Intra-Industry Diffusion of Profit Shifting Strategies

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July 23, 2021
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Abstract: Does tax knowledge spill over across firms? Using data on US-listed firms and an event study, I provide systematic evidence that profit shifting practices spread across companies. An enterprise is more likely to own a subsidiary in a specific tax haven once another enterprise operating in the same sector enters this tax haven. A battery of three-way fixed effects and the absence of pre-trends allow a causal interpretation of the results. These findings suggest that firms replicate the tax avoidance schemes of their peers and carry policy implications.

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

JEL codes: F14, F23, H26, L25, M21.

Funding from the Fund for Scientific Research-FNRS is gratefully acknowledged. Email: baptiste.souillard@gmail.com.

1 Introduction

In light of the recent tax scandals, multinational enterprises (MNEs) have frequently been accused of large-scale tax avoidance. It has been established that some of them artificially shift profits from affiliates implanted in high-tax countries toward affiliates located in low-tax countries to decrease their average effective tax rate. The techniques used to this end are nowadays relatively well-identified and documented in the literature (Beer, de Mooij, and Liu, 2020). However, less is known about the factors prompting MNEs to engage in profit shifting. Tax rate differentials across jurisdictions naturally play a key role in profit shifting. A perhaps more challenging question is whether an MNE influences the income shifting activities of other MNEs. The corporate tax avoidance literature points in this direction. Lim, Shevlin, Wang, and Xu (2018), Barrios and Gallemore (2019), and Gallemore, Gipper, and Maydew (2019) show that firms connected to low-tax firms via auditor, employee, and bank ties have lower effective tax rates. Cen, Maydew, Zhang, and Zuo (2017) demonstrate that the tax planning behavior of companies along the supply chain is determinant. Bauckloh, Hardeck, Wittenstein, and Zwergel (2021) observe that news about tax avoidance practices of an MNE entails a negative stock price reaction among its peers. This response, according to the authors, stems from the fact that investors expect similar firms to employ similar practices.

In this paper, I dig into this assertion and focus on intra-industry spillovers, profit shifting, and tax haven foreign direct investments (FDIs). In the first part of the paper, I build a database on the worldwide network of US-listed firms' subsidiaries between 1993 and 2013. I capitalize on the fact that the Securities and Exchange Commission (SEC) requires these companies to disclose every year a list of their subsidiaries. On this basis, I construct a unique database disaggregated at the firm-country-year level indicating the number of subsidiaries each US-listed enterprise declares in each tax haven and each year. The analysis then departs from the previous ones, often performed at the firm-year level and limited to effective tax rates. In the second part, I proceed with an event study. I scrutinize the evolution of the probability to report a physical presence in a given tax haven when at least one other company operating in the same 4-digit SIC sector also does. The effect is estimated while controlling for a wide set of confounding factors because the fine level of the database allows inserting three-way fixed effects. The latter notably capture the impact of all firm- and country-year-specific causes of tax haven FDIs such as firm pro-

ductivity and corporate tax rates, thereby mitigating a number of endogeneity concerns.

The benchmark results reveal that, all other things being equal, the average probability to report a subsidiary in a specific tax haven is 10 percent higher when a peer is present in this tax haven. The spillover effect grows over time and increases four fold after five years. This finding is corroborated by various sensitivity tests. First, it is driven neither by the estimation methodology (linear probability model versus binary model) nor by the industry classification. Second, the estimate is robust across classifications of tax havens. I take in the baseline equation the lists of tax havens elaborated by Hines and Rice (1994) and Dyreng and Lindsey (2009), standard in the literature. Nonetheless, adopting one or the intersection of the two lists or omitting one tax haven at a time delivers the same results. On the same note, I find consistent results when excluding the largest tax havens. Workhorse international trade theories predict that FDIs should be directed toward large and central countries (Brainard, 1993; Head and Mayer, 2004; Helpman, Melitz, and Yeaple, 2004). As a consequence, FDIs in large and well-connected tax havens like Ireland and Switzerland might have nothing to do with aggressive tax planning in the first place. Yet, small and remote tax havens still concentrate a disproportionately high number of US-listed firms. It is therefore reasonable to consider that FDIs in small and isolated jurisdictions like Jersey and Seychelles have nor or little economic substance and are purely attributable to profit shifting. Furthermore, the results are validated by falsification tests. I randomly assign each 4-digit SIC industry to another 4-digit SIC industry and examine whether profit shifting activities in this random industry affects firms' presence in tax havens. This is not the case. In the same vein, I find no pre-existing trends, i.e., the presence of firms in tax havens does not depend on future peer entry in tax havens. This confirms that the treatment variable does not pick the effect of past and unobserved firm-country-year shocks, lends credence to the parallel trend assumption, and more generally supports the view that the estimates reflect a causal effect.

Lastly, I investigate the existence of heterogeneous effects along two dimensions: over time and across sectors. Profit shifting has been amplifying in the last decades (Grubert, 2012; Klassen and Laplante, 2012) and found to be more prevalent in finance and services (Gumpert, Hines, and Schnitzer, 2016; Merz and Overesch, 2016). Hence, I conjecture that spillovers are more pronounced (i) in the 2004-2013 period than in the 1993-2003 period and (ii) in services and financial sectors than in manufacturing. The regression

results substantiate both assumptions.

