEs	Yes	Yes
Country-year FEs	Yes	Yes
Firm-country FEs	Yes	Yes
No. of obs.	5,514,400	5,498,900

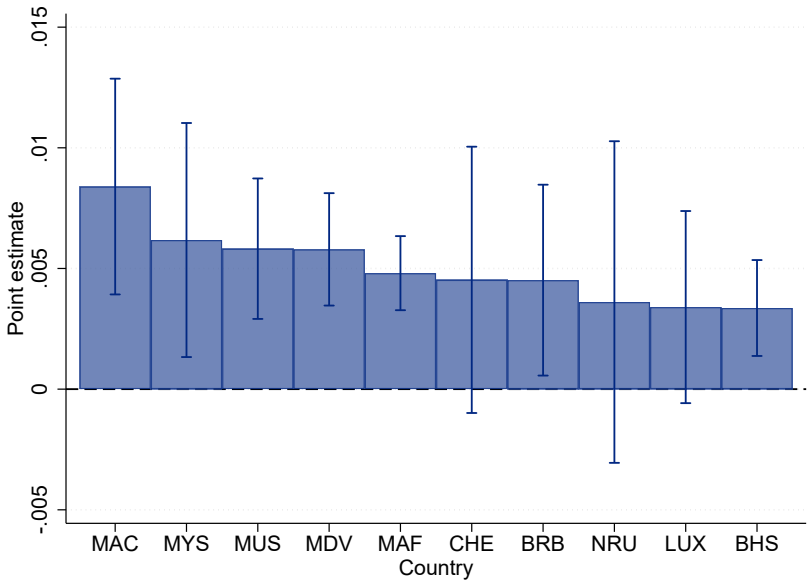
Notes: Results of two slightly modified versions of equation (1). $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. $TREAT^{random}_{i,c,t}$ and $TREAT^{state}_{i,c,t}$ are quite similar to $TREAT_{i,c,t}$ and defined in section 3. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Table AT9 – Profit shifting spillovers over time and across sectors (full table)

Column	(1)	(2)	(3)	(4)
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT_{i,c,t}$	1.81e-4	6.21e-4	2.19e-3[a]	7.04e-4
	(4.73e-4)	(3.73e-4)	(6.78e-4)	(4.57e-4)
Firm-year FEs	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes
No. of obs.	3,002,700	2,480,050	1,346,900	4,167,500
Subsample	1993-2003	2004-2013	Finance and services	Other sectors

Notes: Results of equation (1) for four subsamples. $FDI_{i,c,t}$ is a dummy equal to 1 if firm i has at least one subsidiary in tax haven c in year t. $TREAT_{i,c,t}$ is a dummy equal to 1 if another company operating in the same sector as firm i has at least one subsidiary in tax haven c in year t. Standard errors, in parentheses, are clustered at the sector-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

Figure AF5 – Profit shifting spillovers (by OFCs, top 10)



Notes: Results of equation (4). The figure highlights the top 10 OFCs, i.e., those with the highest spillover effect $\hat{\alpha}_c$. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the sector-year level. See section 3 for more details.