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Abstract

Using aggregate data on U.S. multinational firms' activities, we document the impact of tax havens on the organization and trade of multinational firms. Conventional wisdom says that MNEs set up foreign sales platforms close to large markets to benefit from the proximity to consumers. We show, both theoretically and empirically, that the tax environment plays an important role in explaining the location of the foreign sales platforms. We document that foreign sales platforms in tax havens fuel profit shifting especially in services industries. We shed lights on the attractiveness of different tax havens for distinctive sectoral activities. The back-of-the-envelope computation shows that profit shifting by foreign sales platforms in tax haven amounts to $83bn in 2013.

JEL-Codes: F230, H260.

Keywords: foreign platforms, tax havens, profit shifting, firms' organization.

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1 Introduction

Recent media leaks highlight the spread and magnitude of firm's tax avoidance. Despite numerous anecdotes, little is known on the organization of multinational firms which try to avoid paying taxes in their country of residence.[1] There is yet a common salient feature across most cases that we visualize in Figure 1. Multinational firms locate their sales platforms in low-tax jurisdictions which concentrate worldwide sales (left side of Figure 1) and produce elsewhere (right side of Figure 1). This organization has been chosen by many firms such as Apple in Ireland (Levin, 2013), Caterpillar (Levin, 2014), Kering (Philippin, Malagutti and Rosenberg, 2018) or BASF (Auerbach, 2016) in Switzerland.

— Figure 1 about here —

In this paper, we show that U.S. MNEs organise their profit shifting to tax havens through sales platforms. A sale platform is defined as a foreign affiliate for which the non-local part of the sale activity is prominent. We examine the determinants of the location of these platforms and quantify their contributions to profit shifting activities of U.S. multinationals. Conventional wisdom shows that multinational firms set up foreign sales platforms close to large markets to benefit from the proximity to consumers. Our analysis also investigates the role of the host country tax environment in explaining this location. We find a strong impact of the tax environment on the location of foreign sales platforms which tends to reduce the relative importance of the market access motive. Our analysis sheds lights on the specific role played by tax havens which *deliberately* implement a tax environment favourable to firms' tax avoidance.[2] It also documents their relative specialization in different type of services or manufacturing activities.

To guide our empirical analysis, we discuss the theoretical determinants of the location of foreign sales platforms. Our stylized model captures both market access motives and tax strategies of multinational firms. The model builds on Head and Mayer (2004) as it describes the location of foreign sales platforms. The Head and Mayer (2004) model allows us to predict the impact of the market potential of the foreign sales platforms' host countries

[1] The press released a great number of cases and information on various tax avoidance techniques which has led to a number of very detailed and interesting papers (see for instance Cristea and Nguyen, 2016 Davies et al., 2014 for transfer mis-pricing of goods, Hebous and Johannesen, 2015 for transfer mis-pricing of services, Buettner and Wamser, 2013 for debt shifting, Torslov, Wier and Zucman, 2018 for a global approach).

[2] Our definition of a tax haven is broad and takes into account the tax environment of the country, its degree of compliance to the rules applied in the U.S. and not only its (low) level of corporate tax rate. A precise definition of tax havens is provided in appendix B.

on the location and sales of foreign affiliates. Within this framework, we incorporate the ingredients of the profit shifting literature that we borrow from Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016). We assume that the host countries are heterogeneous in terms of their taxation environment. In particular, firms may locate their affiliates in tax havens to host profits that are shifted from high-tax foreign locations. These shifted profits are the economic outcomes that we analyse later empirically.

The model predicts that profits reported in high-tax countries decrease with the transparency of the country and its tax rate. We also show that taking into account the tax environment decreases the impact of conventional determinants such as the host country market access on the location of foreign sales platforms.

Our empirical analysis uses information at aggregate and sector level from the Bureau of Economic Analysis to examine the location of U.S foreign sales platforms and their role in the profit shifting strategies of U.S multinational firms for the period 1999 to 2013. Importantly, this information is publicly available and commonly used in the economic literature to study firm's international activities.

