Intra-Industry Diffusion of Profit Shifting Strategies

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Abstract: Does tax knowledge spread across firms? This paper provides systematic evidence along these lines using data on US-listed firms' presence in tax havens and an event study. 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. 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 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.

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1 Introduction

In the aftermath of the recent leaks and tax scandals, many multinational enterprises (MNEs) are under public scrutiny. They are suspected of artificially shifting profits from affiliates in high-tax countries toward others in low-tax jurisdictions to decrease their average effective tax rate. The techniques designed to this end are now relatively well-identified and documented in the literature (Beer, de Mooij, and Liu, 2020). They notably involve a tax-efficient use of transfer prices, intercompany debt, and a relocation of intellectual property rights in tax havens. However, less is known about the factors prompting MNEs to engage in large-scale tax avoidance and profit shifting activities. Tax rates naturally play a key role in profit shifting. A perhaps more challenging question is whether an MNE influences the income shifting behavior of other MNEs, and the literature points in this direction. An old body of research establishes the existence of technology spillovers. Research and development, innovation, exports, and foreign direct investments (FDIs) activities conducted by some firms generate positive externalities and foster the performance of other firms, for instance through labor mobility. More recently and more closely linked to this paper, Cen, Maydew, Zhang, and Zuo (2017), Lim, Shevlin, Wang, and Xu (2018), Barrios and Gallemore (2019), Gallemore, Gipper, and Maydew (2019), and Bauckloh, Hardeck, Wittenstein, and Zwergel (2021) suggest that the same could apply to tax planning technology. Cen et al. (2017), Lim et al. (2018), Barrios and Gallemore (2019), and Gallemore et al. (2019) show that firms connected to low-tax firms via the supply chain and auditor, employee, and bank ties have lower effective tax rates. Bauckloh et al. (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.

The present paper delves into the latter assertion and focuses on intra-industry spillovers, profit shifting, and tax haven 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 compile 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 approach then departs from the previous ones. They often hinge on firm-level data and (cash) effective tax rates, whose variations can be unrelated to tax avoidance. The second part proceeds with an event study. I examine 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 granularity of the database allows inserting three-way fixed effects so the effect of peer entry in tax havens is quantified while controlling for numerous confounding factors. Among others, the firm-year, country-year, and firm-country fixed effects neutralize the impact of all firm-, sector-, and country-year-specific causes of tax haven FDIs such as firm productivity and corporate tax rates. They thereby 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 tax haven is 10 percent higher when a peer is present in this tax haven. The spillover effect progresses over time, grows four fold five years post peer entry, and is corroborated by diverse sensitivity checks. First, it is driven neither by the estimation methodology (linear probability model versus binary model), nor by the industry classification, nor by mergers and acquisitions. Second, the conclusion is robust across tax haven classifications. The baseline equation uses the lists elaborated by Hines and Rice (1994) and Dyreng and Lindsey (2009), standard in the literature. Nonetheless, adopting only one list, the intersection of the two lists, or omitting one tax haven at a time 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 (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. Furthermore, the results are validated by falsification tests. I assign each company to a random industry and see whether profit shifting activities disseminate within these random industries. This is not the case. In the same vein, there is no pre-existing trend, i.e., the presence of firms in tax havens does not depend on future peer entry in tax havens. 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.

Lastly, I investigate the existence of heterogeneous spillover effects along three dimensions: over time, across sectors, and by tax haven. Profit shifting has amplified in the last decades (Grubert, 2012; Klassen and Laplante, 2012) and has been found to be more prevalent in finance and services (Gumpert, Hines, and Schnitzer, 2016; Merz and Overesch, 2016). Therefore, I posit 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. In addition, profit shifting spillovers differ by tax haven. They are stronger for the most tax aggressive jurisdictions (e.g., Barbados, Luxembourg, and Switzerland), where corporate tax rates are at very low levels.

The findings are new in the literature as they are to the best of my knowledge the first to uncover the existence of (intra-industry) profit shifting spillovers. In a sense, they partly explain the rapid development of profit shifting activities witnessed in the 1990s-2000s and contribute to the literature on the determinants of corporate tax avoidance (Alm, 2019; Beer et al., 2020; Wang, Xu, Sun, and Cullinan, 2020). They also have policy implications. Corporate tax avoidance has become a topical issue in a decade of economic, political, and social turmoil. The multiple tax scandals, the rise of within-country income inequalities, the lasting budget deficits in Europe and the US, and the covid-19 pandemic have pushed governments to implement anti profit shifting measures. Against this background, the results emphasize that firms tend to reproduce the tax schemes of their peers. They indicate that when a firm is found undertaking tax dodging activities in some 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 these tax havens. In this regard, the fact that intra-industry spillovers are more salient in services and financial sectors as well as for very aggressive tax havens suggests that policy makers might want to devote more efforts to these industries and jurisdictions.

The remainder of the paper is structured as follows. First, section 2 introduces the data, presents descriptive statistics, and provides three stylized 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 finally concludes and discusses avenues for subsequent research.