To the best of my knowledge, these findings are new in the literature as they are the first to uncover the existence of (intra-industry) spillovers of profit shifting. In a sense, they help understand the rapid development of profit shifting activities witnessed in the 1990s and 2000s. They also have policy implications. They emphasize that firms tend to reproduce the tax schemes of their peers. The results indicate that when a firm is found undertaking tax dodging activities in tax havens, public authorities could pay particular attention to other corporations operating in the same sector because they are more likely to carry out operations with the incriminated tax havens. In this regard, the fact that intra-industry spillovers seem stronger in services and financial sectors suggests that policy makers might want to devote more efforts to these industries.

The remainder of the paper is structured as follows. First, section 2 introduces the data used to conduct the analysis and presents descriptive statistics. Section 3 then lays out the econometric exercise, the results, and the robustness checks. Section 4 briefly concludes and discusses fruitful avenues for future research.

2 Data

The data originate from two complementary sources: Compustat and Exhibit 21 filings. Compustat is a database providing extensive information on balance sheets, income statements, and cash flows of all publicly listed firms in North America since 1950. These firms, despite being few in number, amass a significant share of overall sales, profits, and employment (Asker, Farre-Mensa, and Ljungqvist, 2014). It is worth noting that they are the most likely to engage in tax haven FDIs and profit shifting. Earlier work points toward the existence of fixed costs for FDIs. Some of these costs derive from the establishment of facilities overseas, and merely the largest and most productive firms can afford and find profitable to pay these costs (Helpman et al., 2004). The same logic applies to profit shifting (Bilicka, Devereux, and Guceri, 2020). Avoiding taxes necessitates an excellent knowledge of the tax code. Firms must recruit expensive tax experts to exploit loopholes, mismatches in tax rules, and other legal technicalities to book their income in tax-friendly jurisdictions (US Senate Permanent Subcommittee on Investigations, 2014; Jones, Temouri, and Cobham, 2018). For these reasons, not having a representative sample of the

FIGURE 1 – Non-exhaustive list of the significant subsidiaries reported by Johnson & Johnson in Exhibit 21 filings in 2011

Name of Subsidiary	Jurisdiction of Organization
U.S. Subsidiaries:	
Acclarent, Inc.	Delaware
ALZA Corporation	Delaware
Alza Development Corporation	California
Alza Land Management, Inc.	Delaware
Animas Corporation	Delaware
Biosense Webster, Inc.	California
Centocor Biologics, LLC	Pennsylvania
Centocor Research & Development, Inc.	Pennsylvania
CNA Development LLC	Delaware
Codman & Shurtleff, Inc.	New Jersey
Cordis Corporation	Florida
Cordis International Corporation	Delaware
Cordis LLC	Delaware
Cougar Biotechnology, Inc.	Delaware
Crescendo Pharmaceuticals Corporation	Delaware
Crucell Holdings Inc.	Delaware
DePuy, Inc.	Delaware
DePuy Mitek, Inc.	Massachusetts
DePuy Orthopaedics, Inc.	Indiana
International Subsidiaries:	
Apsis	France
Beijing Dabao Cosmetics Co., Ltd.	China
Berna Biotech Korea Corporation	Korea
Berna Rhein B.V.	Netherlands
Biosense Webster (Israel) Ltd.	Israel
Cilag Advanced Technologies GmbH	Switzerland
Cilag AG	Switzerland

universe of firms is not a problem for this paper. [1]

The Compustat data are merged with data extracted from Exhibit 21 filings. The SEC requires US-listed firms to disclose, each year, a list of their significant subsidiaries in Exhibit 21 of Form 10-K. [2] A subsidiary is qualified as significant if its assets (or revenues) represent at least 10 percent of consolidated assets (or revenues). Moreover, any subsidiary is treated as significant if by combining all undisclosed subsidiaries into one fictive subsidiary, this composite accounts for at least 10 percent of global assets (or revenues). Therefore, Exhibit 21 filings reflect where more than 90 percent of US-listed firms' assets and revenues are recorded. They allow observing where most of the subsidiaries of US-listed firms are incorporated and how these networks evolve over time. An interesting

1. Small and medium enterprises (SMEs) are less internationally-oriented and more prone to *evade* taxes. The central distinction between tax evasion and tax avoidance is that tax evasion is undoubtedly illegal, so the strategies used are therefore not the same in the two cases. SMEs do not generally have enough financial resources to engage in profit shifting to lighten their tax burden.

2. Note that companies are not obliged to uncover financial information concerning each of these subsidiaries.

feature of Exhibit 21 filings is that they are electronically filed since 1993 and publicly available on the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) platform. I give an example in figure 1, which displays (a part of) the list of subsidiaries reported by the firm Johnson & Johnson in 2011 in the US and abroad. One potential caveat is that firms might have incentives to under-estimate the number of subsidiaries in tax havens. Dyreng, Hoopes, Langetieg, and Wilde (2020) argue however that most disclosures are accurate, even when it comes to tax havens. In this study, I exploit an updated version of the database constructed by Dyreng and Lindsey (2009) covering the 1993-2013 period.