We provide new facts relative to the geographical distribution of U.S. foreign sales platforms with an emphasis on their activity in tax havens. One of the striking facts show that U.S. multinationals concentrate their worldwide sales by the mean of their platforms located in few tax haven countries. When a U.S. foreign sales platform is set up in a low-tax country, it may not be a desirable location to actually manufacture and sell the product. We show that U.S. foreign sales platforms in low-tax jurisdictions intensely contract with manufacturers located in high-tax countries, which will manufacture the goods and ship them directly to the final consumer. In contract manufacturing arrangements, the tax haven country imports the service of producing the good from manufacturing countries in exchange of its property right. By owning the property rights of the products, U.S. multinational firms concentrate their sales in tax havens.[3] We also document that tax havens display a very large amount of profits per employees compared to other countries. Along the description of the dataset, we highlight the role played by different tax havens on the organization of U.S. multinational firms. Caribbean tax havens, which are small and located close to the U.S., are relatively more specialized in hosting foreign sales platforms in services sectors while larger and more

[3]In terms of trade statistics, three transactions are observed: the transaction between the tax haven and the manufacturing country corresponds to an import of service from the tax haven. When the good is bought there is a physical transaction, recorded in customs data as an import of the country of the final consumer from the manufacturing affiliate. There is also a financial transaction between the country of the final consumer and the tax haven. This would be recorded as an import in the balance of payments since the balance of payment measures trade based on the change of ownership.

distant tax havens located in Europe and in Asia are relatively more specialized in hosting foreign sales platforms in manufacturing sectors.

Our econometric methodology proceeds into several steps. In a first step, we examine the determinants of U.S. foreign sales platforms locations and sales decisions. As U.S. multinationals may use these foreign sales platforms to both serve the market of the host country and other markets outside the host country, we analyse whether their location is primarily determined by the host countries' market access. The location of foreign sales platforms may as well be affected by the local tax environment. We control for the role of the corporate tax rate, the haven status of the host country and for tax agreements with the United States differentiating between double taxation conventions (DTC) and tax information exchange agreements (TIEA). We know since the work of Zucman (2014) that the world distribution of profits is biased towards tax havens. However, less is known about the organization of firms in these countries. Consequently, we analyse the profits of U.S. multinationals firms with a particular focus on the role of the foreign sales platforms and on the impact of tax havens. In a second step, we quantify the impact of foreign sales platforms in the profit shifting strategies of U.S. multinational firms.

We show that the tax environment, especially the tax haven status of the host country and the lack of effective exchange of information and transparency between the host country and the U.S. are key determinants of the location of foreign sales platforms. Their location is only marginally influenced by market-driven factors such as the foreign and domestic market access of the host country. Compared to the aggregate analysis, exploiting the broad industry classification informs on the specifics effects of foreign market access and the tax environment on the location of sales platforms across industries. Overall, the examination of the location of sales platforms across industries suggests that the tax haven effects found earlier are driven by the services sectors, while the foreign market access remains a determinant of the location of U.S. sales platforms in manufacturing industries.

When disentangling the effect across tax havens, we show that tax havens located in the Caribbean are specialized in concentrating the sales of foreign sales platforms active in services industries while other (and bigger) tax havens such as Switzerland or Ireland are relatively specialized in concentrating the sales in the manufacturing sector.