2 Data

2.1 Sources

The data originate from two sources: Compustat and Exhibit 21 filings. Compustat is a database containing extensive information on balance sheets, income statements, and cash flows of all publicly listed firms in North America. These firms are the most produc-

TABLE 1 – List of tax havens

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, and Vanuatu.

tive ones. Albeit few in number, they amass a significant share of overall sales, profits, and employment (Asker, Farre-Mensa, and Ljungqvist, 2014). Importantly, it is worth noting that they are the most likely to engage in tax haven FDIs and profit shifting. Earlier work acknowledges the existence of fixed and sunk costs for FDIs. Besides establishing facilities overseas, FDIs generally require completing market research ex ante, creating new distribution networks, etc. 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 and not all MNEs are profit shifters. Firms must recruit expensive tax experts to exploit loopholes and other legal technicalities to book their income in tax-friendly jurisdictions (Jones, Temouri, and Cobham, 2018). For example, PricewaterhouseCoopers received nearly $55 million from Caterpillar for developing its tax dodging strategy (US Senate Permanent Subcommittee on Investigations, 2014). For these reasons, not having a representative sample of the universe of firms should not be seen as a major problem. [1]

Compustat is 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, the composite 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 most of the subsidiaries of US-listed firms are

1. Small and medium enterprises (SMEs) have less resources, have a lower probability to be audited, and are less internationally-oriented. As such, they are more prone 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.

2. Note that companies are not obliged to convey financial information on each of these subsidiaries.

FIGURE 1 – Non-exhaustive list of the significant subsidiaries reported by Johnson & Johnson in Exhibit 21 filings in 2012

EX-21 5 ex21-subsidiariesxform10xk.htm SUBSIDIARIES

EXHIBIT 21

SUBSIDIARIES

Johnson & Johnson, a New Jersey corporation, had the domestic and international subsidiaries shown below as of December 30, 2012. Certain U.S. subsidiaries and international subsidiaries are not named because they were not significant in the aggregate. Johnson & Johnson has no parent.

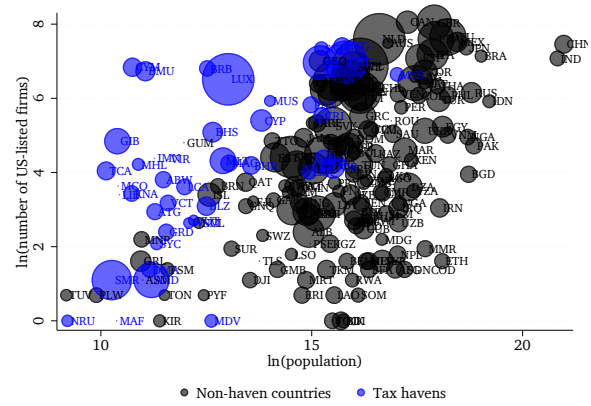
Name of Subsidiary	Jurisdiction of Organization
U.S. Subsidiaries:	
Acclarent, Inc.	Delaware
ALZA Corporation	Delaware
Animas Corporation	Delaware
Biosense Webster, Inc.	California
CNA Development LLC	Delaware
Codman & Shurtleff, Inc.	New Jersey
Cordis Corporation	Florida
Cordis International Corporation	Delaware
Cordis LLC	Delaware
DePuy Mitek Holding Corporation	Delaware
DePuy Mitek, LLC	Massachusetts
DePuy Orthopaedics, Inc.	Indiana
Rutan Realty LLC	New Jersey
Scios Inc.	Delaware
SterilMed, Inc.	Minnesota
Synthes USA Products, LLC	Delaware
Synthes USA, LLC	Delaware
Synthes, Inc.	Delaware
The Anspach Effort, LLC	Florida
Wellness & Prevention, Inc.	Michigan
International Subsidiaries:	
Almaco Holding AG	Switzerland
Apsis	France
Apsis Germany GmbH	Germany
Beijing Dabao Cosmetics Co., Ltd.	China
Berna Biotech Korea Corporation	Korea, Republic of
Berna Rhein B.V.	Netherlands
Biosense Webster (Israel) Ltd.	Israel
Cilag Advanced Technologies GmbH	Switzerland
Cilag AG	Switzerland
Cilag GmbH International	Switzerland

Notes: See https://www.sec.gov/Archives/edgar/data/200406/000020040613000038/ex21-subsidiariesxform10xk.htm.