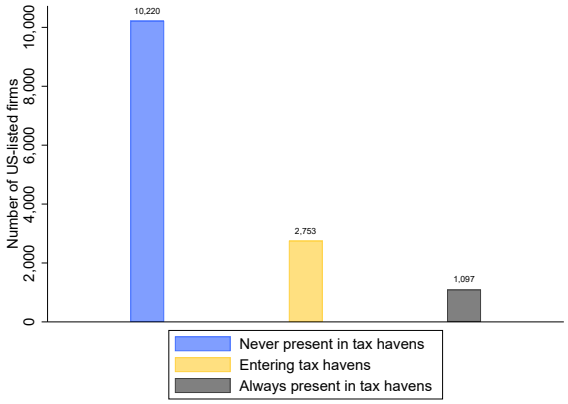
The final sample consists of 14,070 firms, all of which reported one or several subsidiaries at some point, inside or outside the US. The database is compiled at the firm-tax haven-year level. The list of tax havens draws on those of Hines and Rice (1994) and Dyreng and Lindsey (2009), both typical in the corporate tax avoidance literature. A country is assumed to be a tax haven if it figures in at least one of the two lists. In total, 52 foreign countries are viewed as tax havens. [3]

Among the 14,070 companies, 10,220 of them (73 percent) never declared a subsidiary in a tax haven while 2,753 of them (19 percent) entered at least one tax haven between 1993 and 2013 (see figure 2a). The 1,097 remaining firms (8 percent) always reported at least one subsidiary in a tax haven. It means that beyond data availability, 1993-2013 is convenient for the analysis since the number of firms operating in tax havens has more than tripled during this period. On average, firms present in tax havens were located in three distinct tax havens. 40 (18) percent of these companies were established in one (two) tax haven(s), so the average is driven by a very few companies having subsidiaries in multiple tax havens (see figure 2b). According to figure 2c, Hong Kong was the most popular tax haven of US-listed firms. 11.66 percent of the firms disclosed at least one subsidiary in this jurisdiction. Singapore (10.97 percent), Switzerland (7.60 percent), Ireland (7.49 percent), and the Cayman Islands (6.62 percent) complete the top 5.

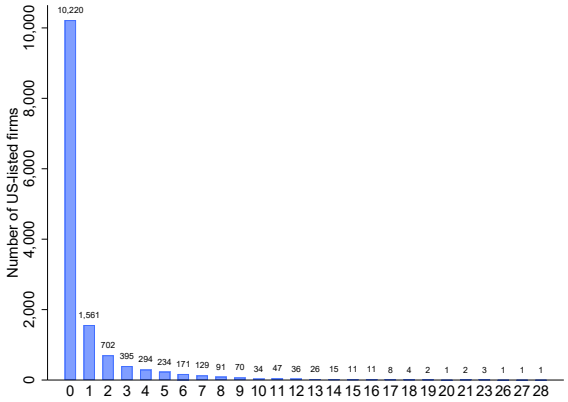
3. The list is composed of Andorra, Anguilla, Antigua, Aruba, Bahamas, Bahrain, Barbados, Barbuda, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Costa Rica, Cyprus, Dominica, Gibraltar, Grenada, Guernsey, Hong Kong, Ireland, Isle of Man, Jersey, Jordan, Lebanon, Liberia, Liechtenstein, 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, and Vanuatu. Although Channel Islands and UK Caribbean Islands appear in Hines and Rice (1994), they are left aside in this paper due to data limitations.

FIGURE 2 – Summary statistics

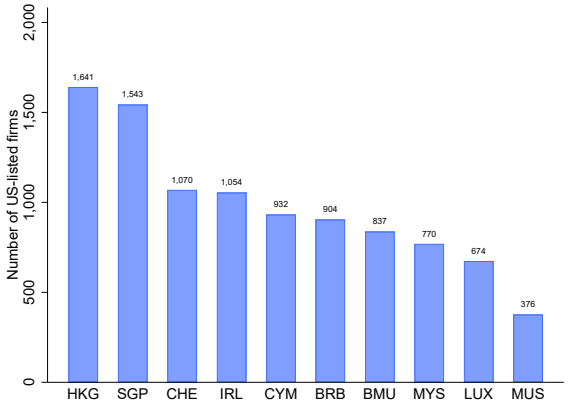
(a) Presence of US-listed firms in tax havens (1)



(b) Presence of US-listed firms in tax havens (2)



(c) Top 10 tax havens



3 Econometric analysis

3.1 Identification strategy

Armed with this database, I run the following linear probability model (LPM) with ordinary least squares to see whether tax dodging schemes propagate within sectors:

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

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 operating in the same 4-digit SIC sector discloses in year t a subsidiary in tax haven c. To mitigate endogeneity, I introduce a battery of three-way fixed effects: firm-year fixed effects $\mu_{i,t}$, country-year fixed effects $\upsilon_{c,t}$, and firm-country fixed effects $\gamma_{i,c}$. The first set of fixed effects absorb sector- and firm-year determinants of FDIs and aggressive tax planning. They incorporate, among other things, determinants already highlighted in the literature such as productivity and intangible assets. The country-year fixed effects capture country-year factors influencing foreign countries' inward FDIs from US-listed firms. These factors include (but are not limited to) corporate tax rates and opacity. The third and last set of fixed effects, firm-country specific, finally ensures to capture firm-country time-invariant causes of FDIs like distance between the headquarter and the tax haven as well as firm-country specific knowledge.