We use a back-of-the-envelope computation to show that profit shifting by foreign sales platforms in tax haven amounts to $83bn in 2013. This corresponds to a substantial share of the profit shifting activities of U.S. firms.[4]

[4]Using national account and balance of payment data, Zucman (2014) evaluates that US firms avoid around 20% of the corporate tax income by shifting profits to tax havens. In a recent contribution, Torslov, Wier and Zucman (2018) estimates to approximately $140bn the profit shifting of U.S. firms in tax havens

Our paper is related to a strand of the literature that has investigated the tax avoidance strategies of U.S. multinational firms (Grubert and Mutti, 1991; Hines and Rice, 1994; Clausing, 2016). Similar to these papers, we estimate a profit equation. We however extend it to understand how multinational firms organize their sales and production in the presence of tax havens. We also contribute to the literature that examines the role of tax havens in explaining the location of foreign affiliates. Desai, Foley and Hines (2006) using similar data as ours at the micro level shows that larger and more internationally-oriented U.S. firms are most likely to own affiliates in tax havens. They also document the different uses of different tax havens by the U.S. MNEs. Particularly, they show that larger tax havens are used to shift profits while smaller ones are used to facilitate the deferral of U.S. taxation. Using German data Gumpert, Hines and Schnitzer (2016) show that a higher foreign tax rate is associated with a larger probability of owning a foreign affiliate in a tax haven. Manufacturing firms drive this relationship while it is less stringent for firms operating in service industries.[5] We show that U.S. foreign sales platforms concentrate sales in tax havens in order to shift profits. Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016) also provide theoretical grounds about optimal profit shifting in a simple framework. Our model is built on these grounds.

Our paper is related to the trade literature which examines the determinants of the location of foreign sales platforms.[6] We differentiate foreign sales platforms from export platforms as the activity of multinationals in tax havens could involve foreign sales without exports. Hanson, Mataloni and Slaughter (2001) analyse the determinants of the vertical organization of the firm, examining export-platforms and wholesale affiliates. They note that affiliates' activity in tax havens could be subject to tax minimization strategies through wholesale affiliates. Their empirical results are sensitive to the definition of estimation sample when it includes tax havens. We show both theoretically and empirically that tax havens have specific location effects. Head and Mayer (2004) provide a straightforward model of the location of foreign affiliates which serve both local and non-local demand. We integrate this concept in our theoretical framework.

This paper has several contributions. To the best of our knowledge, our paper is the first to analyse the impact of tax havens on firms' organization and trade using macro-level data that are publicly available. Other important papers using macro data are Zucman

in 2015.

[5]We are also related to papers that study the impact of the tax environment on firm location despite not taking into account tax havens particularities. An example is Barrios et al. (2012).

[6]Theoretical contributions to this literature include Head and Mayer (2004); Ekholm, Forslid and Markusen (2007); Mrázová and Neary (2011); Tintelnot (2017) and Ito (2013).

(2014), Clausing (2016) and Torslov, Wier and Zucman (2018) which estimate for the U.S. or at the world level the amount of profit shifted to tax havens. We go beyond these papers by analysing how the existence of low-tax jurisdictions shape the organization of the firms. Profit shifting is a phenomenon which is generally hard to identify. It is by definition hidden and it necessitates precise and multi-country information to identify it at the micro level. In our study, following the contribution of Zucman (2014), we show that some important patterns and channels of profit shifting could be documented from simple variables (sales, profits, employment) provided by publicly available and aggregated data sets.

The empirical exercises are guided by a straightforward model of foreign sales platforms location that includes profit shifting incentives. This model uses simple tools and show that market-based determinants of foreign sales platforms loose importance when the tax environment is taken into account.

We also document the heterogeneity of tax havens. In the tax avoidance literature, the tax havens are generally classified according to their population.[7] In line with the location model, we adopt an other point of view and separate the tax havens according to their remoteness from the U.S.[8] We document that Caribbean countries (close from the U.S. and small countries) and large tax havens (remote from the U.S. and larger countries) are used differently by U.S. MNEs. Caribbean tax havens are relatively specialized in hosting affiliates from service industries while the other tax havens are relatively specialized in hosting affiliates from manufacturing industries.

We provide a quantification of the impact of foreign sales platforms on profit shifting of U.S. firms. Comparing our quantification to other and more general ones, such as Torslov, Wier and Zucman (2018) or Clausing (2016), we show that foreign sales platforms account for a large share of the total profit shifting. This finding challenges the view that sales is a good factor to determine the proportion of a firm base that a country could tax (Common Consolidated Corporate Tax Base proposed by the European Union; Zucman (2014)).