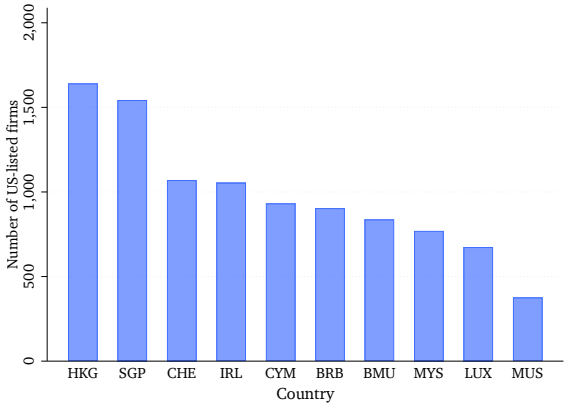
incorporated and how these networks evolve over time. An interesting feature of Exhibit 21 filings is that they are electronically filed since 1993 and publicly available on the Electronic Data Gathering, Analysis, and Retrieval (EDGAR) platform. Figure 1 gives an example. It displays (a part of) the list of subsidiaries reported by the firm Johnson & Johnson in 2012 in the US and abroad. 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 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. Relatedly, some significant subsidiaries in tax havens may not be involved in profit shifting. Insofar as tax havens are essentially small jurisdictions (see stylized fact 1 below), such subsidiaries are unlikely to reach the 10 percent threshold. One robustness check will abstract from the largest tax havens to better address this concern.

FIGURE 2 – Firm internationalization

(a) Presence in foreign countries



(b) Top 10 tax havens



Notes: For the first graph, population size data are from 2003 and come from the World Bank. Bubble size for country c is proportional to $\sum_j GDP_{j,2003}/dist_{jc}$ after standardization of the two components (data retrieved from the Geodist database of CEPII).

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 assembled at the firm-tax haven-year level. The tax haven definition draws on the lists 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, 50 foreign countries are marked as tax havens (see table 1).

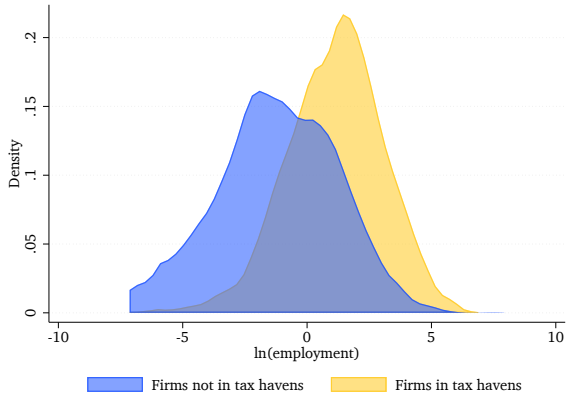
2.3 Summary statistics

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

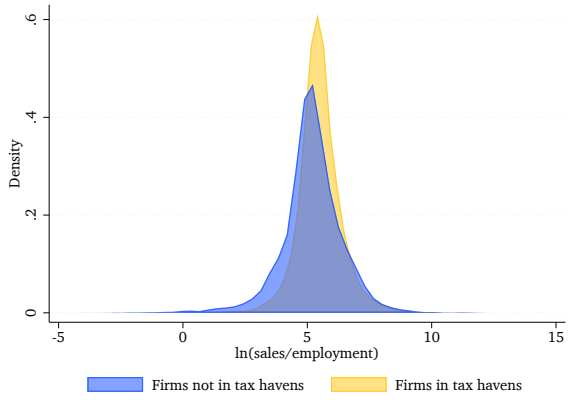
Figure 2a illustrates the relationship between countries' attractiveness, size, and centrality. Tax havens in blue are separated from non-haven countries in black. The blue point cloud is higher than the other one. Tax havens thus concentrate more US-listed companies on average than non-haven countries of comparable size. A similar reasoning holds for centrality. This pattern is worth noticing because it re-questions the empirical validity of common international trade models according to which small and isolated countries receive less FDIs. It also hints that FDIs in tax havens are principally motivated by the

FIGURE 3 – Firm size and productivity

(a) Firm size



(b) Firm productivity



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

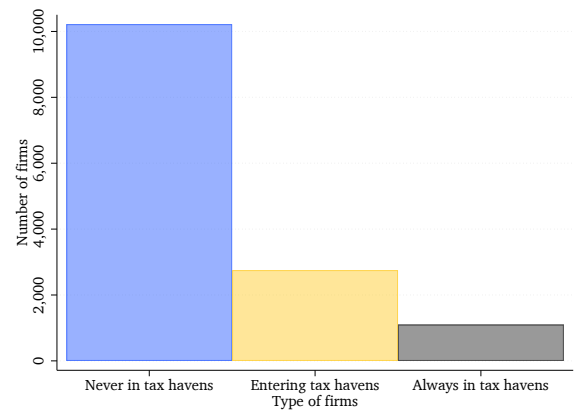
tax environment of the latter, characterized by low rates and financial secrecy. Among tax havens, Hong Kong appears as the most attractive. 11.66 percent of the US-listed firms in the sample disclosed at least one subsidiary in this jurisdiction (see figure 2b). Singapore (10.97 percent), Switzerland (7.60 percent), Ireland (7.49 percent), and the Cayman Islands (6.62 percent) join the top 5.

Stylized fact 2: Firms in tax havens are scarce, but their number is rising over time. In addition, they tend to be larger and more productive.

