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Abstract

We show that U.S. multinationals record sales and the profit from these sales in tax havens, while their goods and services are physically sold in other countries. We propose a framework illustrating the strategy of sales shifting. Our results reveal the importance of tax havens which attract a disproportionate fraction of worldwide sales. Our quantification shows a large contribution of sales shifting to multinationals' profit shifting that amounts to $80bn in 2013. Our findings suggest that international corporate tax rules based on sales may not efficiently address profit shifting if the policy designs are unable to identify sales by destination.

JEL Classification: F23, H26, H73

Keywords: multinational firms, International Taxation, Tax avoidance, Transfer Pricing, tax havens, Profit shifting, sales shifting

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Multinationals' Sales and Profit Shifting in Tax Havens*

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Résumé

We show that U.S. multinationals record sales and the profit from these sales in tax havens, while their goods and services are physically sold in other countries. We propose a framework illustrating the strategy of sales shifting. Our results reveal the importance of tax havens which attract a disproportionate fraction of worldwide sales. Our quantification shows a large contribution of sales shifting to multinationals' profit shifting that amounts to $80bn in 2013. Our findings suggest that international corporate tax rules based on sales may not efficiently address profit shifting if the policy designs are unable to identify sales by destination.

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The current international tax system, based on transfer pricing rules and separate accounting, is designed to ensure "*that profits are taxed where economic activities take place and value is created*" (OECD, 2015). This fundamental rule does not apply in practice. The basic strategy used by multinational corporations to shift profit is twofold : they shift sales from high-tax to low-tax jurisdictions, while moving expenses in the opposite direction. This paper focuses on *sales shifting*. In Figure 1, we show that U.S. MNEs record their worldwide sales and therefore the associated profit in low-tax jurisdictions (left side of Figure 1) and produce elsewhere (right side of Figure 1). This illustrates the discrepancy between the place where the "value" is created (proxied by the location of employment) and the place where the sales are registered *for fiscal purposes* – and profits are taxed.

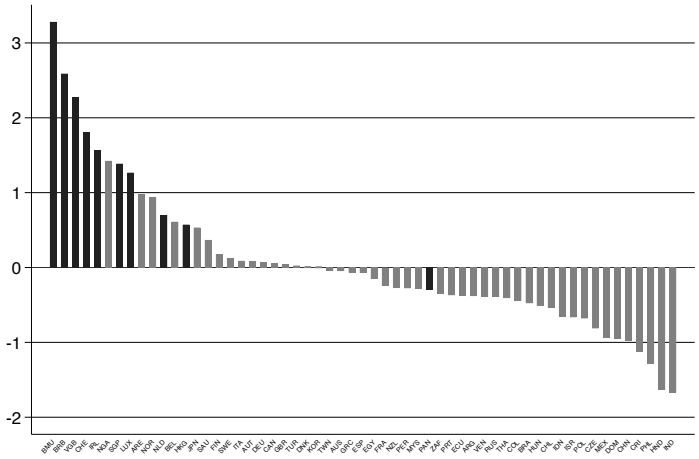

FIGURE 1 – Distribution of U.S. multinational firms' sales and employment

Note : Figure 1 represents the worldwide distribution of U.S. multinational firms' sales and employment. Each bar is a country's sales-to-employment gap, defined as the average log ratio of the share of total sales to the share of total employees of U.S. affiliates over the period 1999–2013. Large discrepancies remain after accounting for country-level productivity differences. This suggests that U.S. multinationals register their worldwide sales in low-tax jurisdictions (the black bars correspond to tax havens) but produce in other countries (on the right-hand side of the figure)

We study the extent of sales shifting and proposes a quantification of its contribution to the overall profit that is shifted through the foreign activities of U.S. multinational firms. Our results suggest that they use complex strategies that involves many countries and record in low-tax jurisdictions most of their sales originating from high-tax jurisdictions. Our results indicate that an important source of excess profits in tax havens stems from sales shifting.

Quantifying the role of sales shifting has implications for the design and efficacy of tax policy. Sales are an important tool for both firms' tax planning strategies and states' tax policies. Yet, they have received little academic attention. The recent discussions around the reform of international corporate taxation partly focus on revenues generated from the sales of goods or services directly to consumers. These sales are one of the important factors that are discussed to allocate the taxing rights under the Pillar One of the current OECD/G20 negotiations (OECD, 2020). The key element is to identify sales according to their final destination. This is however

challenging because sales are most commonly identified on an origin basis, at the location of the seller, and not where the final consumers are located (see for instance Neubig, 2019 and Delpeuch et al., 2019 on Country-by-Country reporting). The revenue is from the location of the entity selling the product or the service, not where the final consumers are located. Destination-based policies would therefore be less effective in providing a better environment for a robust corporate tax if the rules and policy design are unable to identify the true destination of sales. Our analysis questions the relevance of databases reporting sales on an origin basis to study this question. The OECD's country-by-country reporting (CbC-R) dataset does not precisely identify the location of consumers. More generally, other databases on multinational production such as OECD's AMNE or Eurostat's FATS, do not inform on the destination of sales.

There exists several cases across different sectors and countries showing that multinational enterprises use various techniques and corporate tax loopholes to relocate their sales (Murphy, 2013). Until recently, Apple had for instance set up its sales operations in Europe in such a way that customers were contractually buying products from Apple Sales International, one of the Irish incorporated companies, rather than from the Apple stores that *physically* sold the products to the customers (Levin, 2013). In this way, Apple recorded all sales, and the profit stemming from these sales, directly in Ireland (The European Commission, 2016). A number of detailed and interesting papers examines corporate tax avoidance by using bilateral transactions datasets. [1] Recording sales in low-tax jurisdictions may however require the use of strategies that are more complex and perhaps less documented, such as contract manufacturing or cost-sharing agreements, and are difficult to capture in bilateral datasets. [2] Multinational firms create complex structures across countries that increase the cost of enforcing anti-tax avoidance regulations (see e.g. Hopland et al., 2019 which discuss triangular structures). The use of complex strategies involving many countries may be the underlying reason why estimates of profit shifting vary from large when using macro-level datasets at the country level to small when using mostly bilateral micro-level information. [3]

We make several contributions. We examine sales shifting for the first time. The literature shows that multinational firms set up foreign affiliates, also called export platforms, close to large markets to benefit from the proximity to foreign demand. [4] Hanson, Mataloni and Slaughter

1. See for instance Clausing (2003), Cristea and Nguyen (2016) and Davies et al. (2018) for transfer mispricing of goods, Hebous and Johannesen (2015) for transfer mispricing of services. Buettner and Wamser (2013) use micro-data for the analysis of debt shifting.

2. See Jenniges et al. (2018) on cost-sharing agreements. Gravelle (2015) describes the techniques associated with contract manufacturing. The cases of Apple and many other companies which use contract manufacturing and cost-sharing agreements across many different countries are described in details in Appendix A.

3. Clausing (2020) discusses in details alternative explanations for the reason why macro-level data sources find larger estimates of profit shifting than micro-level data sources. The lack of firm-level information from tax havens is one of major issue (Tørsløv, Wier and Zucman, 2019). This concern is reinforced by the extreme distribution of aggressive tax planning in a handful of tax havens. As pointed by Reynolds and Wier (2016) a few large corporations are responsible for the vast majority of profit shifting. Bilicka (2019) and Davies et al. (2018) provide an explanation of this pattern based on the existence of fixed costs associated with profit shifting. As shown by Dowd, Landefeld and Moore (2017), the bulk of tax avoidance comes from a few large firms operating in a relatively limited number of tax havens. There is relatively less tax responsiveness in the data when tax haven destinations are disregarded. Thus, studies based on typical firms will understate the problem.

4. Theoretical contributions on this topic include Head and Mayer (2004), Ekholm, Forslid and Markusen

(2001) notice however that the effect of market access on the location of export platforms depends on how the estimation sample is defined, whether it includes tax havens or not. We define the concept of *foreign sales platforms* as these affiliates do not only export but also record the worldwide sales of goods and services. These transactions may not even require physical trade. We identify the countries where U.S. MNEs record *excessive* ratios of foreign to total sales, which indicates sales shifting. We show that the share of foreign sales recorded in tax havens is disproportionately larger than in non-tax havens. The access to large markets does not explain excessive foreign sales ratio in tax havens.

To guide our empirical analysis, we propose an illustrative framework that helps to predict how the ratios of foreign to total sales are affected by sales shifting. Our framework builds on Head and Mayer (2004) which shows that market access and production costs are important factors determining the location of sales and *normal* profits of foreign affiliates. Within this framework, we incorporate elements of the tax avoidance literature borrowed from Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016) that explain the shifting behavior of firms. The model predicts that, all other things equal, the ratio of foreign sales to total sales recorded in tax havens is larger than those registered in non-tax havens. It also predicts a weaker impact of market access on this ratio in tax havens compared to other countries. The market access motive is not prevalent in explaining the activity of U.S. multinationals in tax havens.

Our empirical analysis uses aggregate and sector-level information on sales and profits before income tax of foreign affiliates of U.S. multinationals from the Bureau of Economic Analysis for the period 1999–2013 (Bureau of Economic Analysis, n.d.). The study of Clausing (2020) describes the strengths of this dataset to examine our economic question. According to the BEA data, 22% of the total sales of U.S. majority-owned foreign affiliates take place in tax havens. This figure goes up to 33% when restricting the data to intra-firm sales. This shows the importance of tax haven locations for U.S. multinational firms. Important papers based on macro-level data estimate the amount of profit shifted to tax havens for the U.S. or at the global level (Zucman, 2014, Clausing, 2016, 2020, Tørsløv, Wier and Zucman, 2019, Wright and Zucman, 2018, or Janský and Palanský, 2019). In the spirit of Zucman (2014), we show that several important patterns and channels of sales and profit shifting can be documented using simple variables (sales, profits, and employment) found in publicly available and aggregated datasets. The dataset provides information on local and foreign sales which is crucial for our empirical design and has not been used in previous studies. It allows to identify sales shifting which is particularly difficult to observe in bilateral or micro-level datasets. Firms use complex operations that involve many countries in order to record sales in a single tax haven. The use of aggregate data is therefore particularly relevant as we can quantify the overall amounts of excessive sales that are recorded in each jurisdictions. We show that sales shifting is pervasive in services industries across small and large tax havens and in manufacturing industries in large havens located in Europe and Asia. The revenues stemming from sales of services may be easier to shift to tax havens as they do not involve reporting to customs. We show that sales shifting to tax havens is also prominent when examining transactions of goods.

Based on our theoretical framework, we develop a quantification methodology which is partly

(2007), Mrázová and Neary (2011), Ito (2013), and Tintelnot (2017).

inspired by Clausing (2016) and Tørsløv, Wier and Zucman (2019) to estimate the contribution of sales shifting to the overall foreign profit shifting of U.S. multinational firms. The estimation of excessive profits requires defining a benchmark level of (normal) profits. Our model can be informative about this benchmark level. Our quantification of excessive profits takes into account corporate tax rates, the tax haven status of the country, and its level of transparency with respect to U.S. tax authorities. We evaluate the contribution of sales shifting to overall profits by including negative and zero values of profit and show that sales shifting accounts for at least one fourth of U.S. foreign profits.

Our paper is organized as follows. In Section 1, we present our data sources and some facts about the geographical distribution of sales and profits of U.S. multinational corporations. The illustrative framework is described in Section 2 and we present our econometric strategy in Section 3. In Section 4, we provide the results on the distribution of the foreign sales ratio and the estimation of the profit shifted through sales shifting. We conclude and discuss related issues, especially current policy debates, in Section 5.

1 Data and facts

The data on the activity of U.S. owned foreign affiliates come from the annual and benchmark surveys of the Bureau of Economic Analysis (BEA). The BEA dataset tracks affiliate sales not only in manufacturing but also in service sectors, which have received less attention in the literature. It includes many different variables such as total assets, property, plant and equipment assets, employment, local and foreign sales of goods and services, and net income or profit-type return. Importantly, the profit-type return variable measures profit before income taxes and excludes non-operating items (such as special charges and capital gains and losses) and income from equity investments (Bureau of Economic Analysis, 2004). [5] This measure of profit is particularly interesting for our study. It excludes financial revenue that is by definition not generated by the export activities of firms. Importantly, it is also immune from double counting as noted for instance by Wright and Zucman (2018) and Clausing (2020). [6]

Our empirical analysis focuses on the activities of majority-owned foreign affiliates in 56 countries and 11 industries from 1999 to 2013. We provide the list of countries, the definition of the different industries and details on the sample's construction in Appendix B. Appendix C provides the descriptive statistics of our sample.

1.1 Foreign sales plateforms

The share of foreign sales of U.S. multinationals' foreign affiliates reported for each industry k in country i at year t is computed as the ratio of foreign to total sales :

$$FS_{ikt} = \frac{Foreign\ sales_{ikt}}{Total\ sales_{ikt}}.$$

5. The profit-type return data may miss some foreign-to-foreign shifting, hybrid dividends, and income that goes entirely untaxed (see the details in Appendix A of Clausing, 2020). See also Dyreng, Hills and Markle (2019) about the importance of untaxed foreign profits.