3.2 Main results

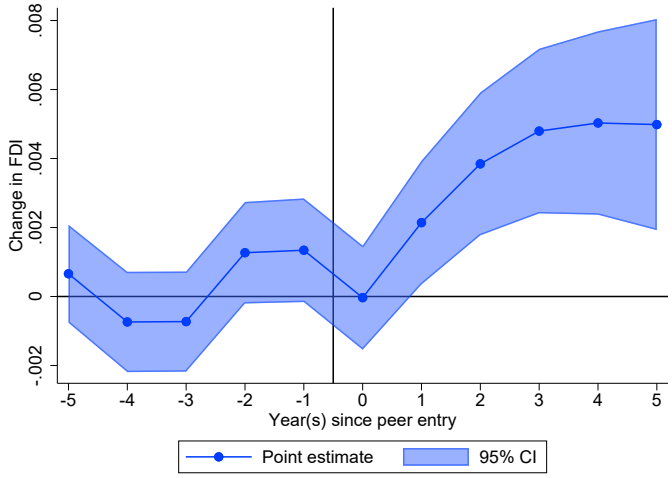
The benchmark result is outlined in table 1. The coefficient of interest $\hat{\alpha}$ is positive and statistically significant at the 1 percent level. Given that the average predicted value of $FDI_{i,c,t}$ is equal to 1.33 percent, the regression result indicates that, other things held constant, the average probability to own a subsidiary in a given tax haven increases by 10 percent if another firm in the same sector also does.

TABLE 1 – 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
Nb. of obs.	5,514,400

Notes. This table reports the baseline regression results of equation (1). The standard error, in parentheses, is clustered at the firm-year level. [a] $p < 0.01$. See section 3 for more details.

FIGURE 3 – Dynamics



Notes. This figure outlines how $FDI_{i,c,t}$ varies before and after the treatment. Standard errors are clustered at the firm-year level. See section 3 for more details.

3.3 Robustness

Binary model I now evaluate the robustness of this finding. In table 2 panel A, I prove that it is not ascribable to the estimation technique. There is no consensus in the econometrics literature on the estimator one should use when the dependent variable is binary (Horrace and Oaxaca, 2006; Angrist and Pischke, 2009; Battey, Cox, and Jackson, 2019; Gomila, 2020). LPMs and binary models have their own advantages and drawbacks. For instance, 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 incidental parameters problem. An important point, indeed, is that estimating binary models with high-dimensional fixed effects is not trivial. Groups for which the dependent variable does not vary should be excluded. This omission leads to the so-called incidental parameters problem, and the estimates, biased, need to be corrected accordingly. I estimate a logit model building on Hinz, Stammann, and Wanner (2020). They design a correction procedure for binary models with three-way fixed effects akin to mine. Reassuringly, $\hat{\alpha}$ remains positive and statistically significant at standard levels.

Dynamics Next, I enrich equation (1) 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. They allow examining how the probability of a firm to disclose a subsidiary in a tax haven fluctuates before and after peer entry in this specific tax haven. Without loss of generality, I select a 10-year window around the treatment and estimate equation (2) below:

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

The results can be visualized in figure 3 and two comments are in order. First, the effect is progressive and equal to +38 percent after five years. Second, there is little evidence of pre-existing trends. The probability to report a subsidiary in a given tax haven does not significantly vary before the treatment, thereby corroborating the common trend assumption. Note that parallel trends imply that the treatment variable is unlikely to be correlated with past unobserved firm-country-year shocks and greatly alleviate reverse causality concerns.

TABLE 2 – Sensitivity analysis

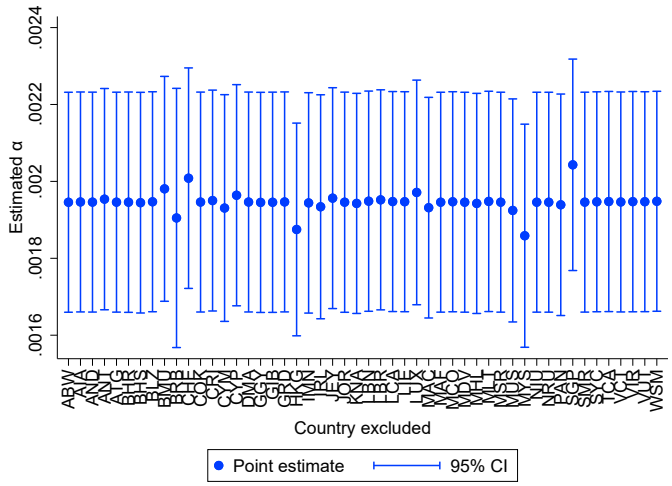
Dependent variable	$FDI_{i,c,t}$
Panel A: Binary model	
$TREAT_{i,c,t}$	0.13[b]
Panel B: Treatment variable	
$TREAT^{C}_{i,c,t}$	1.95e-3[a]
$SHARE_{i,c,t}$	0.11[a]
Panel C: Classification of tax havens	
$TREAT^{HR}_{i,c,t}$	9.33e-4[a]
$TREAT^{DL}_{i,c,t}$	1.32e-3[a]
$TREAT^{DL \cap HR}_{i,c,t}$	8.95e-4[a]
$TREAT^{EX6}_{i,c,t}$	1.53e-3[a]
Panel D: Industry definition	
$TREAT^{>15}_{i,c,t}$	1.74e-3[a]
$TREAT^{3-digit}_{i,c,t}$	1.23e-3[a]
Panel E: Falsification test	
$TREAT^{random}_{i,c,t}$	1.74e-4
Firm-year FEs	Yes
Country-year FEs	Yes
Firm-country FEs	Yes