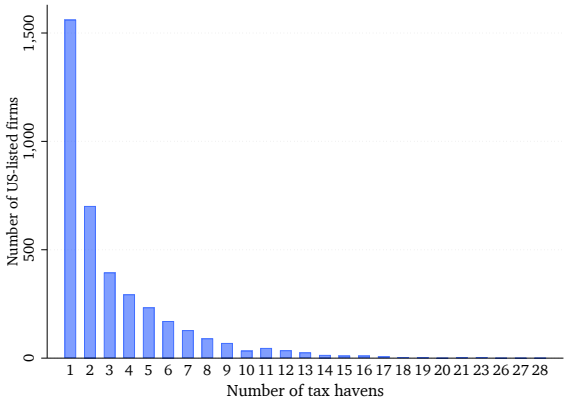
Out of the 14,070 companies in the sample, 7,677 companies (55 percent) did not divulge any subsidiary in a non-haven country (USA excluded), and 10,220 companies (73 percent) never declared a subsidiary in a tax haven between 1993 and 2013. Among MNEs linked with tax havens, 2,753 firms (19 percent) entered at least one tax haven for the first time, while the 1,097 remaining firms (8 percent) always reported at least one subsidiary in a tax haven (see also Appendix figure A1). It means that a handful of firms were in tax havens and that the 1993-2013 period is optimal for the analysis since operations in tax havens soared over the time span. Moreover, figure 3 highlights a mapping between firm presence in tax havens, firm size, and firm productivity. 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 are the very "happy few" (Mayer and Ottaviano, 2008). They form a club of superstar MNEs that not only affect macroecono-

FIGURE 4 – Presence in tax havens

(a) Extensive margin



(b) Intensive margin



mic outcomes but also are profitable enough to engage in aggressive tax planning.

Stylized fact 3: Firms implanted in tax havens are mostly located in one or two tax havens.

On average, shifting firms 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, for example, were active in more than twenty tax havens. The skewness of the distribution reinforces the idea that the subgroup of MNEs that shift profits across borders comprises the most performing corporations.

3 Econometric analysis

3.1 Identification strategy

Armed with the database described above, I run a 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 reduce endogeneity and purge the treatment effect of confounding factors, 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 encompass country-year factors influencing 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, captures firm-country time-invariant causes of FDIs like distance between the headquarter and the tax haven as well as firm-country specific knowledge.

The coefficient of interest α translates the average effect of peer presence in a tax haven on the firm's probability to own subsidiaries in this tax haven. Take two firms A and B active in two different sectors S_A and S_B. Assume that they have comparable global trends in tax haven FDIs, i.e., $\mu_{A,t} - \mu_{A,t-1} \approx \mu_{B,t} - \mu_{B,t-1}$, and that no firm was established in tax haven c in year $t-1$. Further assume that at least one firm in S_A enters tax haven c in year t while no company in S_B penetrates tax haven c in year t. The identification of α relies on the hypothesis that FDIs of both enterprises in jurisdiction c would have evolved similarly between $t-1$ and t in absence of the entry occurred in S_A.

3.2 Main results

The benchmark result is outlined in table 2. The coefficient of interest $\hat{\alpha}$ is equal to 1.35e-3 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 particular tax haven increases by 10 percent if another firm in the same sector also does.

3.3 Robustness

Binary model A series of tests evaluate the robustness of this finding. Table 3 panel A proves 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. On the one hand, LPMs are easier to interpret and more transparent but they might

TABLE 2 – 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

Notes: This table reports the baseline regression results of equation (1). The standard error, in parentheses, is clustered at the firm-year level. [b]$p < 0.05$, [a]$p < 0.01$. See section 3 for more details.

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 equation (1). 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 $TREAT_{i,c,t}^{t-k}$ and $TREAT_{i,c,t}^{t+k}$ 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:

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

The results can be visualized in figure 5. Two comments are in order. First, the effect is progressive and persistent. It amounts to + 38 percent after three years and then stabilizes. Second, there is little evidence of pre-existing trends. Before the treatment, the probability to report a subsidiary in a given tax haven does not significantly vary at the 5 percent level. Common trends imply that the treatment variable is unlikely to be cor-