6. Blouin and Robinson (2019) discuss issues related to the double counting of profits in U.S. datasets.

	Non-Tax Havens	Tax Havens
Mining	0.24	0.33
Food	0.19	0.29
Chemicals	0.22	0.57
Primary and Fabricated Metals	0.31	0.34
Machinery	0.37	0.41
Computers and electronic products	0.43	0.48
Electrical equipment, appliances, and components	0.31	0.32
Transportation equipment	0.34	0.29
Wholesale trade	0.16	0.70
Information	0.12	0.48
Professional, scientific, and technical services	0.15	0.37
Average	0.24	0.46

TABLE 1 – Foreign sales ratio by country type and sector.

This ratio is the basis for our empirical analysis. A higher ratio of foreign to total sales indicates that U.S. foreign affiliates record a large amount of foreign sales in the host country. While the average foreign sales ratio remains rather low at 28% in our sample, Table 1 reports great differences across industries between tax haven and non-tax havens.

The foreign sales ratio is below average in non-tax havens (24%), while it is 1.5 times greater in tax havens (46%). In the wholesale sector, the ratio is 16% in non-tax havens and 70% in tax havens. In the sector of chemical products, the foreign sales ratio is more than twice as great in tax havens as in non-tax havens (57% against 22%). The empirical analysis shows that both sectors play an important role in the sales shifting strategy of U.S. MNEs. The vast majority of transactions in these sectors involves trade in goods rather than trade in services. Figure 2 visualizes the average foreign sales ratios for each country in our sample. We find large ratios of foreign sales to total sales in tax havens for both types of transactions. This finding suggests that sales shifting is not only used to record intangible assets in tax havens.

The foreign sales ratio has been used in the literature studying the role of the foreign export platforms of U.S. multinational companies (see for instance Tintelnot, 2017). We use a different terminology and name these affiliates *foreign sales platforms* as their foreign activities may involve transactions that do not require physical trade to cross the border. The BEA datasets are particularly helpful to understand this new concept. U.S. trade in goods must be reported on a "shipped" basis (meaning on the basis of the *physical* transaction), whereas U.S. sales and purchases are reported on a "charged" basis (meaning on the basis of the *financial* transaction). According to the BEA (Bureau of Economic Analysis, 2004, page 34) : "*The two bases are usually the same, but they can differ substantially.*" Foreign sales may differ from exports, particularly in transactions involving tax havens. This is the case for instance if a foreign sales platform located in a tax haven purchases goods from a third-party contractor in China to sell them in the U.S. The tax haven affiliate records in its books the sales to the U.S. However, the customs data report an export from China to the U.S. if the goods are shipped directly from China to the U.S. This example illustrates a simple case of tax-based contract manufacturing agreement and the gap that arises between foreign sales and exports. BEA declaration requirements allow

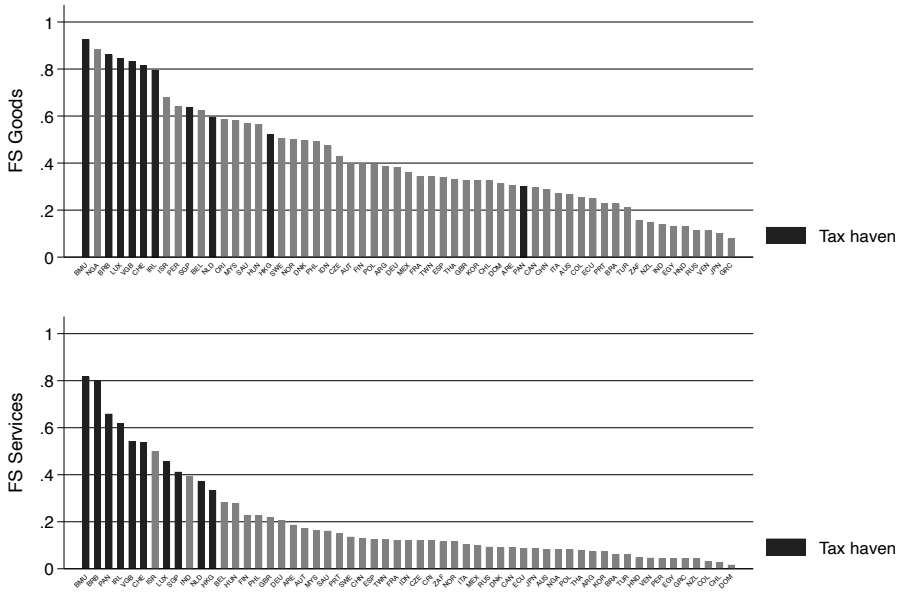

FIGURE 2 – Average foreign sales ratio of U.S. MNEs.

Note : This figure shows the average foreign sales ratios of each country in our sample, in the upper panel for the trade of goods and in the lower panel, for the trade of services. Sectors are pooled. Tax havens are in black.

us to compare foreign affiliates sales of goods to official U.S. trade data (Bureau of Economic Analysis, 2004). Since the BEA does not record exports to countries other than the U.S., Figure 3 shows the *sales-to-exports ratio* computed by excluding all destinations other than the U.S.

To make sure that the two measures are comparable, we concentrate on the sales and physical exports of goods *only*. Contrary to conventional wisdom, the sales-to-exports ratio is larger than one in many countries. On average, the sales of foreign affiliates to the U.S. are 26 times larger than their exports to the U.S. A striking feature of Figure 3 is the disproportionate role of tax havens in explaining the sales-to-exports ratio. Panel A shows that the deviation is larger for tax havens than for non-tax havens. U.S. foreign affiliates sales in tax havens are 171 times larger than exports. The corresponding *sales-to-exports ratio* from non-tax havens is 1.6. Panels B and C show that this imbalance is mainly due to transactions within U.S. multinational companies.

These findings suggest that U.S. parent companies shift sales from affiliates located in non-tax havens to affiliates located in tax havens. It is worth stressing that a large part of these shifts take place within multinational firms (Murphy, 2013). As argued by Gravelle (2015), low-tax countries may not be good locations to actually manufacture and sell products. Instead, affiliates in tax havens can contract with a firm in a different country as a *contract manufacturer* to produce the good with a fixed mark-up that may involve transfer mispricing (as suggested by Levin, 2013, 2014 in the cases of Apple and Caterpillar). Subpart F regulations should impede this type of contract, but these arrangements can involve hybrid entities that allow firms to defer their U.S. tax bill through the check-the-box loophole. Indeed from 1997 to 2004, 25% of U.S. MNEs' foreign income was located in affiliates that used the check-the-box exception (see Grubert, 2012).

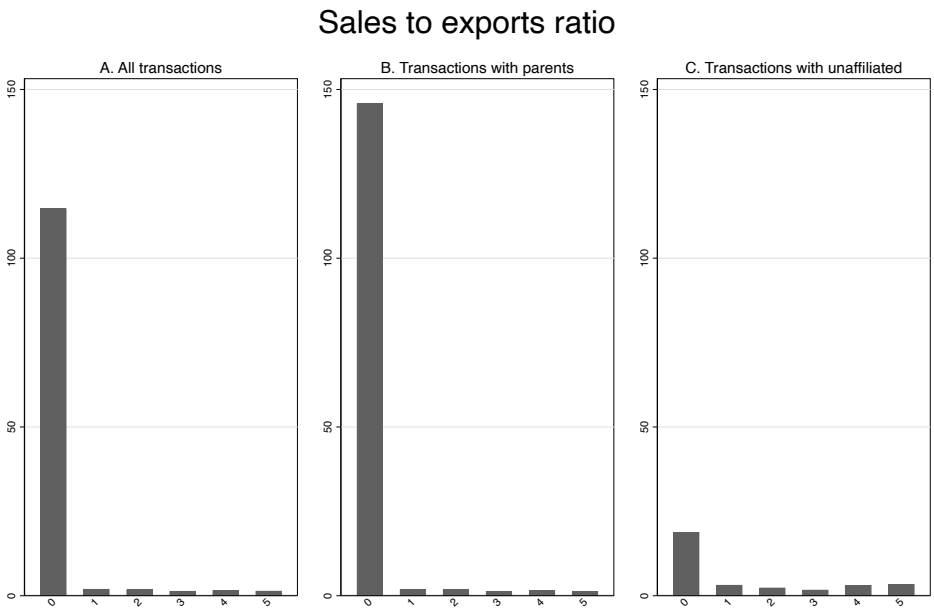

FIGURE 3 – Evidence of contract manufacturing.

Note : This figure displays the foreign sales to export ratio for transactions with the U.S. On the x-axis, the first bar corresponds to tax havens and the other bars correspond to tax rate quintiles, excluding tax havens. The left panel considers all transactions, the middle panel, relations with the parent company, and the right panel, transactions with unaffiliated companies. Sectors are pooled.

1.2 The host country's tax environment

Our main corporate tax rate variable, which is widely used in the profit-shifting literature is the statutory tax rate (Grubert and Mutti, 1991 ; Schwarz, 2009 ; Clausing, 2016 ; or Dowd, Landefeld and Moore, 2017). It has the advantage to be exogenous and widely available. However, one could argue that the relevant costs associated with the profit-shifting process are based on the average effective tax rate which, due to special tax rules or negotiated tax rates, more accurately reflects the true tax cost of reporting income in a jurisdiction. The average tax rate is the percentage of a firm's overall taxable income that is paid in taxes. It may be more accurate in reflecting the true tax cost but has several drawbacks. First, the average tax rate is endogenous to the profit-type measure which is our dependent variable in the quantification exercise. Second, our empirical analysis could also suffer from a selection bias (in case of losses as the ratio of foreign income taxes over profit-type returns cannot be computed for negative profit values) and an aggregation bias (because we may aggregate profit-making and loss-making firms). Third, the average tax rate is also volatile and may be affected by losses made during the crisis period. For these reasons, we present the baseline results using the statutory tax rate and the results using the average tax rate variable in the Appendix E. We collect information on corporate taxes for each of the 56 countries in the sample from the OECD tax database (OECD, n.d.*b*), KPMG's *Corporate Tax Rates Table and Corporate Tax Rate Surveys* (KPMG, n.d.), Deloitte's *International Tax Source* (Deloitte, n.d.), EY's *Corporate Tax Guide* (Ernst and Young, n.d.) and Center for Business Taxation Tax Database (Center for Business Taxation, 2017).

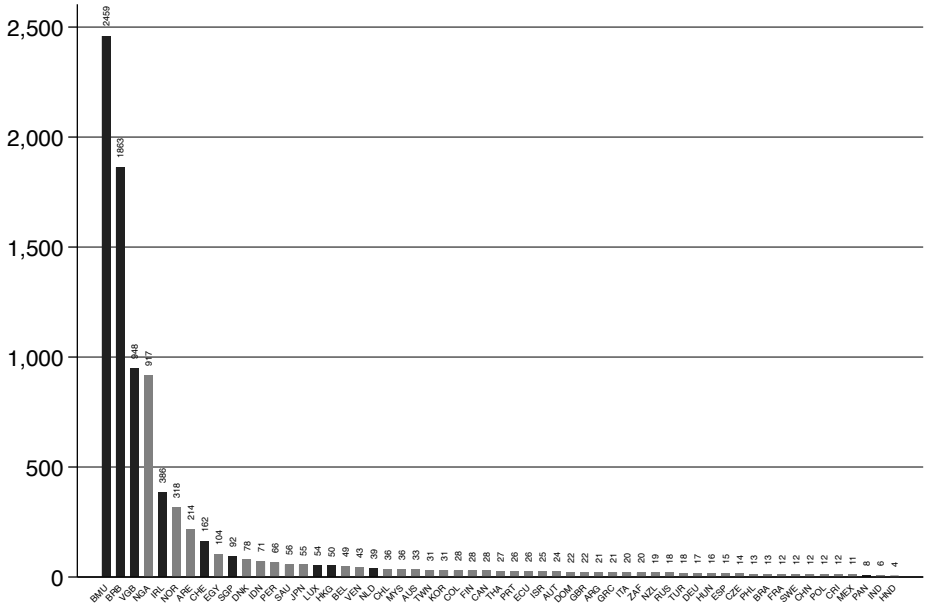

FIGURE 4 – Profits of U.S. foreign affiliates across countries.

Note : This figure displays the average profits per employee in each country. Tax havens are in black.

To characterize tax havens, we use the definition proposed by Hines and Rice (1994) and later used by Dharmapala and Hines (2009). We add the Netherlands to this list as it is considered as a major tax haven destination given the low amount of taxes paid by U.S. firms in this country (see for instance Dowd, Landefeld and Moore, 2017, Tørsløv, Wier and Zucman, 2019, Clausing, 2020). We provide a full characterization of these countries in Appendix B. In our estimation sample, Barbados, Bermuda, the British Virgin Islands, the Cayman Islands, Hong Kong, Ireland, Luxembourg, Montserrat, the Netherlands, Panama, Singapore, Switzerland, and the Turks and Caicos Islands are classified as tax havens. The available data on foreign affiliates' activities for the British Virgin Islands, the Cayman Islands, Montserrat, and Turks and Caicos are gathered into a single country which we call "British Virgin Islands". Our empirical analysis therefore includes ten tax havens which are listed among the top countries that have done the most to proliferate corporate tax avoidance and break down the global corporate tax system according to the Tax Justice Network (2019).

In Figure 4, we display the distribution of average profits per employee across countries in our sample. We observe extremely large profits per employee in British Virgin Islands, Bermuda, and Barbados and to some extent in Ireland and Switzerland compared to the profits per employee in non tax haven countries.