Notes. This table gauges the robustness of the results outlined in table 1. Standard errors are clustered at the firm-year level and not reported for space. [b] $p < 0.05$, [a] $p < 0.01$. See section 3 for more details.

Treatment variable In table 2 panel B, I replace $TREAT_{i,c,t}$ by $TREAT^{C}_{i,c,t}$, counting the number of firms in the same sector reporting at least one subsidiary in tax haven c and year t, or by $SHARE_{i,c,t}$, measuring the share of firms in the same sector reporting at least one subsidiary in tax haven c and year t. These variables include information on both the extensive and intensive margins of peer entry in tax havens. Again, the two regressions yield a positive and coefficient consistent with the benchmark estimate.

Classification of tax havens In table 2 panel C, I modify this time the set of tax havens. Different classifications coexist because a low statutory corporate income tax rate is not a sufficient condition to be seen as a tax haven. Other criteria are determinant: lack of effective exchange of information, lack of transparency in legislative, legal or administrative provisions, etc. Insofar as they are difficult to assess, characterizing a country as a tax haven is somewhat vague and arbitrary. This is why I rerun the regression by using

FIGURE 4 – Eliminating one tax haven at a time



Notes. This figure show how $\hat{\alpha}$ varies when we exclude one tax haven at a time from regression (1). Standard errors are clustered at the firm-year level. See section 3 for more details.

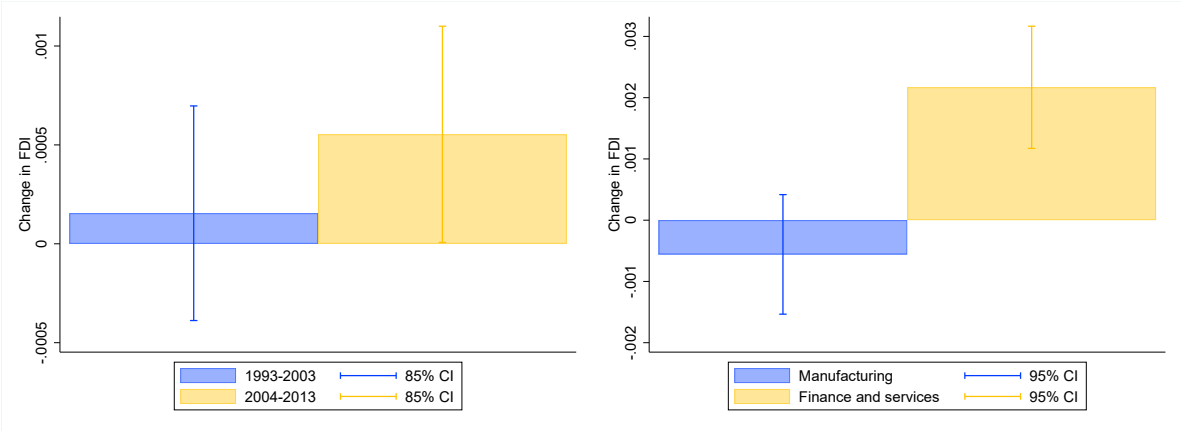
the classifications of Hines and Rice (1994) and Dyreng and Lindsey (2009) separately ($TREAT^{HR}_{i,c,t}$ and $TREAT^{DL}_{i,c,t}$) or by forming a more restricted list composed of the countries found in the two lists ($TREAT^{DL\cap HR}_{i,c,t}$). [4] A fourth regression puts six tax havens aside: Hong-Kong, Ireland, Luxembourg, Malaysia, Singapore, and Switzerland ($TREAT^{EX6}_{i,c,t}$). Because these countries are relatively large and well-connected with the rest of the world, FDIs of US-listed firms in these countries could be unrelated to tax avoidance. FDIs in remote and small jurisdictions like Jersey and Nauru, for their part, more certainly fall within the scope of profit shifting. Appendix figure A1 illustrates that small and distant tax havens, despite their size and isolation, attract a high number of US-listed firms that is disproportionate with what international trade theories would predict. Along similar lines, I reproduce in figure 4 the results when omitting one tax haven at a time. The results are stable and coincide with the baseline estimate in all cases, so they should hold for a large range of classifications.

Industry definition In table 2 panel D, I remove the smallest sectors. Firms operating in concentrated sectors may be more connected, for instance through strategic alliances.

4. The two lists share 35 tax havens. Nonetheless, the classification of Dyreng and Lindsey (2009) is the only one to enumerate Aruba, Costa Rica, Guernsey, Jersey, Malaysia, Mauritius, Nauru, Niue, Samoa, San Marino, and Seychelles. On the other hand, Hines and Rice (1994), unlike Dyreng and Lindsey (2009), retain the British Virgin Islands, Jordan, Maldives, Saint Martin, Channel Islands, and UK Caribbean Islands.