TABLE 3 – Sensitivity analysis: main tests

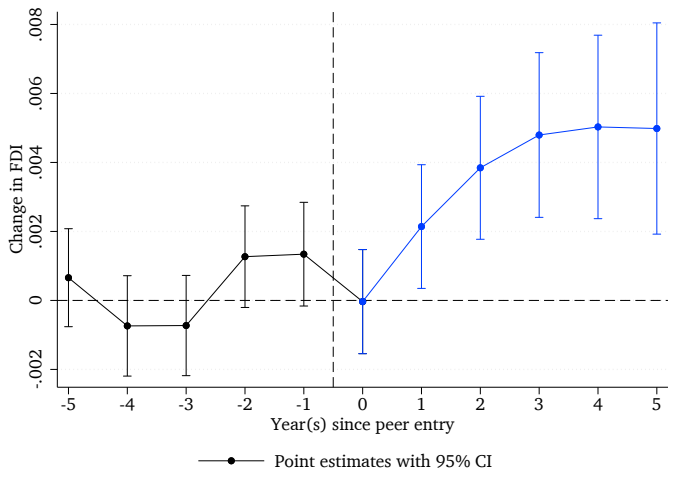
Dependent variable	$FDI_{i,c,t}$
Panel A: Binary model	
$TREAT_{i,c,t}$	0.14^{b}
Panel B: Treatment variable	
$TREAT^{C}_{i,c,t}$	1.95e-3^{a}
$SHARE_{i,c,t}$	0.11^{a}
Panel C: Tax haven classification	
$TREAT^{HR}_{i,c,t}$	9.33e-4^{a}
$TREAT^{DL}_{i,c,t}$	1.32e-3^{a}
$TREAT^{DL \cap HR}_{i,c,t}$	8.95e-4^{a}
$TREAT^{EX6}_{i,c,t}$	1.53e-3^{a}
Panel D: Industry definition	
$TREAT^{>15}_{i,c,t}$	6.77e-4^{a}
$TREAT^{3-digit}_{i,c,t}$	1.23e-3^{a}
$TREAT^{acquisitions}_{i,c,t}$	5.91e-4^{b}
$TREAT^{1993-2013}_{i,c,t}$	1.36e-3^{a}
Panel E: Falsification test	
$TREAT^{random}_{i,c,t}$	-2.80e-4
Firm-year FEs	Yes
Country-year FEs	Yes
Firm-country FEs	Yes

Notes: This table gauges the robustness of the results for equation (1) outlined in table 2. 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 and Appendix table A1 for a full table.

related with past unobserved firm- and sector-country-year shocks and greatly alleviate reverse causality concerns.

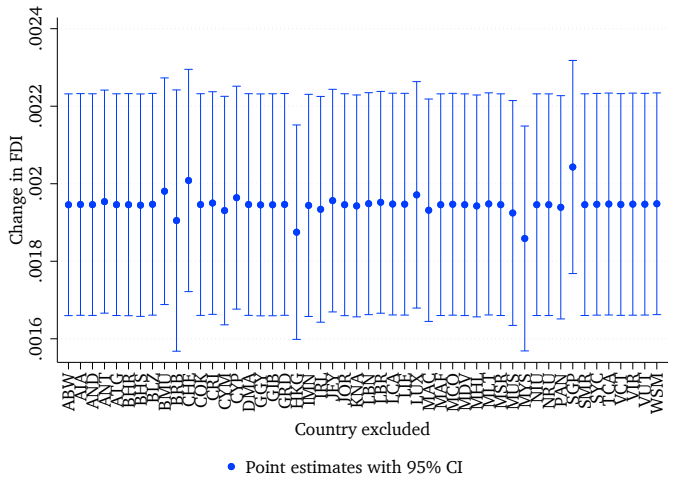
Treatment variable Table 3 panel B replaces $TREAT_{i,c,t}$ by $TREAT^{C}_{i,c,t}$, counting the number of firms in the same sector reporting at least one subsidiary in tax haven c and year t, or by $SHARE_{i,c,t}$, measuring the share of firms in the same sector reporting at least one subsidiary in tax haven c and year t. These alternative variables include information on both the extensive and intensive margins of peer presence in tax havens. Again, the two regressions yield a positive and significant coefficient consistent with the benchmark estimate.

FIGURE 5 – Sensitivity analysis: dynamics



Notes: This figure outlines how $FDI_{i,c,t}$ varies before and after the treatment. The black coefficients correspond to $\hat{\beta}_k$, i.e., what happens before the treatment. For instance, the coefficient for "-3" is given by $\hat{\beta}_3$. The blue coefficients correspond to $\hat{\alpha} + \sum_k \hat{\zeta}_k$, i.e., what happens after the treatment. For instance, the coefficient for "3" is given by $\hat{\alpha} + \sum_{k=1}^{3} \hat{\zeta}_k$. Standard errors are clustered at the firm-year level. See equation (2) and section 3 for more details, and Appendix table A2 for a full table.