We include information on Double Taxation Conventions (DTCs) and Tax Information Exchange Agreements (TIEAs) between the host country and the U.S. DTCs are mainly used to avoid taxing firms twice. They often include an article implementing the sharing of tax information between the two signatories (see Article 26 of the OECD Tax Convention Model). TIEAs guarantee the exchange of information to prevent tax fraud or tax avoidance. However, the majority of TIEAs did not involve the *automatic* exchange of information. A request by one of

the two signatories must be supported by well-documented suspicion of tax avoidance, which is often difficult to gather (see, Johannesen and Zucman, 2014 or Chavagneux, Palan and Murphy, 2010). The information on worldwide tax treaties is obtained from the Exchange of Information database provided by the OECD (OECD, n.d.*a*). The coverage of the dataset is particularly good for the U.S. which had signed agreements with 88 jurisdictions in 2017. Both DTC and TIEA conventions have special clauses on the exchange of information between the host countries and the U.S. The exchange of information is particularly relevant when characterizing the degree of compliance of each partner country with the U.S. tax authorities. We therefore construct a measure of exchange of information from both DTC and TIEA conventions. In our empirical exercises, we include information on the exchange of information as well as on double taxation conventions.

Multinational firms use indirect investment routes through countries with favorable tax treaties (see Hong, 2018 and van 't Riet and Lejour, 2018). They can therefore return profits to their home countries through tax-minimizing indirect routes. The OECD (2015) highlights that this so-called *treaty shopping* is one of the most important sources of concern regarding the Base Erosion and Profit Shifting (BEPS) project. We proxy the centrality of a country's tax treaty network through the number of Double Tax conventions (DTCs) the country has signed. This is not a direct measure of actual treaty shopping, but it may accurately describe the opportunities of treaty shopping when controlling for GDP and foreign market access, as we do in all regressions.

1.3 Other variables

The activities of U.S. foreign affiliates do not only depend on the tax environment of their host country. They also reflect local and foreign demand (Redding and Venables, 2004 ; Head and Mayer, 2004 ; and Head and Mayer, 2011). In the framework of Head and Mayer (2004), foreign affiliates sell to domestic and foreign countries, with foreign sales discounted by bilateral trade costs. We compute the foreign market access of each country in our sample following methodology described by Head and Mayer (2011). The computation details are described in Appendix B. Finally, the series on real GDP were obtained from the Penn World tables (Feenstra, Inklaar and Timmer, 2015).

2 Illustrative Framework

In this section, we present a framework that illustrates sales shifting. We follow the approach pioneered by Hines and Rice (1994) and extended more recently by Clausing (2016) and Tørsløv, Wier and Zucman (2019) which rely on the direct observation of pre-tax profit. The premise of their methodology is that the observed pretax profits of a firm represents the sum of *normal* profits and *shifted* profits. In our framework, we assume that firms shift sales made in high-tax countries and the profits stemming from these sales to a tax haven. The model helps to predict how the ratios of foreign to total sales are affected by sales shifting. The model is informative on the level of reported profit that would have been declared by the firm without corporate tax

avoidance.

2.1 The tax environment of multinational firms.

Multinationals can invest in a range of countries $i = 1, \cdots, n$ including a tax haven, indicated by the superscript th. We decompose the observed pre-tax profits of a firm as the sum of *normal* and *shifted* profits. We denote ρ_i the normal level of pre-tax profits earned in country i by the U.S. foreign affiliate. We denote F_i the fixed cost of operating foreign affiliates. The reported profits are taxed at rate T_i in country i. The tax haven is assumed to have a corporate tax rate of zero, $T_0 = 0$.

As in Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016), firms can reallocate an amount Ψ_i of their actual income stemming from their sales made in country i to the tax haven. By shifting profit, the firm incurs a reallocation cost that becomes increasingly expensive as the amount shifted increases relative to the amount earned in country i (Huizinga and Laeven, 2008 also use a similar approach). These costs are incurred in the country from which the income is shifted and are assumed to be $\left(a^{1/\gamma_i}/2\right)(\Psi_i^2/\rho_i)$.[7] The parameter $a \in (0, \infty)$ captures how much the cost of income reallocation increases with the amount reallocated. In contrast to Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016), we assume that this cost depends on a parameter $\gamma_i \in (1, \infty)$ which decreases with the degree of transparency of a country i's tax environment. Empirically, this degree depends on exchange of information between the U.S. and each host country (OECD, 2001). The reported profit in country i, π_i can be written as :

$$\pi_i = \rho_i - \Psi_i - \frac{a^{1/\gamma_i}}{2}\frac{\Psi_i^2}{\rho_i} \ . \tag{1}$$

As in Gumpert, Hines and Schnitzer (2016), and assuming that the firm has a tax haven affiliate, we derive the optimal amount of income, Ψ_i^*, to be reallocated.

$$\Psi_i^* = \frac{1}{a^{1/\gamma_i}} t_i \rho_i \ , \tag{2}$$

with $t_i = \frac{T_i}{(1-T_i)}$. **Proof :** See Appendix D.

2.2 Profits and sales of foreign affiliates

We now turn to the formal definition of the normal pre-tax profit, ρ_i. Assume that households love variety and that firms generally engage in monopolistic competition. As in Head and Mayer (2004), we derive the expected profits of a foreign affiliate in each location.[8] Each monopolistic firm faces a demand curve $q_{ij} = \frac{\sigma-1}{\sigma}\frac{(c_i\tau_{ij})^{-\sigma}}{G_j}E_j$ with constant elasticity σ where c_i is the marginal cost in country i, τ_{ij}, the iceberg trade costs between the pair of countries i and j, and G_j the price index. The level of normal profit is $\rho_i = \frac{c_i^{1-\sigma}}{\sigma}M_i$ where $M_i = \sum_j \tau_{ij}^{1-\sigma}\frac{E_j}{G_j}$ is the market

7. Our illustrative framework does not consider fixed costs due to profit shifting (Bilicka, 2019, Davies et al., 2018 and Reynolds and Wier, 2016).

8. Since the model determines the *aggregate* foreign sales ratio and not its *distribution* across firms, our illustrative framework does account for firm-specific mark-up (for a model of corporate tax avoidance with firm specific markup, see Martin, Parenti and Toubal, 2020).

access of country i. The market access can be decomposed into the country real GDP, $M_i^d = \frac{E_i}{G_i}$ (assuming $\tau_{ii} = 1$), and the foreign market access, $M_i^f = \sum_j \tau_{ij}^{1-\sigma} \frac{E_j}{G_j}$ for $i \neq j$. The expression of normal profit suggests that firms face a trade-off between low production costs and high market potential.

Given equation (2) and assuming a tax rate equal to zero in the tax haven, the reported profit of the tax haven affiliate (indexed th) can be written as [9]

$$\Pi_i^{th} = \rho_i + S_j - F_i \ , \tag{3}$$

with $S_j = \sum_j \frac{1}{a^{1/\gamma_j}} \frac{c_j^{1-\sigma} M_j}{\sigma} t_j$.

The first term on the right-hand side of equation (3) is the normal profit of the firm earned in the tax haven. The second term, S_j, is the amount of profit shifted to the tax haven. It depends positively on the corporate tax rates in non-tax havens, but decreases the more transparent the country is, in particular regarding the exchange of tax information with the U.S.

The reported profit of a foreign affiliate that is not located in a tax haven is given by

$$\Pi_i^{nth} = \rho_i \left(1 - \frac{t_i}{a^{1/\gamma_i}} \left(1 + \frac{t_i}{2}\right)\right) - F_i \ . \tag{4}$$

The reported profit is decreasing with the tax rate and the degree of transparency of the non-tax haven country. Interestingly, equation (4) shows that the reported profit is lower than the normal profit that the firm would have declared without corporate taxation.

Given Equations (3) and (4), and recalling that profits are given by sales discounted by the relative markup, we can compute the foreign sales ratios in tax havens and in non-tax haven countries. The difference between these ratios allows us to determine the value of sales that is shifted to tax havens.

$$FS_i^{nth} = \frac{M_i^f}{(M_i^f + M_i^d)} \ , \tag{5}$$

$$FS_i^{th} = \frac{c_i^{1-\sigma} M_i^f + S_j}{c_i^{1-\sigma}(M_i^f + M_i^d) + S_j} \ . \tag{6}$$

Proposition 1. Assuming sales shifting to tax havens, the foreign sales ratio of tax havens is larger than the foreign sales ratio of non-tax havens all else being equals.

It is straightforward to show that $FS_i^{th} > FS_i^{nth}$. This inequality holds because M_i is positive and always larger than M_i^f. We can moreover show that the market access effect on the foreign sales ratio decreases with the amount of profit shifted to tax havens.

Proposition 2. Assuming positive profit shifting through sales shifting implies that foreign market access has a weaker impact on the foreign sales ratio in tax havens than in non-tax havens.

Proof. Let $\xi_{nth} = \frac{\partial FS^{nth}}{\partial M_i^f} = \frac{M_i^d}{(M_i^f + M_i^d)^2}$ and $\xi_{th} = \frac{\partial FS^{th}}{\partial M_i^f} = \frac{c_i^{2(1-\sigma)} M_i^d}{\left[c_i^{1-\sigma}(M_i^f + M_i^d) + S_j\right]^2}$. The foreign market access has a weaker impact on the foreign sales ratio in tax havens than in non-tax

9. For ease of exposition, we drop the index th and ^{nth} from the market access and production cost variables.

havens iff $\frac{\xi^{th}}{\xi^{nth}} < 1$.

$$\begin{aligned}\frac{\xi^{th}}{\xi^{nth}} &= \frac{c_i^{2(1-\sigma)} M_i^d}{\left[c_i^{1-\sigma}(M_i^f + M_i^d) + S_j\right]^2} \times \frac{(M_i^f + M_i^d)^2}{M_i^d} \\ &= \frac{\left[c_i^{1-\sigma}(M_i^f + M_i^d)\right]^2}{\left[c_i^{1-\sigma}(M_i^f + M_i^d) + S_j\right]^2} < 1\end{aligned}$$

3 Econometric Analysis

According to the theoretical predictions, the market access and the tax environment have different effects on the foreign sales ratio in tax havens and in other countries. We conduct an empirical analysis that allows us to identify the average effects of taxes and market access on the foreign sales ratio within each group of countries. We also propose a methodology to quantify the contribution of sales shifting to the amount of profits shifted by U.S. multinationals to tax haven countries.

3.1 The determinants of sales shifting

We follow Papke and Wooldridge (1996) and estimate a fractional logit model to account for the bounded nature of our fractional dependent variable as 86% of the observations of foreign sales ratio fall between zero and one (excluded). [10] This is an improved methodological approach given the fractional dependent variable. We also report in the baseline table the results of the OLS regressions for comparison. The fractional logit model assumes that the expected value of the foreign sales ratio FS_{ikt}, conditional on a vector of time-variant country specific variable X_{it}, the tax haven dummy variable, $Haven_i$ and the sector-specific shocks that vary over time, ν_{kt} is given by

$$E\left(FS_{ikt}|Haven_i, X_{it}, \nu_{kt}\right) = G\left(\alpha Haven_i + X_{it}\beta + \nu_{kt}\right). \tag{7}$$

where $G\left(\alpha Haven_i + X_{it}\beta + \nu_{kt}\right) = \frac{exp(\alpha Haven_i + X_{it}\beta + \nu_{kt})}{[1+exp(\alpha Haven_i + X_{it}\beta + \nu_{kt})]}$ is the cumulative distribution function of the logistic distribution. X_{it} includes the logarithms of the foreign and domestic market access, the statutory tax rate, the tax treaties between the host countries and the U.S. and the number of signed Double Tax conventions (DTCs). The use of sector-time fixed effects accounts for a broad set of unobserved attributes of the activities at the sector level that might also account for the share of foreign sales. Sectors may for instance differ in the average costs of income reallocation a, reflecting differences in the importance of intangible assets and other business features that facilitate sales shifting (Gumpert, Hines and Schnitzer, 2016).

Throughout our empirical investigation, we display the marginal effects evaluated at the mean values of the explanatory variables. Standard errors are clustered at the country level. [11]

10. As mentioned by Papke and Wooldridge (1996, 2008) the fractional logit model is well suited to examine our question for three reasons. First, it accounts for the boundedness of the dependent variables. Second, it predicts response values within the unit interval. Third, it captures the nonlinearity of the data, thereby yielding a higher fit compared to linear models.

11. In unreported regressions, we also show that our results are not sensitive to the choice of the levels of clustering regarding standard errors. The results are available upon request.