FIGURE 5 – Heterogeneous effects

(a) 1993-2003 versus 2004-2013 (b) Manufacturing versus finance and services



Notes. These graphs compare the intensity of spillovers over time and across sectors. Standard errors are clustered at the firm-year level. See section 3 for more details.

Hence, we may expect the results to be driven by such sectors. To verify that it is not the case, I reproduce the results by keeping only 4-digit SIC sectors with more than 15 enterprises ($TREAT^{>15}_{i,c,t}$) or by extending sectors at the 3-digit SIC level ($TREAT^{3-digit}_{i,c,t}$). Unsurprisingly, the point estimates are of lower magnitude. They are still coherent with the reference one and validate that profit shifting spillovers are quite pervasive.

Falsification Following a comparable reasoning, in table 2 panel E, I randomly assign each 4-digit SIC industry to another 4-digit SIC industry as a placebo test. If the estimates exposed thus far truly reflect intra-industry spillovers, then we should observe no reaction when another company from a random sector enters a tax haven. The result substantiates this claim. All in all, the aforementioned sensitivity tests reinforce the benchmark result displayed in table 1. [5]

3.4 Heterogeneous effects

Before concluding, I explore the existence of heterogeneous effects over time and across industries. Grubert (2012) and Klassen and Laplante (2012) find that profit shifting of US MNEs has escalated in recent years. Another stream of research emphasizes considerable industry-specific heterogeneity in profit shifting. In particular, Gumpert et al. (2016) and

5. In Appendix, I replicate figure 3 for table 2 panels B, C, D, and E.

Merz and Overesch (2016) show that profit shifting is more intense in services and financial sectors compared to manufacturing. In the same spirit, I study whether spillover effects are larger (i) between 2004 and 2013 and (ii) in services and financial sectors (SIC 60-67, SIC 70-88) than in manufacturing (SIC 20-39). To do so, I run regression (1) on the four corresponding subsamples. Figure 5 graphically depicts the regression results and supports the two hypotheses. Spillover effects appear stronger in the second subperiod (figure 5a) and in services and financial industries (figure 5b).

4 Conclusion

Using information on subsidiaries of US-listed companies in tax havens and an event study, I unveil in this paper the existence of intra-industry spillovers of profit shifting. A firm is more likely to own a subsidiary in a specific tax haven once another firm in the same industry establishes a physical presence in this tax haven. The results pass several robustness checks and suggest that firms tend to duplicate the tax dodging schemes of their peers. From a policy viewpoint, it means that auditing peers of firms accused of profit shifting could help public authorities deter profit shifting. More work is now needed to identify the exact channels whereby profit shifting knowledge disseminates across multinational firms.

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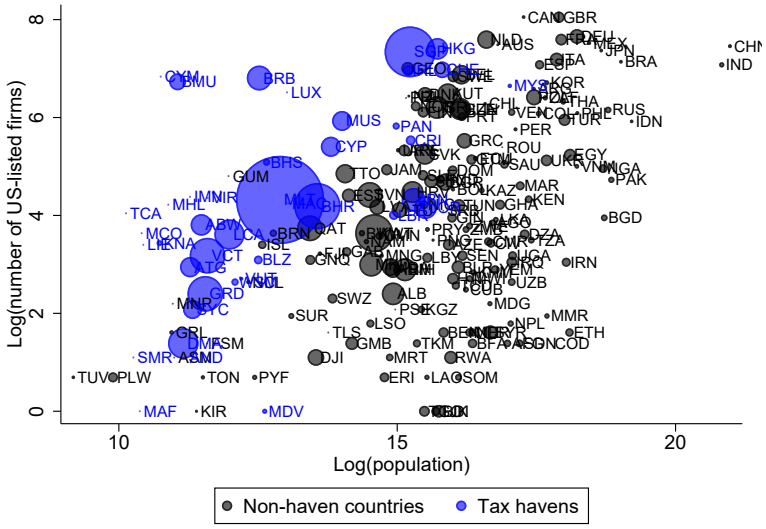
Appendix

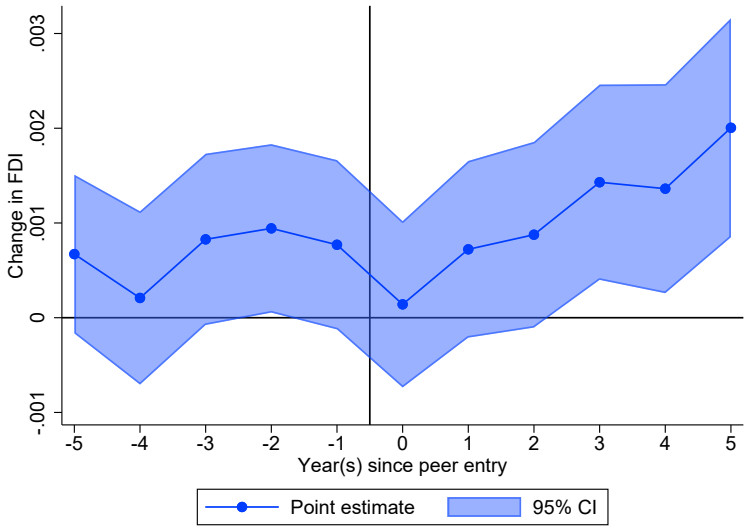
FIGURE A1 – Presence of US-listed firms in foreign countries