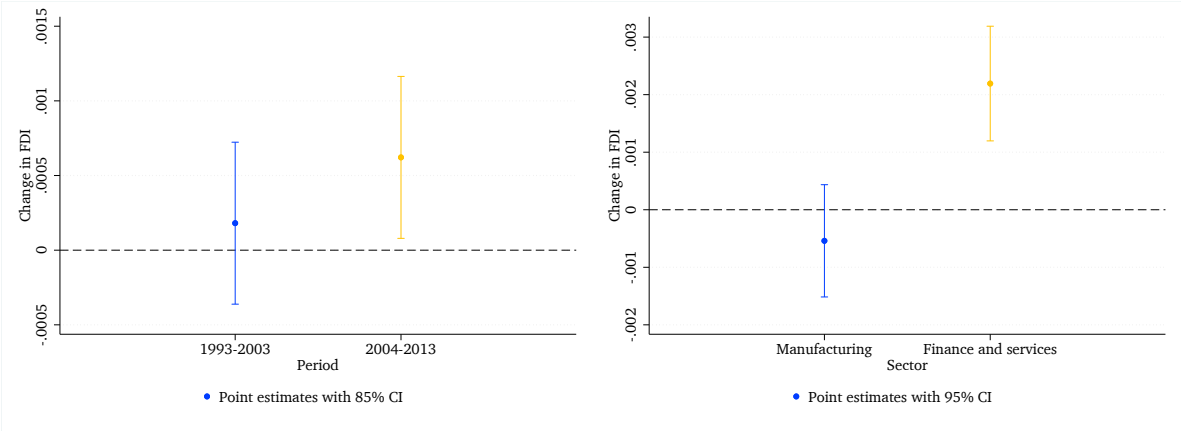
FIGURE 6 – Sensitivity analysis: eliminating one tax haven at a time



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

FIGURE 7 – Heterogeneous spillover effects: time and sectors

(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 and Appendix table A3 for a full table.

Tax haven classification In table 3 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 deemed 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. That is why I rerun the regression by using 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 ($TREAT^{DL \cap HR}_{i,c,t}$).[3] Along similar lines, figure 6 replicates the results after omitting one tax haven at a time. A complementary regression puts six tax havens aside: Hong-Kong, Ireland, Luxembourg, Malaysia, Singapore, and Switzerland ($TREAT^{EX6}_{i,c,t}$). Since 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. Notice in this regard that all six countries are in figure 2b. FDIs in remote and small jurisdictions like Jersey and Mauritius, for their part, more certainly fall within the sole scope of profit shifting. On the whole, the results are stable and coincide with the baseline estimate in all cases. They should therefore hold for a large range of classifications.

3. The two lists share 37 tax havens. Nonetheless, 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. On the other hand, Hines and Rice (1994), unlike Dyreng and Lindsey (2009), retain the British Virgin Islands, Jordan, Maldives, and Saint Martin.

Industry definition Table 3 panel D adjusts the industry definition. The effect might be driven by small sectors, where firms could be more connected for instance through 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 ($TREAT_{i,c,t}^{>15}$) or by extending sectors at the 3-digit SIC level ($TREAT_{i,c,t}^{3-digit}$). Unsurprisingly, the point estimates are of lower magnitude but stay statistically significant, so they validate that profit shifting spillovers are rather pervasive. To cope with the particular issue of M&A operations, a regression retains only companies recording no acquisitions between 1993 and 2013 ($TREAT_{i,c,t}^{acquisitions}$) [4] and one regression re-performs the analysis with firms appearing in the database over the entire time span ($TREAT_{i,c,t}^{1993-2013}$). The results are still positive and significant, which means that they are not mechanically due to M&A operations.

Falsification test In table 3 panel E finally, I mix all firms together and form 436 sectors in a random way as a placebo test. If the estimates exposed thus far truly reflect intra-industry spillovers, then we should observe no changes in FDIs when another company from the same simulated sector enters a tax haven. The result substantiates this claim. All in all, the aforementioned exercises attest to the existence of intra-industry profit shifting spillovers.

3.4 Heterogeneous effects

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

Disparities over time and across sectors Equation (1) estimates an average profit shifting spillover effect, but 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 has escalated notably thanks to the implementation of the "check-the-box" rules in 1997. In parallel, another stream of research emphasizes considerable industry-specific heterogeneity in profit shifting. Gumpert et al. (2016) and Merz and Overesch (2016) show that profit shifting is more intense in services and financial sectors compared to manufacturing, in line with the view that intangible assets facilitate income transfers. Accordingly, I conjecture that 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 confront these hypotheses with data, regression (1) is run on the four corresponding

4. Such firms are identified with the $ACQMETH$ Compustat variable.

TABLE 4 – Heterogeneous spillover effects: the role of tax havens' characteristics

Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$	$\hat{\alpha}_c$
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)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.12	0.30	0.08	0.05	0.00	0.09	0.38
No. of obs.	27	27	27	27	27	27	27

Notes: This table reports the regression results of equation (4) with different specifications. All variables are standardized. Standard errors, in parentheses, are heteroskedasticity-robust. The missing values stem from the fact that the tax haven score is not defined for all 50 tax havens. $^b p < 0.05$, $^a p < 0.01$. See section 3 for more details.

subsamples. Figures 7a and 7b graphically depict the regression results and support both hypotheses. As expected, spillovers effects are stronger in the second subperiod (figure 7a) and in services and financial industries (figure 7b).