3.2 Sales and profits shifting to tax havens

We quantify the contribution of sales shifting to the amount of foreign profits shifted by U.S. multinationals. To quantify the amount of excessive profits, we rely on the observation that pre-tax profits reported by a firm represent the sum of normal profits and shifted profits. The firms generate income from the sales of goods and services and by using inputs. Thus, measures of market access and of capital and labor inputs (fixed tangible assets and number of employees) are included in the empirical analysis, to predict the counterfactual normal level of profit. Shifted income is determined by the tax environment and the ability to shift sales in tax havens. Our methodology borrows features from both Clausing (2016) and Tørsløv, Wier and Zucman (2019). From Tørsløv, Wier and Zucman (2019), we account for tax havens and more generally for the tax environment of the host countries. From Clausing (2016), we regress the pre-tax profits on observable and unobservable characteristics to determine the profit (semi-)elasticities to the tax environment variables. Importantly, we add the possibility for firms to use sales platforms to shift profits to tax havens. To do so, we consider the interaction between the foreign sales ratio and the tax haven dummy variable, $FS_{ikt} \times Haven_i$. Contrary to many studies before, we use data disaggregated at the sectoral level. This allows us to add $sector \times year$ fixed effects. This implies that we compare similar sectors and account for any common sector-level shock. This constitutes another innovation compared with Clausing (2016) and Tørsløv, Wier and Zucman (2019), as they do not consider sectoral heterogeneity. The empirical strategy involves estimating the effects of tax havens and the foreign sales ratio on profits for each sector k of country i conditional on other factors that have proved to be important determinants in the literature (see Hines and Rice, 1994 ; Huizinga and Laeven, 2008 ; Clausing, 2016 ; Dowd, Landefeld and Moore, 2017 ; or Tørsløv, Wier and Zucman, 2019). We propose estimating the following equation :

$$\begin{aligned} \Pi_{ikt} &= \alpha_0 + \alpha_1 FMA_{it} + \alpha_2 FS_{ikt} + \alpha_3 Haven_i + \alpha_4 \left(FS_{ikt} \times Haven_i\right) + \alpha_5 Tax_{it} \\ &+ Treaties_{it}\alpha + X_{ikt}\gamma + \alpha_8 DMA_{it} + \nu_{kt} + \xi_{ikt} \ , \end{aligned} \tag{8}$$

with Π_{ikt} the logarithm of the pre-tax profits. [12] We provide alternative estimators besides the standard OLS log-linear specification which uses positive profits only. We use a generalized linear model with gamma distribution (Gamma GLM) as an alternative estimator to account for zero profits. The Gamma GLM estimator does not allow for negative values of profits. We use a modified cubic-root transformation (CubeR) of the profit series that allows us to account for zeros and negative profits (Cox, 2011). The control variables are defined as before. X_{ikt} is a vector of sector- and country-specific controls that vary over time and γ a vector of coefficients. It includes total employment and the total productive assets of foreign affiliates. These variables allow us to scale the size of the activity. [13] ν_{kt} is a set of $sector \times year$ fixed effects and ξ_{ikt} is the disturbance term.

12. As seen from the illustrative framework in Equation (4), the reported operating pre-tax profits may not be used as a benchmark without applying a correction coefficient $C = \left(1 - \frac{t_i}{a^{1/\gamma_i}}\left(1 + \frac{t_i}{2}\right)\right)$. C can be calibrated by using different assumptions regarding the distribution of the shifting cost parameter a^{1/γ_i} or by using a proxy for this cost. In unreported regressions, we show the main results remain using different alternative calibrations for the benchmark profits.

13. The plant, property, and equipment assets of the affiliates are less likely to be distorted by the tax-planning strategies of an MNE (Schwarz, 2009).

The coefficient of interest, which will allow us to compute the counterfactual profits, is α_4. We use our data and the estimated coefficients of Equation 8 to predict the amount of profits that would have been observed in the absence of sales shifting to tax havens. We therefore set the interaction term to zero and allow the tax havens to have excessive profits that are not explained by the foreign sales ratio. Notice that α_4 is likely to remain unaffected by the correction of the benchmark profit. Indeed, we are interested in the differentiated impact of foreign sales on profits in tax havens and in other countries. As long as the coefficient of correction is not correlated with the foreign sales ratio in non-tax havens, our profit shifting estimates will not be affected by the correction.

One concern may be a potential selection bias that would affect the measurement of α_4. The interaction coefficient could be over-estimated if the most productive firms locate their sales platforms in tax havens to shift their profits. Our identification strategy uses within-industry variations across countries to compare the profitability of the average firm in similar industries across different countries. The estimation equation includes the interaction term and the direct tax haven effect. Contrary to standard profit equations, we use the interaction coefficient to capture the excess profits of firms that are due to larger foreign sales ratios in tax havens. The tax haven dummy variable captures the excess profitability of firms in tax havens that may be due to selection, conditional on other important factors.

Another concern relates to the endogeneity of the foreign sales ratio. The key variable is constructed by interacting the exogenous tax haven dummy variable and the endogenous foreign sales ratio, and the interacted terms are endogenous in the regression in the profit equation. Two recent papers, Bun and Harrison (2019) and Nizalova and Murtazashvili (2016) provide analytical proofs that the interaction of an endogenous variable (foreign sales ratio) with an exogenous one (tax haven dummy) can be interpreted as being exogenous. As shown by Angrist and Krueger (1999), the interaction terms can be interpreted as exogenous, once the main effect of the endogenous variable is directly controlled for as in our case. The identifying assumption is that the endogenous variable and the outcome variable are jointly independent of the exogenous variable.

4 Results

We start by reporting the results regarding the drivers of the foreign sales ratio and quantify thereafter the contribution of sales shifting to profit shifting.

4.1 Baseline results

Columns (1) to (6) of Table 2 show the results of fractional logit regressions. We report the marginal effects that are evaluated at sample means. Columns (7) and (8) report the results of the linear regressions. We show that our major findings remain when using the OLS approach. The estimated coefficients are of the same order of magnitude. This is due to the fact that a large fraction of the data on foreign sales ratios lies between 0 and 1. All specifications include a full set of sector-year specific effects to control for unobserved characteristics. The effects are

Dep. Variable	Foreign To Total Sales Ratio							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Foreign Market Acc.)	0.056	0.055	0.049	0.033	0.039	-0.021	0.040	-0.031
	(0.010)	(0.009)	(0.013)	(0.013)	(0.009)	(0.034)	(0.010)	(0.034)
Tax rate		-0.570	-0.490	-0.277	0.039	-1.089	0.029	-1.035
		(0.233)	(0.211)	(0.194)	(0.178)	(0.270)	(0.174)	(0.289)
Tax Haven				0.126				
				(0.047)				
Treaty of info. exchange			-0.065	-0.038	-0.044	-0.143	-0.038	-0.126
			(0.030)	(0.029)	(0.031)	(0.112)	(0.031)	(0.123)
Double tax. agreement			-0.024	-0.015	0.025	0.004	0.017	0.023
			(0.044)	(0.034)	(0.031)	(0.063)	(0.030)	(0.072)
#DTC / 100			0.110	0.143	0.117	0.421	0.125	0.468
			(0.095)	(0.079)	(0.059)	(0.200)	(0.060)	(0.233)
ln(GDP)	0.007	0.023	0.007	0.014	-0.008	0.036	-0.008	0.032
	(0.008)	(0.009)	(0.013)	(0.012)	(0.011)	(0.024)	(0.011)	(0.027)
Estimator	GLM	GLM	GLM	GLM	GLM	GLM	OLS	OLS
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	Non tax haven	Tax haven	Non tax haven	Tax haven
Observations	5,905	5,905	5,905	5,905	4,955	950	4,955	950
R2	0.229	0.251	0.272	0.290	0.323	0.487	0.300	0.487
Countries	56	56	56	56	46	10	46	10
Sectors	11	11	11	11	11	11	11	11

The dependent variable, FS_{ikt}, is the foreign to total sales ratio in sector k of country i in year t. Panel data (yearly) 1999–2013. GLM estimates in columns 1 to 6, OLS estimates in columns 7 and 8. Robust standard errors adjusted for clustering by country. Marginal effects at the sample mean are displayed.

TABLE 2 – Foreign Sales Ratio - GLM and OLS estimates

therefore identified within sector and year and across countries.

The results in column (1) show that the host country's foreign market access has a strong effect on the foreign sales ratio of U.S. multinationals' foreign affiliates. This result is in line with Hanson, Mataloni and Slaughter (2001) and Tintelnot (2017), who show that U.S. multinational companies set up foreign affiliates to sell to nearby countries and beyond. The host country size as measured by GDP does not significantly affect the foreign sales ratio.

Column (2) includes the level of corporate taxes as an additional variable. The foreign sales ratio is significantly smaller in countries with high corporate taxes. This result suggests that U.S. multinational corporations reduce the amount of sales that are registered in countries with higher corporate taxes. In particular, increasing the tax rate by 1 percent decreases the foreign to total sales ratio by about 0.57 percentage point on average. The marginal effect is significant at the 95% confidence level. The introduction of the corporate tax rate variable increases the marginal effects of the GDP variable which becomes significant at the 99% confidence level. This suggests that U.S. firms select larger host country markets to operate their foreign sales

activities when corporate tax rates are higher.

In column (3), the marginal effect of the corporate tax rate variable is smaller when we include the variables that control for the information on tax agreements between the affiliate's country and the U.S. In line with the predictions of the model, we find that the exchange of information between the host country and the U.S. reduces the foreign sales ratio of U.S. foreign affiliates. As expected, the estimated effect of double taxation agreements on the foreign sales ratio is small and non significantly different from 0 at the conventional levels. [14] The number of double taxation agreements, which controls for the opportunities of treaty shopping is positive but imprecisely estimated. The negative effect of corporate taxes and of the exchange of information on the foreign sales ratio is much less important when we control for the tax haven dummy variable in column (4). The marginal effect of the tax haven dummy variable is positive and significant at the 99% confidence level. As tax havens often provide optimization mechanisms other than low tax rates, such as confidentiality with respect to the tax authorities, this suggests that the results in column (3) are biased because the tax haven status was not controlled for. The correlation between the tax haven and the double taxation treaty dummy variables is about -0.11, and the correlation between the tax haven and the treaty of information exchange dummy variables is around -0.05. As mentioned above, half of the tax havens in our estimation sample had not signed or enforced a TIEA with the U.S. at the end of our estimation period in 2013. [15] The effect of the tax treaty network is larger and becomes significant at the 95% confidence level suggesting that the opportunity of treaty shopping becomes important given the tax haven status of some countries in our sample. In line with the predictions of our model, column (4) shows that the foreign sales ratio of U.S. foreign affiliates is strongly influenced by the host country's tax environment. [16] The detailed characterization of the host country's tax environment reduces the importance of the foreign market access variable. The marginal effect of the foreign market access variable is precisely estimated but falls in magnitude.

In columns (5) and (6), we estimate the specification in both samples of non-tax havens and tax havens to test Proposition 2. As predicted by our theoretical framework, foreign market access is a strong predictor of the foreign sales ratio in non-tax havens, while it has no influence in tax havens. In line with our model, these results suggest that large amounts of profits are shifted to tax havens through sales shifting. There are several other major differences between the determinants of the foreign sales ratios in both samples. The level of corporate tax rates does not significantly affect the ratio of foreign sales in non-tax havens, while its effect is strong and negative in tax havens. One can argue that the statutory tax rates are meaningless in the sample of tax haven. In Appendix E, we show that our results remain by substituting the statutory tax rates for the average effective tax rates. [17]

14. This last finding supports the results of Blonigen and Davies (2004) who find no robust impacts of double taxation agreements on Foreign Direct Investments.

15. Bermuda, the Bahamas, Panama, and the British Virgin Islands are the tax havens that had already enforced the exchange of tax information with the U.S. during the period analyzed.

16. An investigation of the type of transactions that are concerned by sales shifting reveals excess foreign sales ratios stemming from both sales of goods and services (see Appendix E).

17. The average tax rate is the percentage of a firm's overall taxable income that is paid in taxes. It is therefore endogenous to the foreign sales ratio as sales shifting increases income in tax havens.

We also find that the number of DTC prove to be important in both samples. The effect is yet stronger in tax havens. These findings are in line with the results of Hong (2018) and van 't Riet and Lejour (2018) who show the use of treaty shopping by multinational firms.

Anecdotal evidence suggests that the tax avoidance strategies of U.S. multinational companies depend on the location of tax havens. Our sample includes ten tax havens that differ markedly in terms of their economic weight and populations, as noted by Hines and Rice (1994), but also in terms of their degree of transparency. We classify these tax havens into two groups, namely the small havens —Barbados, Bermuda, the British Virgin Islands, and Panama — and the large havens —Hong Kong, Ireland, Luxembourg, Netherlands, Singapore, and Switzerland. As in Hines and Rice (1994), this dichotomization is partially based on the tax havens' population levels. We also take into account their geography and technological factors. Regarding technology, in our sample, U.S. foreign affiliates in the large tax havens employ about 36 times more people than those in the small havens, and use about 9 times more productive equipment.

To ease comparisons across specifications, the results reported in column (1) of Table 3 reproduce the estimates in column (4) of Table 2 above. In columns (2) and (3), we split the sample into broadly defined industries and study the effects of foreign market access and the tax environment on the manufacturing and service industries. [18] In these columns, we do not distinguish between large and small tax havens. Compared to the aggregate analysis, considering industries separately highlights the specific effects of foreign market access and the tax environment on the foreign sales ratio of U.S. foreign affiliates in different industries. Foreign market access has a positive and significant impact on the foreign sales ratio in the manufacturing industries. The significant positive effect of the tax haven dummy in the service sample shows however that the tax environment is an important consideration in this context. Overall, this industry-specific analysis suggests that the tax haven effects described above are driven by the service sector, while foreign market access remains a strong determinant of manufacturing activities.