Our paper proceeds as follows. In section 2, we describe the data sets on foreign activity of U.S. multinationals and on the market access and tax environment of the host countries. In section 3, we present four key facts relative to the geographical distribution of profits and sales of U.S. multinational firms. Our conceptual framework is described in section 4 while we develop on the econometric strategy in section 5. In section 6, we estimate the profit shifted through foreign sales platforms. We conclude and provide further discussions especially on recent policy debates in Section 7.

[7] See for instance Hines and Rice (1994).

[8] Our classification is also supported by the big data analysis of recent leaks. See Garcia-Bernardo et al. (2017)

2 Data

2.1 Data on foreign affiliates

Data on the activity of U.S. owned foreign affiliates comes from the international mandatory annual and benchmark survey of the Bureau of Economic Analysis (BEA).[9] We keep information on majority-owned foreign affiliates as the BEA collects more data from this type of affiliates. These data sets are generally available from 1999 onward for many countries and 14 industries.[10] The data sets provide information on many different variables including total assets, property, plant and equipment assets, employment, local and foreign sales of goods and services, net income or profit-type return which is available for 56 countries. Importantly, the profit-type return variable measures profits before income taxes and excludes non-operating items (such as special charges and capital gains and losses) and income from equity investments (US Bureau of Economic Analysis (2004)). This measure of profit is particularly interesting for the purpose of our study. It excludes financial revenues which are by definition not generated by the export activity of the firm. The measure of profit shifting that we will present later on will then exclude financial transactions as we are only interested in how tax havens shape the real activity of the firm.[11] The data set allows to construct the ratio of foreign to total sales for each industry in each country: $FS_{ikt} = \frac{Foreign\ sales_{ikt}}{Total sales_{ikt}}$. This ratio has been used in the literature when studying the role of U.S. multinational firms' foreign export platforms (Tintelnot, 2017). This ratio will proxy for foreign sales platforms.[12]

The change in the sector classification in 1999 as well as the change from only including non-bank foreign affiliates up to 2008 to including all foreign affiliates thereafter leads us to define a sample from 1999 to 2013 which excludes foreign affiliates of banks for the empirical analysis. When the information on sector is available it includes 11 industries.[13]

[9] These surveys are mandatory under the International Investment and Trade in Services Survey Act. Benchmark surveys are conducted every 5 years. They provide the most comprehensive coverage of U.S foreign business entities, transactions, and data items.

[10] The classification of sectors is shown in Appendix A

[11] Results are however robust if we use the net income as a measure of profits.

[12] Tintelnot (2017) uses this ratio to proxy for export platforms. As explained earlier we believe that it is safer to claim that this ratio proxy for foreign sales platform as foreign sales may differ from exports especially in transactions that involves tax havens.

[13] For the purpose of our study, we do not use the information from the *Utilities* sector. The utilities industry is composed by firms operating in "electric power generation, transmission and distribution", "natural gas distribution" or "water, sewages and others systems". This industry operates locally and represents 0.03% of the U.S. total export share and accounts for 0.75% of the total number of U.S. foreign affiliates. We also exclude the sector of *Other industries* since the coverage of our database in terms of foreign sales

Our estimation sample covers 56 countries including 9 tax havens over the period 1999-2013. This shall represent 9,240 observations. However, some of the observations in the data sets are missing either because of a lack of 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 don't have the precise information about the value of sales or employment. These values are between -$500000 and +$500000 or less than 50 employees. In this case, we set the observation to +$250000 or 25 employees, an arbitrary positive value in the range. In our baseline sample, we impute 6.34% of the observations for the profit variable and 2.37% of the observations for the export-platform variables. Overall, 7.08% of observations contains at least one variable with an imputed value. When the data are subject to disclosure, we erase the information. The sample in our empirical exercise reduces to 6,177 observations. The complete list of the countries is given in appendix A.