Country-specific spillovers Spillover effects could also differ by tax haven. Appendix figure A2 confirms this and, in fact, reveals sizable 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 $\mathbb{1}_c$:

$$FDI_{i,c,t} = \sum_c \alpha_c TREAT_{i,c,t} \times \mathbb{1}_c + \mu_{i,t} + \upsilon_{c,t} + \gamma_{i,c} + \epsilon_{i,c,t} \quad (3)$$

Well-known tax havens such as Barbados, Luxembourg, and Switzerland, already in figure 2b, stand out and feature in the top 10. A natural question emerges: What explains these differentials? One possibility is that spillovers depend on tax havens' aggressiveness:

$$\hat{\alpha}_c = \delta + \eta THS_c + \zeta_c \quad (4)$$

THS_c denotes the tax haven score computed by the Tax Justice Network.[5] $\hat{\alpha}_c$ and THS_j are standardized for the ease of interpretation. The regression results of equation (4), provided in table 4 column (1), 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) and focus on each of 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). They demonstrate the prominent role of corporate income tax rates applicable in tax havens. Leveraging data from the OECD Country-by-Country Reports (CbCR) reaffirms this. CbCR emerged as a result of BEPS Action 13 and under the initiative of OECD and G20. MNEs with group revenues over $750 million and headquartered in the countries that have adopted the regulation are required to report their activities in every country: sales, profits, number of employees, etc. The information is aggregated at the parent-host country level, made publicly available on the website of the OECD, and useful to construct effective tax rates (ETRs) in tax havens. CbCR-based ETRs offer the best indication of the tax rates charged in tax havens for two reasons (Garcia-Bernardo, Janskỳ, and Tørsløv, 2021). First, anecdotal evidence shows that profits parked in tax havens for tax purposes are subject to tax rates far below statutory tax rates (STRs). Second, among ETRs, CbCR-based ETRs are the most likely to capture the tax rate applied to profits shifted in tax havens because only the largest MNEs fill the CbCRs. Domestic companies are not included, unlike in national accounts. Replacing THS_c by the corresponding ETR_c^{CBCR} in equation (4) gives $\hat{\eta}$ = -0.23, negative and significant at the 5 percent level in line with table 4 columns (2) and (7).[6]

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 prone 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. More work is now needed in this direction. Although US-listed firms are for

5. Due to data limitations, the data are from 2019. Given that tax havens' characteristics are quite persistent over time, this should not constitute a major problem.

6. The first year of CbCR data is 2016, but reporting at that time was not mandatory in all countries. I thus use the data from 2017 and take a simple average across parent countries, thereby generating ETR_c^{CBCR} for 37 distinct tax havens. The average value is 7 percent.

many of them multinational and thus likely to appear in alternative databases, it would be interesting to ascertain the external validity of the findings through triangulation of data sources. Identifying the exact channels whereby profit shifting knowledge disseminates across multinational firms is another promising task for future research.

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Appendix

FIGURE A1 – Presence in tax havens over time

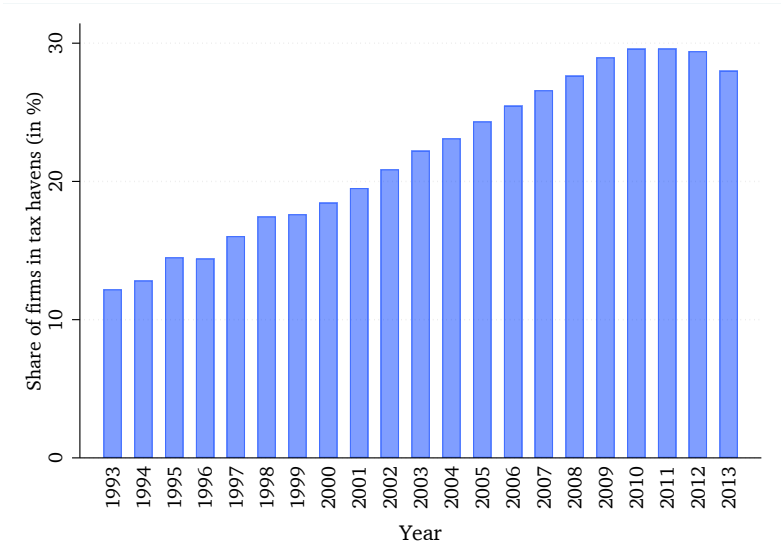


TABLE A1 – Sensitivity analysis: main tests (full table)