In columns (4) to (6), we use a finer decomposition of the tax haven dummy variable by distinguishing between large and small tax havens. The results using the full sample in column (4) suggest that the effect of tax havens described above is mostly driven by the group of large tax havens. In columns (5) and (6), we examine whether the determinants of the foreign sales ratios differ between industries across large and small tax havens. Interestingly, the market access variable has a smaller impact on the foreign sales ratio once we account for a finer decomposition of the effects of tax havens. In the manufacturing sector, the foreign sales ratio is larger in large havens, while it is lower in the small havens. Both groups of tax havens attract U.S. foreign sales platforms in the service industries. This finding supports previous results about the heterogeneity in the use of tax havens (Desai, Foley and Hines, 2006 and Garcia-Bernardo et al., 2017). Small tax havens, which are closer to the U.S., drive the profit-shifting strategies of U.S. firms in the service industry, while the larger and relatively more distant tax havens help to shift profits in both sectors.

18. Table E2 in the Appendix reports the estimated marginal effects of the tax haven dummy variable sector by sector using a finer decomposition of sectors.

Dep. Variable	Foreign To Total Sales Ratio					
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Foreign Market Acc.)	0.033	0.043	0.012	0.024	0.028	0.014
	(0.013)	(0.018)	(0.014)	(0.012)	(0.016)	(0.013)
Tax rate	-0.277	-0.328	-0.128	-0.343	-0.478	-0.117
	(0.194)	(0.276)	(0.182)	(0.179)	(0.249)	(0.187)
Tax Haven	0.126	0.048	0.236			
	(0.047)	(0.067)	(0.034)			
Large havens				0.159	0.104	0.228
				(0.043)	(0.057)	(0.032)
Caribbean havens				-0.057	-0.434	0.276
				(0.056)	(0.109)	(0.077)
Treaty of info. exchange	-0.038	-0.064	0.004	-0.010	-0.015	-0.004
	(0.029)	(0.041)	(0.024)	(0.030)	(0.039)	(0.024)
Double tax. agreement	-0.015	-0.024	0.009	-0.010	-0.015	0.007
	(0.034)	(0.048)	(0.033)	(0.031)	(0.040)	(0.032)
#DTC / 100	0.143	0.177	0.069	0.159	0.203	0.066
	(0.079)	(0.116)	(0.060)	(0.065)	(0.093)	(0.059)
ln(GDP)	0.014	0.022	-0.011	0.002	0.003	-0.007
	(0.012)	(0.016)	(0.011)	(0.013)	(0.017)	(0.012)
Sector × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Manuf.	Services	Full	Manuf.	Services
Countries	56	56	55	56	56	55
Sectors	11	8	3	11	8	3
Observations	5,905	4,064	1,841	5,905	4,064	1,841
R2	0.290	0.278	0.482	0.312	0.324	0.481

The dependent variable, FS_{ikt}, is the foreign to total sales ratio in sector k of country i in year t. Panel data (yearly) 1999–2013. GLM estimates with robust standard errors adjusted for clustering at the country level. Standard errors are displayed in parentheses Marginal effects at the sample mean are displayed. **Manufacturing :** (1) Mining, (2) Food, (3) Chemicals, (4) Primary and Fabricated Metals, (5) Machinery & Equipment, (6) Computer and Electronic products, (7) Electrical Equipment, Appliances, and Components, (8) Transportation Equipment. **Services :** (9) Wholesale trade, (10) Information, (11) Professional, Scientific, and Technical Services. **Large havens :** Hong Kong, Ireland, Luxembourg, Netherlands, Singapore, and Switzerland. **Small havens :** Barbados, Bermuda, Panama, and the British Virgin Islands.

TABLE 3 – Foreign Sales Ratio in Large or Small Tax Havens - (GLM – Aggregate and Sector Results)

4.2 Quantification of sales and profit shifting

Table 4 reports the results of the profits equation which is estimated using OLS and alternative estimators that take into account zero and negative profits.

	(1) OLS	(2) Gamma	(3) CubeR
Dep. Variable	ln(Profit)	Profit ≥ 0	All Profits
ln(Foreign Market Acc.)	-0.024	0.046	-0.016
	(0.041)	(0.053)	(0.113)
FS $\times$ haven	1.708	2.485	4.706
	(0.501)	(0.550)	(1.523)
Tax Haven	-0.036	-0.952	0.030
	(0.256)	(0.324)	(0.561)
Foreign sales ratio	0.240	0.325	-0.348
	(0.163)	(0.231)	(0.591)
Tax rate	0.061	-1.171	-0.769
	(0.889)	(1.569)	(2.084)
Treaty of info. exchange	0.100	-0.154	0.130
	(0.115)	(0.137)	(0.291)
Double tax. agreement	0.075	0.157	0.153
	(0.097)	(0.113)	(0.293)
#DTC / 100	0.267	-0.205	-0.129
	(0.205)	(0.312)	(0.749)
ln(GDP)	-0.007	-0.024	-0.058
	(0.050)	(0.086)	(0.133)
ln(1+ Employment)	0.392	0.199	1.241
	(0.072)	(0.087)	(0.178)
ln(1 + Productive Assets)	0.574	0.638	0.545
	(0.043)	(0.055)	(0.109)
Sector $\times$ Year FE	Yes	Yes	Yes
Sample	Full	Full	Full
Countries	56	56	56
Sectors	11	11	11
Observations	4,691	5,284	5,905
R2	0.787	0.667	0.488

Robust standard errors adjusted for clustering at the country level in parentheses.

TABLE 4 – Profit Equation

We find a positive and statistically significant impact of the interaction coefficients on profits irrespective of the estimator used. These coefficients allow us to quantify the contribution of sales shifting to the amount of foreign profits shifted by U.S. multinationals. Table 5 reports the estimated amounts of profits shifted by the means of sales shifting in 2013. The estimated profits correspond to the overall sum of profits across tax havens i and sectors k.

The profit shifted through sales shifting in 2013 is estimated to be between $66bn and $85bn. Our lowest estimate shows that it corresponds to 68% of all the profits in tax havens and to 24%

Estimation Method	OLS	Gamma	CubeR
Sample (Year 2013)	Profit > 0	Profit ≥ 0	All Profits
Profit Shifted (in billion \$)	66.2	84.9	82.2
% of haven profits (\$98,081bn)	68%	87%	84%
% of total profits (\$273,360bn)	24%	31%	30%

This table shows the estimated profits shifted using sales shifting with 3 different estimations methods for the year 2013.

TABLE 5 – CONTRIBUTION OF SALES SHIFTING TO PROFIT SHIFTING IN TAX HAVENS.

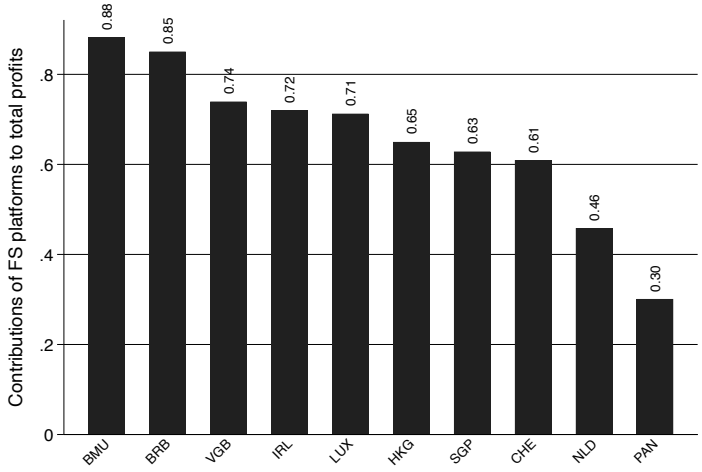

FIGURE 5 – Share of profits explained by sales shifting.

Note : OLS estimates.

of all U.S. affiliates' profits.

In Figure 5, we report the shares of profits across tax havens that are explained by sales shifting. Sales shifting is the main driver of profit in small tax havens : 88% in Bermuda, 85% in Barbados or to 74% in British Caribbean Islands. Sales shifting also explains a large share of the profits observed in large tax havens. In particular, 72% of Ireland's profits or 71% of Luxembourg's profits are explained by sales shifting.

In the Online Appendix, we propose two robustness exercises regarding the specification of the profit equation. In Table E5 we substitute the statutory tax rate by the average tax rate which is measured as the ratio of taxes paid to profits in the country of location of the U.S. foreign affiliate. In the baseline specification, we use the statutory tax rate as it is exogenous and widely used in the literature. However, it may not capture the true tax cost of reporting income in a jurisdiction as firms may benefits from special tax rules or negotiated tax rates and shift profits to low-tax jurisdictions. It is also important to note that we can only observe taxes paid and profits aggregated at the sector level. In particular it means that the average tax rate measure may suffer from a composition bias. In Table E6, we test a non-linear specification of the profit equation by adding squared tax rates to the equation. This allows to differentiate the impact of taxes when taxes are high or low (see for instance Dowd, Landefeld and Moore, 2017

or Fuest, Hugger and Neumeier, 2021). In both exercises, we find a large contribution of sales shifting to the amount of profit shifted to tax havens.

5 Conclusion and Discussion

In this paper, we document the extent of sales shifting and we propose a quantification of its contribution to the overall profits shifted to tax havens. We shed light on the concentration of U.S. foreign sales revenue from goods and services in tax havens, and highlight their relative specialization for services or manufacturing activities. Our empirical exercise is rationalized by a simple model of the location of affiliates that includes profit-shifting incentives. The econometric analysis confirms that the tax environment has a predominant impact on the distribution of U.S. foreign sales ratios. Market access, the factor conventionally considered as the most important in this context, is less important for tax havens.

We quantify the amount of profit shifted using sales shifting. Our estimate is that $66bn to $85bn of profits were shifted using sales shifting in 2013, a substantial proportion of the total amount shifted by U.S. firms. Our results support the evidence that a large share of profit shifting to tax haven countries occurs through sales shifting. This result supports the previous evidence that tax avoidance affects trade patterns and alters the design of global value chains at the firm level. In our view, the use of complex strategies to shift sales to tax haven is one of the reasons why estimates of profit shifting vary from large when using macro-level datasets at the country level to small when using mostly bilateral micro-level information.

Our results have several policy implications. They suggest that any international tax reform that aims at giving more taxing rights to destination countries should be implemented with care for at least two reasons. Firstly, available datasets and in particular the recent country-by-country reportings promoted by the OECD record sales by jurisdiction, not final destination. As a consequence, such data do not help to assess the *final* destination of a sale ; as we have shown, MNEs largely manipulate the locations where sales are registered. This calls for a redefinition and harmonization of the CbC-R guidelines to make them more effective and useful (see for instance Fuest, Parenti and Toubal, 2019 and Delpeuch et al., 2019). Using such data without corrections would lead to a wrongful assessment of the world distribution of final consumption across countries. Secondly, by showing that the locations of sales are manipulated by U.S. MNEs, our results suggest that the sales apportionment factor in any tax system (formulary apportionment or residual profit split for instance) may be manipulated. Many recent propositions of reforms of the international tax system recommend giving taxing rights to destination countries. Under formulary apportionment for instance, the total profits of a multinational are apportioned to its different countries of activity according to a formula based on factors. These are easy to measure and supposed to be hard to manipulate. Generally, the formula contains three equally weighted factors : capital, wages, and sales. [19] The factors that enter the apportion-

19. In the case of the CCCTB, the tax bill of firm f in country i would be calculated as follows : $Tax\ Bill_i^f = t_i^f \times \pi_W^f \times \left(\frac{1}{3}\frac{K_i^f}{K_W^f} + \frac{1}{3}\frac{L_i^f}{L_W^f} + \frac{1}{3}\frac{S_i^f}{S_W^f}\right)$ with t_i the tax rate in country i, K^f, the level of capital, L^f, the number of employees, and S^f, the firm's total sales. Subscript W refers to the worldwide value of the variable for firm f.

ment formula are therefore crucial to limit firms' aggressive tax planning. Avi-Yonah, Clausing and Durst (2009) and Zucman (2014) propose using sales as a single factor to allocate profits. They argue that sales are less subject to manipulation if it excludes intra-firm transactions. The legal analysis of Fleming, Peroni and Shay (2014) yet underlines that sales manipulation is still possible under destination-based taxation by the mean of third-party distributors. Beer et al. (2020) who studies residual profit allocation also recognizes this possibility. We do not argue that sales-based policies should be discarded for the future of international taxation, but that the law should include targeted anti-abuse dispositions to avoid sales shifting. In particular, efficient look-through rules may help to limit tax avoidance in such a system (Avi-Yonah and Clausing, 2019). However, their administrative cost may be very high (see Fleming, Peroni and Shay, 2014).

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Multinationals' Sales and Profit Shifting in Tax Havens. Online Appendix

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A Sales shifting in anecdotal evidences: case studies

To illustrate the novelty of our contributions, we sum up in this section some cases that our framework captures contrary to previous studies. In addition of these less documented methods, it is worth noting that sales shifting also encompass traditional profit shifting methods based on the real (as opposed to the financial) activity of the firm: transfer mispricing of goods and services, location of intangibles in tax havens, etc.

A.1 Apple

The case of Apple is a good example of how an actual foreign sales platform works. The declarations of Apple's representative to the Permanent Subcommittee on Investigations of the U.S. Senate reveal how Apple Inc. organizes its activities to register 64% of its profits in Ireland despite having only 3% of its employees there and 1% of its consumers (in 2011). According to the representative's declarations, this scheme allowed the firm to avoid $12.5bn of taxes in 2011 and 2012.