2.2 The host country tax environment

The tax environment of the host country is characterized by the corporate tax rate, and also by the degree of compliance of the host country tax rules to the rules applied in the U.S. We also control whether the host country is a tax haven. We define each of these items below.

Our main corporate tax rate variable is the statutory tax rate which has been used widely in the profit shifting literature (Grubert and Mutti, 1991; Clausing, 2016; Dowd, Landefeld and Moore, 2017; Schwarz, 2009). However, one could argue that the relevant costs associated to the profit-shifting process rely on the average tax rate because statutory rates do not reflect the true tax cost of reporting income in a jurisdiction due to special rules or negotiated tax rate. The average tax rate is the percentage of its overall taxable income that is paid in taxes. It is less directly observable than the statutory tax rate and its computation reduces the size of the sample. The statutory tax rate is similar to the average tax rate faced by U.S. foreign affiliates in non-haven countries while there are large differences in tax havens (see appendix B for an empirical justification of tax havens). The average tax rate is indeed a function of the statutory tax rate and takes implicitly into

platform share is relatively low for this sector. The sector of *Other industries* includes 3558 affiliates in 1999 (corresponding to 17% of the MOFAs). It accounts for 18% of total assets, 7% of sales, 31% of net income, 21% of employees. Inside this composite sector, the "Management of non-bank companies and enterprises" that include holding companies activity 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 plant and equipment, 1% of sales and 1% of employees of the sector of *other industries*. We provide later on additional tables that include these sectors in order to evaluate the robustness of our results to their inclusion. The complete list of industries in presented in appendix A.

account the advantages of being located in tax haven. Consequently, using an average tax rate variable absorbs part of the effect attributed to the tax haven.

We collect information on corporate taxes for each of the 56 countries of the sample. The OECD tax database reports information for most of these countries. The missing statutory tax rates are collected from various other sources which have series that are comparable across years and countries. We use information from the KPMG's *Corporate Tax Rates Table and Corporate Tax Rate Surveys*, the Deloitte *International Tax Source* and the EY *Corporate Tax Guide*.

Concerning the characterization of tax havens, we follow the definition proposed by Hines and Rice (1994) which has been recently used by Dharmapala and Hines (2009). A tax haven is defined as a location with low corporate tax rates, banking and business secrecy, advance communication facilities and self-promotion as an offshore financial centre (Hines and Rice, 1994, Appendix 1 p. 175). Compared to the list of Tax Havens produced by the OECD (2000), the approach of Dharmapala and Hines (2009) identifies a number of additional tax havens such as Switzerland or Honk-Kong. In our estimation sample, Barbados, Bermuda, the British Virgin Islands, Cayman Islands, Hong Kong, Ireland, Luxembourg, Montserrat, Panama, Singapore, Switzerland and Turks and Caicos Islands are classified as tax havens. In the available data, the information on foreign affiliates' activities for British Virgin Islands, Cayman Islands, Montserrat and the Turks and Caicos Islands is pooled in the same country-level observation. We keep the name of British Virgin Islands which now refers to this meta country.

We add information on tax agreements between the United States and the countries of the affiliates. We distinguish between two types of tax agreements: Double Taxation Conventions (DTC) and Tax Information Exchange Agreements (TIEA). The bilateral tax agreements capture part of the degree of compliance of the tax environment between the host country and the U.S. DTCs are mainly used to avoid double taxation of firms and individuals. They often include an article that implement the sharing of tax information between the two signatories (See article 26 of the OECD Tax Convention Model).[14] TIEAs are about the exchange of information in order to avoid tax fraud or tax avoidance. The number of TIEAs signed increased a lot when the OECD put pressure on some non-cooperative countries by blacklisting them if they had not signed at least 12 TIEAs. In 2015, 665 over 894 TIEAs concerned tax havens. The majority of the TIEAs does not include the automatic exchange of information. It is rather on request of one of the two signatories (Johannesen and Zucman,