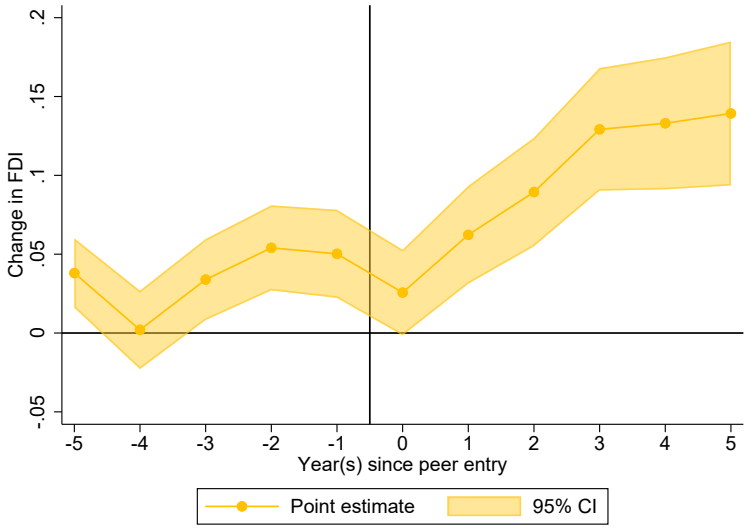
Notes. This figure represents on the y-axis the number of US-listed firms disclosing at least one subsidiary in each foreign country at some point between 1993 and 2013 and on the x-axis the total population of each country. The population size data are from 2003 and come from the World Bank. Bubble size is proportional to the sum of bilateral distances, retrieved from the Market Potentials database of CEPII.

FIGURE A2 – Additional sensitivity check for table 2 panel B

(a) Use of $TREAT^C$



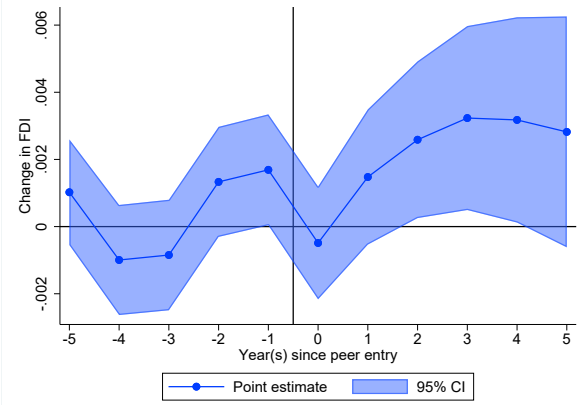
(b) Use of *SHARE*



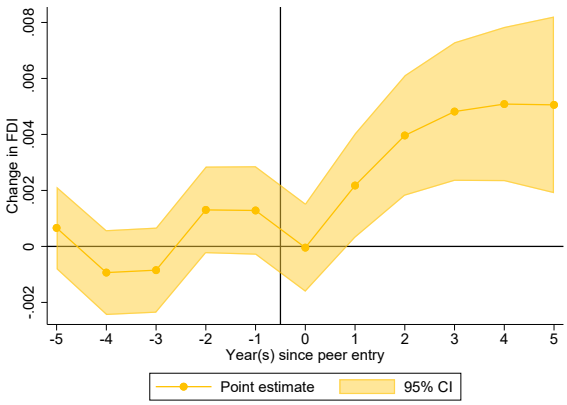
Notes. These figures are the equivalent of figure 3 for table 2 panel B. Standard errors are clustered at the firm-year level. See section 3 for more details.