Figure A.1 shows a simplified version of the structure used by Apple in Ireland. Apple Operations International (AOI) is owned (100%) by Apple Inc. and is the ultimate owner of most of the offshore affiliates of Apple. It has no employees. Despite being incorporated in Ireland, it has no tax residence. Apple uses loopholes in the Irish and U.S. tax laws that lead to both countries considering Apple resident in the other.[1] Because of the different definitions of residency, AOI is a *stateless* entity (Kleinbard, 2011). AOI owns Apple Operations Europe (AOE) that owns Apple Sales International (ASI). While the first two entities are holding companies, ASI is the affiliate that acts as a sales platform. Just like AOI, it has no tax residency. ASI and AOE have a cost-sharing agreement with Apple Inc. According to the Senate report, Apple applies two main strategies to shift its profits to Ireland. The first is the cost-sharing agreement between ASI and Apple Inc. This agreement, according to which Apple Inc. and ASI share the development of Apple products, helps to locate a large share of Apple's intangible assets in Ireland. The Senate report insists on the fact that this agreement is not economically justified and is only motivated by aggressive tax optimization. Most importantly, ASI acts as a foreign sales platform by concentrating the worldwide sales of the whole group.

The structure chosen by Apple is at the heart of its profit shifting strategy. ASI, the foreign sales platform, engages in contract manufacturing. In practice, it contracts with

[1] Irish tax residency is based on where management and control is performed. For ASI this is the U.S. On the contrary, residency in U.S. tax law is the place of incorporation, in this case, Ireland.

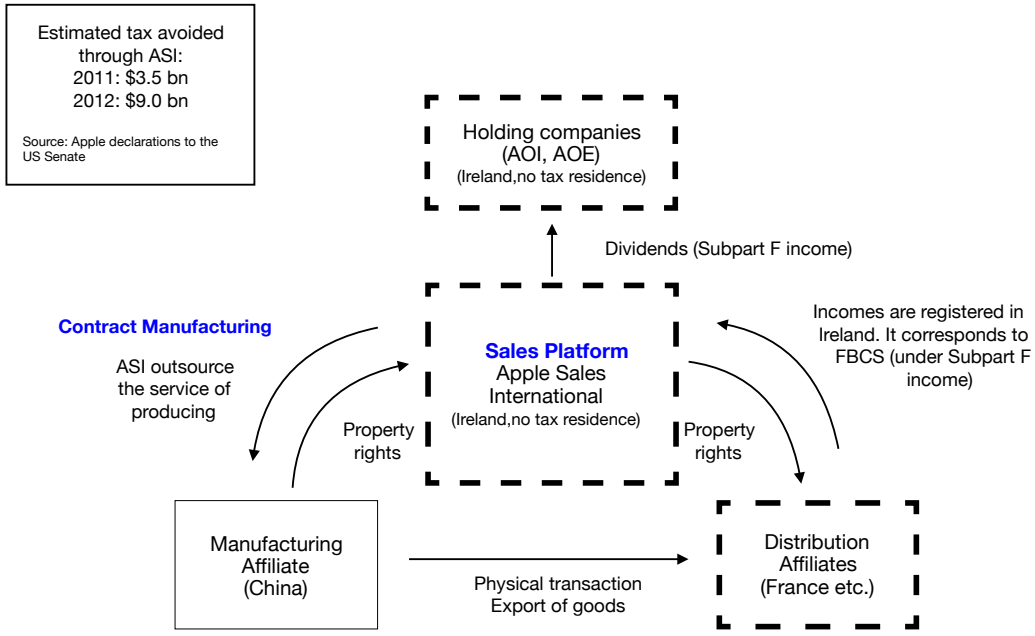


Figure A.1: Simplified structure of Apple in Ireland

a manufacturing affiliate in China to outsource production. The goods are produced by the manufacturing affiliate but are always owned by ASI. In terms of trade statistics, these transactions are registered as an import of services by ASI. When a customer buys an Apple product in a store or over the internet, the product is directly sent from China to the customer. Thus, although the owner of these products is ASI in Ireland, the goods generally never cross the Irish border. However, the financial transaction occurs between the owner of the goods and the final customer, in this case, between the retailer and Ireland. Note the discrepancy between the physical transaction and the financial transaction. Usually, it is almost impossible to identify the two types of transactions. However the BEA data allow us to do this for certain transactions. In terms of trade statistics, customs will register an export of goods from China to the retailer's country, while the balance of payments will register an export from Ireland to the retailer's country.[2] Finally, the revenues from the sales are sent through dividends to the upper-tier subsidiaries AOE and AOI.

To avoid this transfer of revenue to tax havens, the U.S. enacted a law (the Subpart F rules) in 1962 to ensure that passive income (income that results from a passive activity e.g. dividends, interest, royalties, etc.) is always taxed. The objective of this law is to prevent

[2]The customs register trade based on the crossing of national borders while the balance of payments measures trade based on change of ownership.

income being relocated and conserved in tax havens to avoid paying taxes. Passive income is a common component of firms' tax avoidance strategies. The transactions between the retail affiliate and ASI and the transactions between ASI and the upper-tier affiliates should have been taxed under Subpart F. The first transaction is a Foreign Base Company Sale (FBCS, sales of products that have been produced by an affiliate in an other country) and in the second corresponds to Foreign Personal Holding Company income (FPHC, which includes dividends, interest, rents and royalties).

However, the check-the-box regulations enacted in 1997 can be used to circumvent the Subpart F rules. These regulations allow Apple to make the IRS disregard the lower-tier affiliates (AOE, ASI and the distribution and retail affiliates) for tax purposes. The three entities in dashed boxes in the figure are thus considered a single firm by the IRS. Because the IRS does not look at what happens within a firm, it cannot tax the transactions of passive income.

This tax avoidance scheme may be one of the most tax-saving scheme existing. It helped Apple to save around $9 billions in taxes in according to Apple's officials declarations. However, it is most likely that this scheme cannot be identified in micro studies using a bilateral identification of transfer pricing.

A.2 Caterpillar

According to Levin (2014), Caterpillar's Swiss affiliate, called Caterpillar SARL (CSARL), plays a major role in the strategy of tax avoidance of the company since it reports more than 85% of non-US profits of the firm whereas no manufacturing facility is present in Switzerland and only 400 employees (among 118500) are working there. In 1999, Caterpillar negotiated a reduced corporate tax rate between 4 and 6 % with the Swiss authorities. To maximize the benefits from this advantageous tax rate, Caterpillar decided to route (following the strategy imagined by PwC) all its non-US sales through its Swiss affiliate's CSARL. CSARL is designated as the *global purchaser* of replacement parts: CSARL buy to third-party manufacturers the replacement parts. All sales of these replacement parts in the world (except in the US) are then registered in Switzerland (it does not enter in the Subpart F regulation because replacement parts are directly bought to third-party manufacturers). This paper operation does not imply that the goods physically transit through Switzerland. The goods are directly shipped from the US to the buyer. On top of this strategy, Caterpillar has also lowered its tax bill by enabling cost-sharing and tolling agreements that allow to shift more profits to the Swiss affiliate. This strategy allowed Caterpillar to avoid about $2.4 billions between 2000 and 2012 according to the report of the US Senate.

A.3 Google

Google uses several loopholes in the international definition of permanent establishments to shift its taxes to tax havens. We briefly describe here the case of Google France. Google Ireland Limited is a Google affiliate located in Ireland and SARL Google France is Google's French affiliate. The sales of the Google's "Adwords" service to French firms are recorded in the Irish affiliate. These firms either establish directly a contract with Google Ireland Limited or indirectly through SARL Google France. The Paris Administrative Court recognized in 2019 that Google Ireland Limited does not own a French establishment in France (and then its profits from French customers cannot be taxed by France). This decision is based on the fact that the service of "sale assistance" provided by SARL Google France to Google Ireland Limited does not allow SARL Google France to sign contracts in the name of Google Ireland Limited. More specifically SARL Google France cannot negociate contracts or accept commands to Google Ireland Limited.[3]

By avoiding the stable establishment status on this activity, Google is able to register its French sales in Ireland and then to shift its tax duty from the French authorities to the Irish authorities (that negociated a preferential tax rate with Google in Ireland). As this tax avoidance scheme

A.4 Kering

In the general case of contract manufacturing, an affiliate of a MNE located in a tax haven contracts with a manufacturer (either inside or outside of the boundaries of the firm) to produce some goods. This contract takes the form of an import of service from the haven affiliate. The cost of the service corresponds to the cost of inputs plus an underpriced margin (as in the Apple case). Using these types of contracts allows the tax haven entity to hold the property on the goods produced at a price lower than the arm's length price. The good is then directly sent to the distributors at a cost that limits the margin of the distributor. This way, the tax haven affiliate concentrate most of the sales (in value) of the company. The goods do not necessarily physically transit to the tax haven. They are generally exported directly from the manufacturer to the consumption market. Consequently, there is an important distinction between the foreign sale (financial transaction) and the export (physical transaction). Our dataset allows us to distinguish between both flows.

[3]This service provision is linked to the "Marketing and Services Agreement signed in 2002 between Google Inc. and SARL Google France and transferred from Google Inc. to Google Ireland Limited in 2004. See the decision N.17PA03065 of the Paris Administrative Court accessible here https://www.legifrance.gouv.fr/affichJuriAdmin.do?idTexte=CETATEXT000038420177

The case of Kering (Philippin, Malagutti and Rosenberg (2018)), a French group that produces and sell luxury goods, is a variation of this scheme. Here, the goods transit physically to warehouses located in a tax haven. Some goods are produced in Italy, then transit through LGI, the sales platform located in Switzerland, and are finally exported to the rest of Europe.

A.5 The tobacco Industry

In a report on the tobacco industry Vermeulen et al., 2020 discuss alleged cases of tax avoidance strategies used by some tobacco firms. In particular, they point at different strategies that aim at shifting sales from production countries to tax havens. For instance, they describe a sales shifting strategy used by British American Tobacco (BAT): "We found several examples of profit shifting via intra-firm transactions. One is the sale - on paper - of all BAT cigarettes produced by BAT Korea Manufacturing Ltd. (South Korea) to Rothmans Far East BV in the Netherlands. They are immediately re-sold to another South-Korean company, BAT Korea Ltd, at a much higher price. This way, on average each year 98 million in Korean profits are shifted to the Netherlands.". They also describe a strategy used by Phillip Morris (PM) "The Swiss branch of PMI also uses a 'cash pooling system' and a 'tolling system' with subsidiaries in other countries [...]. Under the tolling system, Dutch manufacturing company PM Holland BV buys raw materials from Philip Morris Brands sarl on paper, while revenue from sold products seems to be directed to Switzerland immediately. If the price the Dutch entity pays for these materials to their Swiss counterpart is artificially high, profits in the Netherlands are lowered, resulting in tax avoidance in the Netherlands. The exact importance of this route needs further investigation." These strategies, despite not being proved as tax avoidance practices, underline the role played by the shifting of the origin of sales. In particular they highlight the fact that the transaction only happen "on paper". Besides, it is important to underline that these strategies necessitate the using of contract manufacturing through a tolling system.

B Data Description

The change in the sectoral definition in 1999 and the inclusion of all (rather than just non-bank) foreign affiliates from 2008 onwards led us to define a sample from 1999 to 2013 that excludes the foreign affiliates of banks from the empirical analysis. Our estimation sample covers 56 countries including 9 tax havens, and 11 industries over the period 1999-2013. The list of countries and industries is reported below.

- *Manufacturing:* (1) Mining, (2) Food, (3) Chemicals, (4) Primary and Fabricated Metals, (5) Machinery & Equipment, (6) Computer and Electronic products, (7) Electrical Equipment, Appliance and Components (8) Transportation Equipment. *Services:* (9) Wholesale trade, (10) Information, (11) Professional, Scientific and technical Services.

- Country list (tax havens in bold): Argentina, Australia, Austria, **Barbados**, Belgium, **Bermuda**, Brazil, Canada, Chile, China, Colombia, Costa Rica, the Czech Republic, Denmark, the Dominican Republic, Ecuador, Egypt, Finland, France, Germany, Greece, Honduras, **Hong Kong**, Hungary, India, Indonesia, **Ireland**, Israel, Italy, Japan, the Republic of Korea, **Luxembourg**, Malaysia, Mexico, **the Netherlands**, New Zealand, Norway, **Panama**, Peru, the Philippines, Poland, Portugal, Russia, **Singapore**, South Africa, Spain, Sweden, **Switzerland**, Taiwan, Thailand, Turkey, the United Arab Emirates, the United Kingdom, **British Islands, Caribbean**, Venezuela. **British Islands, Caribbean** includes the British Virgin Islands, the Cayman Islands, Montserrat and the Turks and Caicos Islands.