[14] A recent version of this tax convention model could be found here: https://www.oecd.org/ctp/treaties/model-tax-convention-on-income-and-on-capital-condensed-version-20745419.htm

2014). This request must be based on well-documented suspicions that are likely to be hard to gather (see Chavagneux, Palan and Murphy, 2010). The information about worldwide tax treaties comes from the Exchange of Information database (EOI) made available by the OECD. This database virtually covers all the agreements signed in the World especially if one of the party is member of the OECD (such as the United States). According to this portal, the United States signed agreements with 88 jurisdictions (60 DTCs and 34 TIEAs in 2017). Information is given on the type of the treaty (DTC or TIEA), on the date of signature and on the date of entry into force.

2.3 Other variables

The activities of U.S. foreign affiliates do not only depend on the tax environment of their host country. They are also related to local and foreign demand (Redding and Venables, 2004; Head and Mayer, 2004; Head and Mayer, 2011). In the framework of Head and Mayer (2011), foreign affiliates sale to domestic and foreign countries with foreign sales discounted by bilateral trade costs. In order to compute the foreign market access variable, we follow their panel approach and proceed in two steps. From a bilateral gravity equation, we first compute the empirical predictions of bilateral transport costs between countries. These predictions come from a regression of bilateral trade on 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.[15]

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

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 constructed as $FMA_i = \sum_j exp(\hat{\mu}_{jt}) \times \hat{\phi}_{ij}$ which does not include the own demand of the country. Countries close to large foreign

[15] 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)

export markets have a high value of FMA, while remote countries have low values of this measure.

The foreign market access variable is computed using (external) data for all bilateral pairs of countries in the world. The series on bilateral trade are from UN COMTRADE while the vectors of trade impediments are obtained from CEPII gravity. The common language data set is taken from Melitz and Toubal (2014).

Finally, the series on real GDP are taken from the Penn World tables (Feenstra, Inklaar and Timmer, 2015).

3 Facts

Table 1 reports the descriptive statistics related to the estimation sample. We show these statistics for the two samples used in our analysis. The second sample *Profit* only reports positive profit observations. Both samples are similar in terms of descriptive statistics. As expected, firms in the sample with positive profits only have more employees and more productive assets. Table 6 in Appendix C shows that U.S. foreign affiliates in tax havens are reporting larger average sales per employees and larger profit per employees than foreign affiliates in other countries, a feature that we attribute to sale and profit shifting as we will see later on.

There are at least four salient facts when examining the activities of U.S. foreign affiliates across countries. First, contrary to common wisdom, we show that U.S. multinationals concentrate their sales by the mean of their platforms which are located in few tax haven countries. Secondly, we show that the usual determinants of U.S. foreign sales platforms may not apply when the host country is a tax haven. Thirdly, we show that U.S. foreign affiliate sales from tax haven countries to the U.S. are an order of magnitude larger than their exports. We interpret it as a clue for tax-based contract manufacturing. Finally, we show that foreign affiliates located in tax havens report average profits that are not surprisingly way above the average.

Fact 1. Tax haven and U.S. multinational firms' foreign sales platforms. Multinational firms may organize their global production such as to concentrate their sales and purchases in low-tax countries. For instance, Caterpillar SARL, the Swiss affiliate of Caterpillar reports more than 85% of the non-US profits of Caterpillar despite having no manufacturing facilities and only 0.3% of the total number of employees (Levin, 2014). More generally, recent anecdotal evidences show that firms use tax havens as to produce where it is optimal

to produce and register sales where it is optimal to do it (See Appendix D for more details on the case of Apple). This suggests a distribution of activities across countries which is specific to global manufacturers and global sellers. To illustrate this idea, we compute the ratio of foreign sales to total sales (foreign and domestic sales) for each country. This *foreign sales* ratio gives us an idea of the magnitude of U.S multinational firms' foreign sales platforms. In order to examine the geographic distribution of these platforms and to inform on which countries attract relatively most of them, we proceed as above and regress the foreign sales ratio on a set of country i fixed effects μ_i and a trend μ_t. Given the availability of the data, we cannot exploit the sector classification at a detailed level. We can however compute the prediction of this equation for both sales of goods and sales of services.