Panel	A	B	B	C	C	C	C	D	D	D	D	E
Dependent variable	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$	$FDI_{i,c,t}$
$TREAT_{i,c,t}$	0.14[b]											
	(0.07)											
$TREAT^{C}_{i,c,t}$		1.95e-3[a]										
		(1.45e-4)										
$SHARE_{i,c,t}$			0.11[a]									
			(5.69e-3)									
$TREAT^{HR}_{i,c,t}$				9.33e-4[a]								
				(3.07e-4)								
$TREAT^{DL}_{i,c,t}$					1.32e-3[a]							
					(2.85e-4)							
$TREAT^{HR\cap DL}_{i,c,t}$						8.95e-4[a]						
						(3.22e-4)						
$TREAT^{EX6}_{i,c,t}$							1.53e-3[a]					
							(2.45e-4)					
$TREAT^{>15}_{i,c,t}$								6.77e-4[a]				
								(2.47e-4)				
$TREAT^{3-digit}_{i,c,t}$									1.23e-3[a]			
									(7.43e-5)			
$TREAT^{acquisitions}_{i,c,t}$										5.91e-4[b]		
										(3.03e-4)		
$TREAT^{1993-2013}_{i,c,t}$											1.36e-3[a]	
											(3.83e-4)	
$TREAT^{random}_{i,c,t}$												-2.80e-4
												(3.31e-4)
Firm-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (for LPMs only)		0.69	0.69	0.69	0.69	0.70	0.64	0.70	0.69	0.69	0.67	0.69
No. of obs.	82,736	5,514,400	5,514,400	4,301,232	5,073,248	3,860,080	4,852,672	3,646,650	5,514,400	1,741,200	305,550	5,514,400

Notes: This table evaluates the robustness of the benchmark estimate in table 2. Standard errors, in parentheses, are clustered at the firm-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

TABLE A2 – Sensitivity analysis: dynamics (full table)

Dependent variable	$FDI_{i,c,t}$
$TREAT_{i,c,t}^{t+5}$	6.59e-4
	(7.17e-4)
$TREAT_{i,c,t}^{t+4}$	-7.38e-4
	(7.35e-4)
$TREAT_{i,c,t}^{t+3}$	-7.28e-4
	(7.34e-4)
$TREAT_{i,c,t}^{t+2}$	1.27e-3
	(7.44e-4)
$TREAT_{i,c,t}^{t+1}$	1.34e-3
	(7.59e-4)
$TREAT_{i,c,t}$	-0.34e-4
	(7.62e-4)
$TREAT_{i,c,t}^{t-1}$	2.18e-3^{a}
	(7.35e-4)
$TREAT_{i,c,t}^{t-2}$	1.70e-3^{b}
	(7.20e-4)
$TREAT_{i,c,t}^{t-3}$	9.51e-4
	(7.24e-4)
$TREAT_{i,c,t}^{t-4}$	2.34e-4
	(7.29e-4)
$TREAT_{i,c,t}^{t-5}$	-4.58e-5
	(7.40e-4)
Firm-year FEs	Yes
Country-year FEs	Yes
Firm-country FEs	Yes
R^2	0.81
No. of obs.	1,238,800

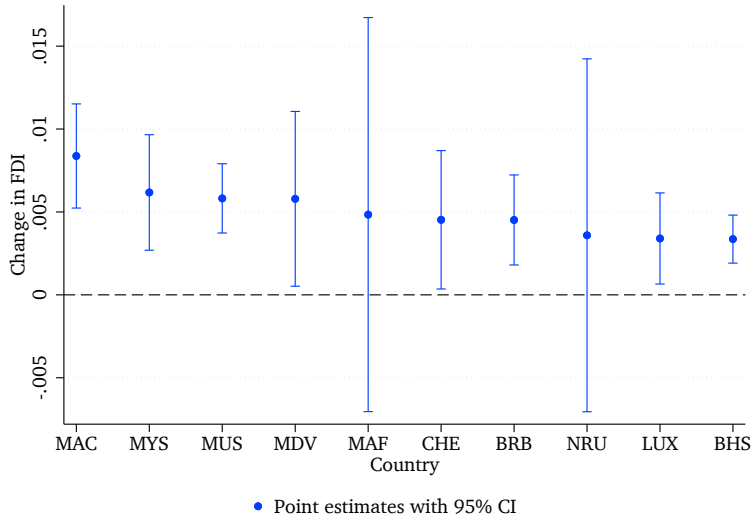
Notes: This table reports the baseline regression results of equation (2). Standard errors, in parentheses, are clustered at the firm-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

TABLE A3 – Heterogeneous spillover effects: time and sectors (full table)

Subsample	1993-2003	2004-2013	Manufacturing	Finance and services
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	-0.54e-3	2.19e-3^{a}
	(3.74e-4)	(3.74e-4)	(4.23e-4)	(5.03e-4)
Firm-year FEs	Yes	Yes	Yes	Yes
Country-year FEs	Yes	Yes	Yes	Yes
Firm-country FEs	Yes	Yes	Yes	Yes
R^2	0.74	0.81	0.70	0.70
No. of obs.	3,002,700	2,480,050	2,535,450	1,346,900

Notes: This table reports the baseline regression results of equation (1) for different subsamples. Standard errors, in parentheses, are clustered at the firm-year level. $^{b}p < 0.05$, $^{a}p < 0.01$. See section 3 for more details.

FIGURE A2 – Heterogeneous spillover effects: tax havens



Notes: This figure represents the regression results for equation (3) and highlights the top 10 tax havens. They correspond to the tax havens with the highest $\hat{\alpha}_j$. Standard errors are clustered at the firm-year level. See section 3 for more details.