We do not use the information from the *Utilities* sector in this study. The utilities industry consists of firms operating in “electric power generation, transmission and distribution," “natural gas distribution," or “water, sewage and other systems." This industry operates locally and represents 0.03% of the total U.S. export share, accounting for 0.75% of the total number of U.S. foreign affiliates. We also exclude the *Other industries* sector since the coverage of our database in terms of foreign sales ratio is relatively low for this sector. The *Other industries* sector includes 3,558 affiliates in 1999 (corresponding to 17% of the MOFAs). It accounts for 18% of total assets, 7% of sales, 31% of net income, and 21% of employees. Inside this composite sector, the "Management of non-bank companies and enterprises" including holding companies accounts for a large share of affiliates (43%), of total assets (74%), and of net income (89%). On the other hand, this sub-sector only accounts for 3% of net property plants and equipment, 1% of sales, and 1% of employees of the *Other industries* sector. This should represent 9,240 observations. However, some of the observations in the dataset are missing either because of insufficient precision in assessing

the value of the activity or because the data are subject to disclosure. In the first case, the BEA indicates that they do not have the exact value of sales and number of employees. This occurs for sales of between −$500,000 and +$500,000, and for a number of employees below 50. Data subject to disclosure are erased. Our sample is reduced to 5,905 observations. It however covers 72.5% of the total sales of foreign U.S. MNE affiliates in 2013.

B.1 Empirical Definition(s) of Tax Havens

There is no commonly accepted definition of what constitutes a tax haven. According to Geoffrey Colin Powell (former economic adviser to Jersey cited in *The Economist*, 2002): "What identifies an area as a tax haven is the existence of a composite tax structure established deliberately to take advantage of, and exploit, a worldwide demand for opportunities to engage in tax avoidance." Chavagneux and Palan (2012) propose a list of criteria that encompass many definitions of tax havens: low or zero taxes, reinforced bank secrecy, extended professional secrecy, easy and fast registration procedure for firms, total free movement of capital, political and economic stability, and a network of bilateral agreements with other countries. We add to this definition the central idea that a tax haven is used as a fictive location for the individuals and firms that use it. An important point is that tax havens are not just low-tax and/or opaque countries.

The OECD (OECD, 2000) also outlines some of the features that characterize a tax haven. It is a country with no or only nominal taxes, no effective exchange of information[4] and no substantial activities (meaning that investment and transactions are mainly driven by tax incentives). Ireland, Luxembourg, Hong-Kong and Singapore do not appear in the OECD's list of tax havens.

In the academic literature, the definition of Hines and Rice (1994), based the U.S Internal Revenue Service's (IRS), is close to the OECD's definition: low tax rate, business and banking secrecy, a good communication network and self-promotion as a tax haven. In this paper we use the list compiled by Dharmapala and Hines (2009), which fills in the gaps in the OECD's by including countries considered tax havens by Hines and Rice (1994). This list corresponds to a *de jure* classification and may suffer from a construction bias.

A first argument to justify our list is that the countries included appear in many other lists of tax havens. According to Chavagneux, Palan and Murphy (2010), our tax havens appear in at least 8 other lists (among eleven): Bermuda (11), Panama (11), Barbados (10), the British Virgin Islands (10), Hong-Kong (9), Singapore (9), Switzerland (9), Ireland (8),

[4]There is a growing body of evidence in the literature showing that tax agreements are ineffective at hindering harmful tax practices, see Bilicka and Fuest (2014) or Johannesen and Zucman (2014).

Luxembourg (8).

We can also justify this list empirically by simply looking at the tax bills of US affiliates in foreign countries. As noted by Kleinbard (2011), the ability to generate stateless income affects the US tax bill as well as the local tax bill. This explains why Google only paid 2.9% of its 2009 profits in taxes, which is much lower than the average statutory tax rate that should have applied. In figure B.2, we plot the effective tax rate paid by US MNEs in tax havens and non tax havens and we compare it to the (weighted) statutory tax rate. In countries that are not tax havens, the average effective tax rate is almost equal to the weighted statutory tax rate. There is nonetheless a large dispersion around this average. In tax havens, the effective foreign tax rate line is almost flat and substantially lower than the statutory line, suggesting specific legislative arrangements that allow firms to lower their tax bills. The points are less dispersed and more cluster around the effective tax rate line.

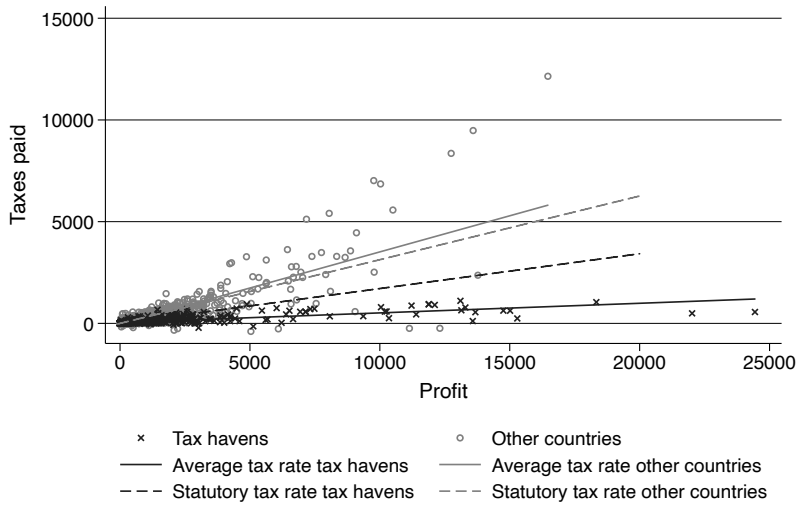


Figure B.2: Statutory and effective tax rate.

B.2 Foreign Market Access computation

Our methodology is based on Head and Mayer (2004) and Head and Mayer (2011) approaches. We first calculate the predicted bilateral transport costs between countries using a bilateral gravity equation. These predictions come from a regression analysis of bilateral trade against bilateral distance ($Distance_{ij}$), contiguity ($Contig_{ij}$), former colonial status ($Colony_{ij}$), common language ($ComLang_{ijt}$), regional trade agreements (RTA_{ijt}) and

exporter×year (μ_{it}) and importer×year (μ_{jt}) fixed effects for the period 1999-2013.[5]

$$\begin{aligned} ln(Trade_{ijt}) &= \alpha + \beta_1 ln(Distance_{ij}) + \beta_2 Contig_{ij} + \beta_3 Colony_{ij} \\ &+ \beta_4 ComLang_{ijt} + \beta_5 RTA_{ijt} \\ &+ \mu_{it} + \mu_{jt} + \epsilon_{ijt} \end{aligned}$$

where ϵ_{ijt} is the error term. We compute the ease of access to market j for exporters in i at year t:

$$\hat{\phi_{ijt}} = Dist_{ij}^{\hat{\beta_1}} \times exp(\hat{\beta}_2 Contig_{ij} + \hat{\beta}_3 Colony_{ij} + \hat{\beta}_4 ComLang_{ijt} + \hat{\beta}_5 RTA_{ijt})$$

The foreign market access variable can be defined as $FMA_{it} = \sum_j (exp(\hat{\mu}_{jt}) \times \hat{\phi}_{ijt})$, which does not include the country's internal demand. The FMA is high for countries close to large foreign export markets and low for remote countries.

The foreign market access variable is computed using data for all bilateral pairs of countries in the world. The series on bilateral trade were taken from the BACI database, constructed by the CEPII (Gaulier and Zignago, 2010) using the UN COMTRADE data on trade flows. The gravity variables are from the CEPII gravity database (Head, Mayer and Ries, 2010) and the common language data from Melitz and Toubal (2014).

[5]This corresponds to a theoretically-founded gravity equation, with exporter×year (μ_{it}) and importer×year (μ_{jt}) fixed effects accounting for multilateral resistance terms (Head and Mayer, 2011).

C Descriptive statistics

The descriptive statistics of the estimation sample is given in Table C.1 below .

Table C.1: Descriptive Statistics

	Whole (56 countries, 5,905 obs.)	
	Mean	Std. Dev.
Foreign sales ratio	5,905	0.280
Profit	5,905	457.9
ln(Foreign Market Acc.)	5,905	16.34
Tax rate	5,905	0.285
Tax Haven	5,905	0.161
Treaty of info. exchange	5,905	0.235
Double tax. agreement	5,905	0.698
ln(GDP)	5,905	13.08
ln(1+ Employment)	5,905	1.724
ln(1 + Productive Assets)	5,905	4.946

We report some statistics on employment, sales, and profit in tax havens and non-tax havens in Table C.2. We show that U.S. foreign affiliates in tax havens report larger average sales per employee and larger profits per employee than foreign affiliates in other countries. Importantly, this table also shows that despite representing 7.2% of the total employment of foreign U.S. affiliates in 2013, total sales and total profits registered in tax havens amount to 30.8% and 35.8%, respectively. It is noteworthy that all these statistics are calculated using the regression sample, i.e. excluding financial affiliates and the *Utilities* sector.

Table C.2: Descriptive Statistics (56 countries)

	Tax Havens	Other countries
Employees:		
Total employees in 2013	400500	5183700
Share employees in 2013 (%)	7.2	92.8
Average yearly number of employees	5412	14001
Sales (millions of $):		
Total sales in 2013	1155752	2602569.
Share sales in 2013 (%)	30.8	69.2
Average yearly sales	15618	7034
Average sales per 1000 employees	3523	549
Profits (millions of $):		
Total profits in 2013	98081	175960
Share profits in 2013 (%)	35.8	64.2
Average yearly profit	1325	476
Profits per 1000 employees	227	46

Average values are given at the country level. All years and sectors in the sample are pooled. Profits are shown pre-tax and excluding financial items.

D Optimal profit shifting

This proof is based on Gumpert, Hines and Schnitzer (2016). The maximisation problem at the firm level, given that it has a tax-haven affiliate is

$$\max_{d_i,\Psi_i} \sum_{i=1}^{n} d_i \Big[\Psi_i + (1-T_i)\Big(\rho_i - \Psi_i - \frac{a^{1/\gamma_i}}{2}\frac{\Psi_i^2}{\rho_i}\Big)\Big]$$

with $d_i \in \{0,1\}$, s.t

$$\rho_i - \Psi_i - \frac{a^{1/\gamma_i}}{2}\frac{\Psi_i^2}{\rho_i} \geq 0, \forall i = 1,\ldots,n$$

Following Gumpert, Hines and Schnitzer (2016) and assuming that the constraint is fulfilled, the first-order condition for Ψ_i is

$$1 - (1-T_i) - (1-T_i)\frac{a^{1/\gamma_i}\Psi_i}{\rho_i} = 0$$

It implies

$$\Psi_i^* = \frac{T_i}{1-T_i}\frac{\rho_i}{a^{1/\gamma_i}}$$

We insert Ψ_i^* into our constraint in order to produce a condition under which the constraint holds

$$\rho_i - \frac{T_i}{1-T_i}\frac{\rho_i}{a^{1/\gamma_i}} - \frac{T_i^2}{(1-T_i)^2}\frac{\rho_i}{2a^{1/\gamma_i}} \geq 0 \tag{1}$$

$$\Leftrightarrow \quad T_i \leq 1 - \sqrt{\frac{1}{2a^{1/\gamma_i}+1}} \tag{2}$$

E Additional Tables

This section contains additional tables. A first subsection is dedicated to extensions and a second one to robustness tests.

E.1 Extensions

In Table E.1, we examine the foreign sales ratio computed from goods and services transaction data separately. This information is yet only available at the country level. The table reveals that tax havens have a disproportionately large foreign sales ratio for both sales of goods and services.

Table E.1: Foreign Sales Ratio - GLM (Country-Level)

Dep. Variable	FS Goods	FS Services
ln(FMA)	0.040	-0.000
	(0.013)	(0.014)
Tax Rate	-0.435	-0.104
	(0.207)	(0.174)
Tax haven	0.177	0.243
	(0.043)	(0.037)
Treaty of info. exchange	0.047	0.019
	(0.038)	(0.030)
Double tax. agreement	-0.041	0.043
	(0.041)	(0.037)
# DTC	0.079	0.098
	(0.083)	(0.064)
ln(GDP)	-0.047	-0.017
	(0.015)	(0.011)
Year FE	Yes	Yes
Countries	55	56
Observations	618	648
R2	0.615	0.641

The dependent variable, is the foreign to total sales ratio of goods of country i in year t in column (1), and the foreign to total sales ratio of services in column (2). Panel data (yearly) 1999–2013. GLM estimates with robust standard errors adjusted for clustering by country. Marginal effects at the sample mean are displayed. Standard errors are in parentheses.

Contrary to the conventional wisdom that multinational firms only record the sales of services in tax havens, our findings suggest that both service and goods transactions are concerned. An investigation of the BEA benchmark survey dataset on royalty payments and licence fees shows that both account for a small to moderate share of the total profits reported in European tax havens.[6] We find that royalty payments and licence fees account

[6]The BEA benchmark survey reports data on intra-firm receipts of royalties and licence fees at the sector level for many countries. The available dataset allows us to get information on intra-firm payments or licence fees for some sectors in European countries. For instance, intra-firm payments in the chemical sector are not disclosed for tax havens. These payments are observed for Europe as a whole and for different European countries. In these cases, we allocate the difference between the intra-firm payments in the chemical sector in Europe and in other non-European tax havens to large tax havens.

for a heterogeneous share of the total profit of large tax havens – from 0.1% in the primary and fabricated metals industry to 34% in professional, scientific, and technical services.