FIGURE A3 – Additional sensitivity check for table 2 panel C

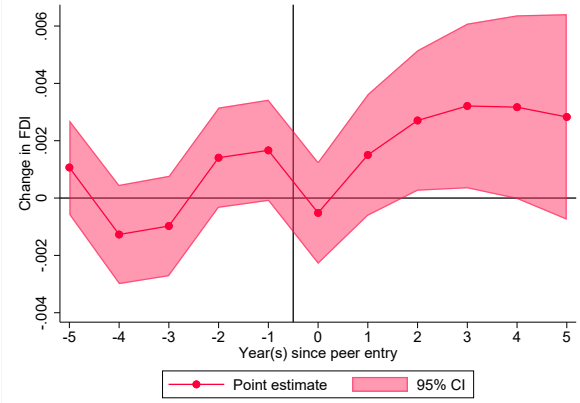
(a) Use of $TREAT^{HR}$



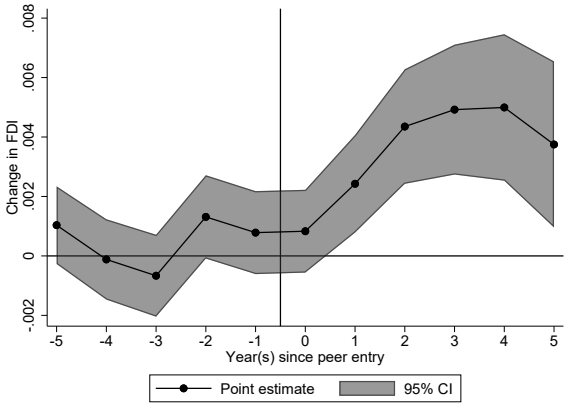
(b) Use of $TREAT^{DL}$



(c) Use of $TREAT^{DL \cap HR}$



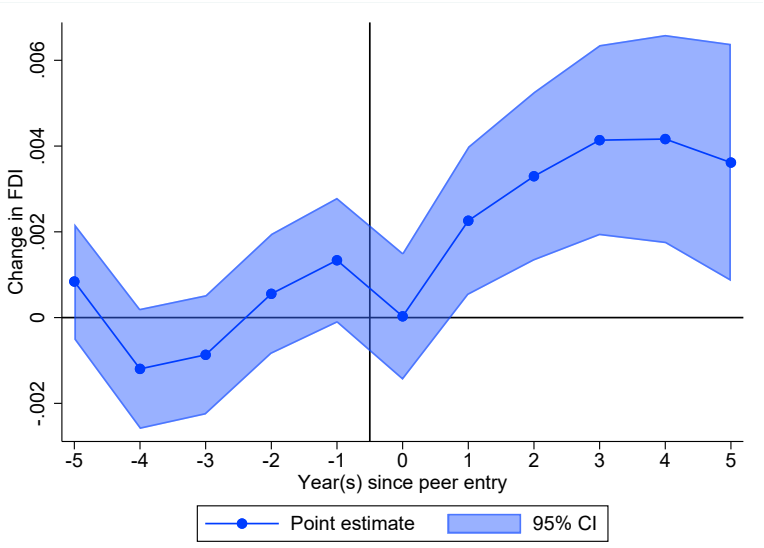
(d) Use of $TREAT^{EX6}$



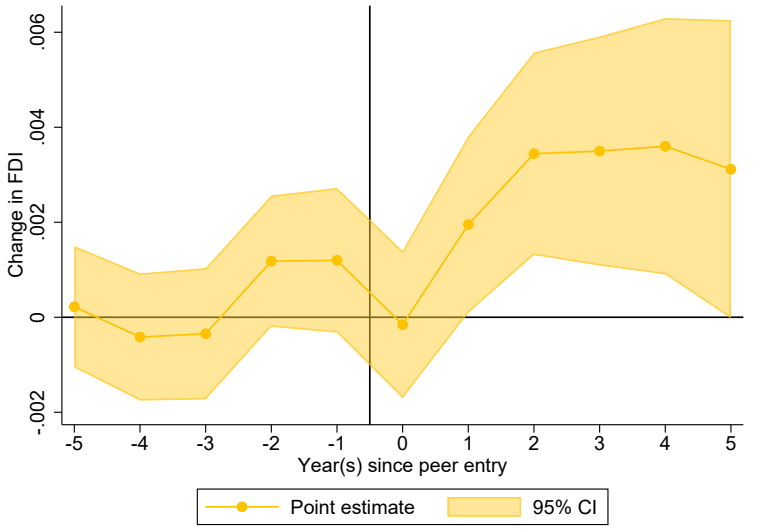
Notes. These figures are the equivalent of figure 3 for table 2 panel C. Standard errors are clustered at the firm-year level. See section 3 for more details.

FIGURE A4 – Additional sensitivity check for table 2 panel D

(a) Use of $TREAT^{>15}$



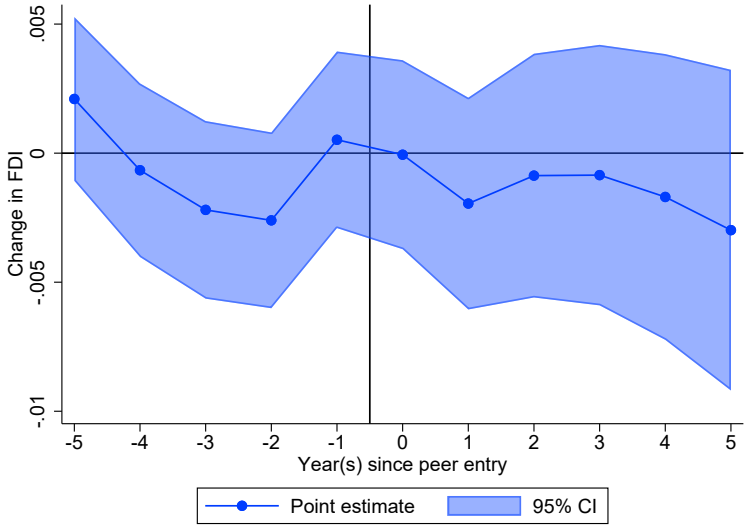
(b) Use of $TREAT^{3-digit}$



Notes. These figures are the equivalent of figure 3 for table 2 panel D. Standard errors are clustered at the firm-year level. See section 3 for more details.

FIGURE A5 – Additional sensitivity check for table 2 panel E

(a) Use of $TREAT^{random}$



Notes. This figure is the equivalent of figure 3 for table 2 panel E. Standard errors are clustered at the firm-year level. See section 3 for more details.