In Table E.2, we run sector-level regressions in order to study the sectoral heterogeneity of foreign sales platforms. We also dichotomize our main variable between large and small tax havens as defined in the paper. Each regression contains year fixed effects. The table reveals both sectoral and geographical heterogeneities both in manufacturing and in services sectors. Interestingly, we find a positive and (slightly) significant coefficient for small tax havens in the mining sector. It suggests that small tax havens may be used to shift sales in the mining sector, more than large tax havens, for which the point estimate is smaller and non-significantly different from zero. Small tax havens are also specialized in the wholesale sector and in the information sector. We obtain large positive and significant estimates for large tax havens in the "Chemicals", "Primary and fabricated metals", "Electrical Equipment", "Wholesale" , "Information" and "Professional, scientific and technical services" sectors.

Table E.2: Sectoral and Geographic heterogeneity - GLM

Type of haven	Large	Small	Obs.	R^2
Manufacturing sectors:				
Mining	0.104	0.363	394	0.0968
	(0.128)	(0.188)		
Food	0.087	-2.157	503	0.189
	(0.095)	(0.268)		
Chemicals	0.285	-0.120	657	0.672
	(0.040)	(0.131)		
Primary Fabricated Met.	0.139	-0.886	466	0.367
	(0.052)	(0.223)		
Machinery	0.042	-2.950	554	0.484
	(0.065)	(0.220)		
Computer	0.020	-3.785	528	0.203
	(0.108)	(0.291)		
Electricat Eqp.	0.142	-2.818	463	0.489
	(0.082)	(0.283)		
Transportation eqp.	-0.018	-3.013	499	0.421
	(0.154)	(0.293)		
Service sectors:				
Wholesale	0.286	0.356	693	0.707
	(0.039)	(0.110)		
Information	0.200	0.175	543	0.475
	(0.050)	(0.100)		
Prof. Science and techn. Serv.	0.164	0.128	605	0.277
	(0.062)	(0.135)		

The dependent variable, FS_{ikt}, is the foreign to total sales ratio in sector k of country i in year t. Panel data (yearly) 1999–2013. GLM estimates with robust standard errors adjusted for clustering by country. Marginal effects at the sample mean are displayed. All regressions include standard control variables and a time fixed effect. Regressions with aggregates includes *sector* × *year* fixed effects. Each line corresponds to a sector-level regression. **Large havens:** Hong Kong, Ireland, Luxembourg, Netherlands, Singapore, and Switzerland. **Small havens:** Barbados, Bermuda, Panama, and the British Virgin Islands. Standard errors are in parentheses.

E.2 Robustness tests

The robustness tests are described in the paper. We provide here more precisions on the placebo tests.

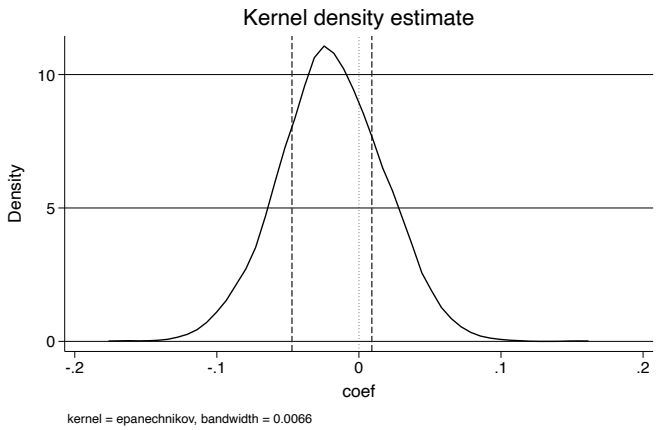
Placebo tests We construct a tax haven dummy variable which takes the value one for 9 randomly selected countries among the set of non-havens and zero otherwise.[7] We estimate specification (4) of Table 2 using the placebo tax haven variable and repeat the exercise 3,000 times in total. This placebo experiment allows us to confirm the specific impact of tax havens on the share of the foreign sales of U.S. foreign affiliates. We expect the average coefficient of the placebo tax haven variable to be insignificant.

Figure E.3 displays the distribution of the estimated coefficients and the confidence intervals. The marginal effect is $\bar{\beta}_4 = -0.016$ and is insignificant at conventional levels of significance. The effect is slightly negative when the tax havens are kept in the control group. The second placebo experiment concerns the validity of Proposition 2. We again permute the tax havens and 9 randomly chosen countries among the set of non-tax havens. We estimate specification (6) of Table 2 using the placebo tax havens and repeat the exercise 3,000 times in total. We expect the average coefficient of the foreign market access variable to be significant contrary to our earlier finding.

Figure E.4 displays the results. The marginal effect is positive and statistically significant ($\bar{\beta}_1 = 0.046$). This finding suggests that the absence of a significant effect of the market access variable is due to specific characteristics in tax havens.

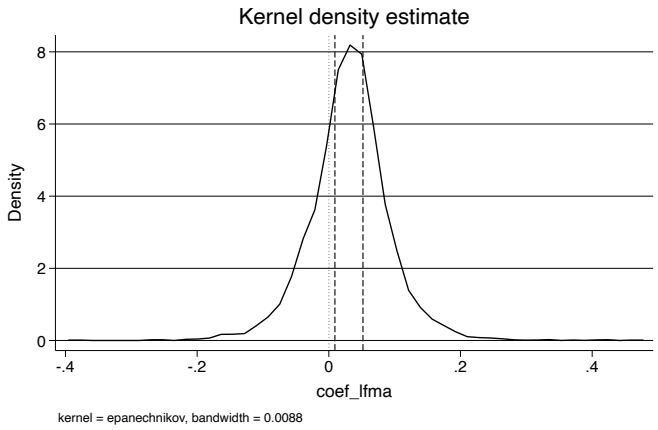
Other tests We propose other tests: we run an exercise with an alternative foreign sales ratio in Table E.3, we replicate columns 5 to 8 of table 2 using the average tax rate in table E.4 and we reproduce the profit regression with different specifications of the tax rate. In table E.5 we replace the statutory tax rate by the average observed tax rate. In table E.6, we allow for a non-linear response to taxes by adding a square term for the statutory tax rate (columns 1 to 3) and the average tax rate (columns 4 and 5).

[7] The (*real*) tax havens are therefore kept in the control group



Note: estimation of specification (4) of Table 2 using the permuted tax haven variable. Dark dashed lines represent 95% confidence intervals around the mean.

Figure E.3: Tax haven dummy estimated coefficients with 9 randomly selected countries (3,000 permutations)



Note: estimation of specification (6) of Table 2 using the permuted countries. Dark dashed lines represent 95% confidence intervals around the mean.

Figure E.4: Market access coefficients in the sample of permuted tax havens (3,000 permutations)

Table E.3: Foreign Sales Ratio - Alternative dependent variable

Dep. Variable	$FS_{ikt}^{No\ US}$		
	(1)	(2)	(3)
ln(Foreign Market Acc.)	0.033	0.037	-0.023
	(0.013)	(0.014)	(0.035)
Tax rate	-0.277	-0.025	-0.858
	(0.177)	(0.146)	(0.292)
Tax Haven	0.088		
	(0.034)		
Treaty of info. exchange	-0.061	-0.068	-0.174
	(0.032)	(0.028)	(0.112)
Double tax. agreement	-0.028	0.011	0.003
	(0.024)	(0.023)	(0.068)
#DTC	0.193	0.171	
	(0.067)	(0.064)	
ln(GDP)	0.006	-0.014	0.030
	(0.012)	(0.011)	(0.020)
Sector × Year FE	Yes	Yes	Yes
Sample	Full	Non haven	Tax haven
Observations	4,862	4,046	816
R2	0.372	0.415	0.567
Countries	56	46	10
Sectors	11	11	11

Dependent variable, $FS_{ikt}^{No\ US}$, is a the foreign to total sales ratio that excludes sales to the U.S. from foreign sales in sector k of country i in year t. Panel data at yearly frequencies. GLM estimates with robust standard errors adjusted for clustering by country × industry. Marginal effects at the sample mean are displayed.

Table E.4: Foreign Sales Ratio - GLM and OLS estimates

Dep. Variable	Foreign To Total Sales Ratio			
	(1)	(2)	(3)	(4)
ln(Foreign Market Acc.)	0.031	0.019	0.032	0.020
	(0.009)	(0.031)	(0.010)	(0.036)
Average Tax rate	-0.008	-0.072	-0.006	-0.067
	(0.005)	(0.039)	(0.005)	(0.040)
Treaty of info. exchange	0.041	-0.006	0.036	-0.008
	(0.038)	(0.094)	(0.037)	(0.112)
Double tax. agreement	-0.021	-0.000	-0.023	-0.002
	(0.023)	(0.080)	(0.024)	(0.093)
#DTC	0.114	0.179	0.117	0.181
	(0.053)	(0.160)	(0.053)	(0.189)
ln(GDP)	-0.027	-0.048	-0.027	-0.047
	(0.009)	(0.011)	(0.009)	(0.013)
Estimator	GLM	GLM	OLS	OLS
Sector × Year FE	Yes	Yes	Yes	Yes
Sample	Non tax haven	Tax haven	Non tax haven	Tax haven
# Countries	46	10	46	10
# Sectors	11	11	11	11
Observations	3,690	613	3,690	613
R2	0.378	0.453	0.368	0.448

The dependent variable, FS_{ikt}, is the foreign to total sales ratio in sector k of country i in year t. Panel data (yearly) 1999–2013. GLM estimates in columns 1 and 2, OLS estimates in columns 3 and 4. Robust standard errors adjusted for clustering by country. Marginal effects at the sample mean are displayed. e Standard errors are in parentheses.

Table E.5: Profit Equation - Average Tax Rate as a Determinants

	(1) OLS	(2) Gamma
Dep. Variable	ln(Profit)	Profits
ln(Foreign Market Acc.)	0.010	0.086
	(0.039)	(0.044)
Foreign sales ratio	0.207	0.039
	(0.181)	(0.144)
Average Tax rate	-0.206	-1.384
	(0.371)	(0.623)
Tax Haven	0.154	-0.500
	(0.350)	(0.282)
FS times haven	1.298	2.290
	(0.577)	(0.379)
Treaty of info. exchange	0.039	-0.046
	(0.099)	(0.129)
Double tax. agreement	-0.055	0.132
	(0.079)	(0.109)
#DTC	0.239	-0.648
	(0.224)	(0.261)
ln(GDP)	0.049	0.038
	(0.045)	(0.049)
ln(1+ Employment)	0.401	0.306
	(0.066)	(0.083)
ln(1 + Productive Assets)	0.544	0.576
	(0.043)	(0.052)
Sector x Year FE	Yes	Yes
Countries	54	54
Sectors	11	11
Observations	2,761	2,761
R-squared	0.860	0.818

Robust standard errors adjusted for clustering by country level. Standard errors are in parentheses. The sample corresponds to observations with positive profits as the average tax rate is computed on positive profits only.

Table E.6: Profit Equation: Non-linear tax specification

	(1) OLS	(2) Gamma	(3) CubeR	(4) OLS	(5) Gamma
Dep. Variable	ln(Profit)	Profit ≥ 0	All profits	ln(Profit)	Profit ≥ 0
ln(Foreign Market Acc.)	-0.027	0.041	-0.024	0.006	0.079
	(0.037)	(0.048)	(0.113)	(0.038)	(0.044)
FS times haven	1.493	1.986	5.076	1.273	2.230
	(0.455)	(0.469)	(1.562)	(0.574)	(0.384)
Tax Haven	-0.034	-0.704	-0.343	0.173	-0.441
	(0.241)	(0.305)	(0.604)	(0.348)	(0.280)
Foreign sales ratio	0.225	0.516	-0.344	0.194	0.016
	(0.162)	(0.204)	(0.585)	(0.181)	(0.149)
Tax rate	-10.040	-10.031	-15.218		
	(1.887)	(3.200)	(3.886)		
Tax ^{2}	18.231	16.636	27.936		
	(3.012)	(4.776)	(7.405)		
Average Tax rate				-2.389	-5.780
				(1.107)	(1.571)
Average Tax^2				6.184	12.417
				(2.741)	(3.313)
Treaty of info. exchange	0.062	-0.230	0.055	0.036	-0.062
	(0.092)	(0.121)	(0.280)	(0.097)	(0.125)
Double tax. agreement	0.110	0.196	0.173	-0.049	0.172
	(0.086)	(0.101)	(0.291)	(0.080)	(0.117)
#DTC	0.353	-0.062	0.039	0.280	-0.554
	(0.175)	(0.268)	(0.739)	(0.217)	(0.251)
ln(GDP)	0.000	0.030	-0.041	0.043	0.043
	(0.048)	(0.091)	(0.135)	(0.043)	(0.049)
ln(1+ Employment)	0.409	0.191	1.238	0.406	0.330
	(0.062)	(0.094)	(0.171)	(0.065)	(0.079)
ln(1 + Productive Assets)	0.564	0.637	0.536	0.539	0.551
	(0.041)	(0.056)	(0.109)	(0.043)	(0.052)
Semi-elasticity at t=0	-10.04	-10.03	-10.30	-2.389	-5.780
Semi-elasticity at t=0.5	8.191	6.605	8.609	3.796	6.637
Sector x Year FE	Yes	Yes	Yes	Yes	Yes
Countries	56	56	56	54	54
Sectors	11	11	11	11	11
Observations	4,691	5,284	5,905	2,761	2,761
R-squared	0.795	0.731	0.492	0.861	0.831

Robust standard errors adjusted for clustering by country level.
Standard errors are in parentheses.

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