$$\frac{Foreign\ Sales_{it}^{j}}{Total\ Sales_{it}^{j}} = \mu_t + \mu_i + \epsilon_{it} \quad j = goods; services$$

In Figure 2, we report the deviation of the predictions from the non-haven average (*predicted*) global sales of non-tax haven countries. Panel A of Figure 2, report the deviations for the foreign sales of goods and Panel B for the deviations of sales of services.

— Figure 2 about here —

Interestingly, the magnitudes of the deviations from average are larger for services sales than for sales of goods. This tends to confirms the relative specialization of tax haven countries in services sectors. But the ranking remains: the figure shows large deviations from the average in tax haven countries.

Fact 2. The location of U.S firms' foreign sales platforms Figure 3 visualizes how the foreign sales ratio relates to foreign market access. According to the standard model, U.S. firms should locate their foreign sales platforms in distant and low costs foreign locations characterised by a relatively large foreign market access (Tintelnot, 2017; Mrázová and Neary, 2011). Figure 3 indicates a positive correlation between the U.S. foreign sales ratio and their foreign market access. This positive relationship is less important for countries close to the U.S. (Canada, Mexico, Central America, Caribbean countries) and for tax havens. The pattern of the correlations for the tax havens is interesting as there is no clear evidence that their foreign market accesses relate to the foreign to total sales ratio.

The market-size based determinants of the foreign activity do not apply to tax havens.

— Figure 3 about here —

Fact 3. A hint on contract manufacturers. The cases of Caterpillar and Apple may hint at the firm's strategy to concentrate her sales and profits in tax haven countries. Focusing on goods rather than services, we compare the foreign sales of each country to the U.S. to their total exports to the U.S. The BEA requirement allows to compare the values to the official U.S. trade data (see US Bureau of Economic Analysis, 2004). The U.S. exports in goods have to be reported on a "shipped" basis (meaning on the basis of the *physical* transaction). The U.S sales are however reported on a "charged" basis (meaning on the basis of the *financial* transaction). According to the BEA (US Bureau of Economic Analysis, 2004, page 34): "The two bases are usually the same, but they can differ substantially. For example, if a U.S. parent buys goods from country A and sells them to country B and if the goods are shipped directly from country A to country B, the parent's books would show a purchase from country A and a sale to country B. Because the goods never entered or left the United States, on a shipped basis, they would not be recorded as either U.S. imports or U.S. exports. However, if the parent's trade data were reported on a charged basis, the purchase would appear as a U.S. import and the sale would appear as a U.S. export." In the case of tax-based contract manufacturing, if an affiliate located in a tax haven purchases goods from China and sells them to the U.S. and if the goods are shipped directly from China to the U.S., the affiliate's books would show a sale to the U.S. and the export in Customs data will be recorded in China.

Figure 4 reports the U.S. foreign affiliates sales to exports ratio for the countries available in our sample. Since the BEA is not reporting exports to other countries than those to the U.S., Figure 4 reports the *sales-to-exports ratio* computed by excluding all other destinations than the U.S. To ensure the comparability of the two measures we concentrate only on sales and physical exports of goods *only*. Contrary to common wisdoms, the sale-to-exports ratio is larger than one in many countries. The average sales of foreign affiliates to the U.S. is 55 times larger than their exports to the U.S. A striking feature of Figure 4 concerns the disproportionate role of tax havens in explaining the sales-to-exports ratio. In Panel A, we show that the deviation is larger for tax-haven countries compared to non-tax haven countries. U.S. foreign affiliates' sales from tax-haven countries to the U.S. are 371 times larger than their exports. The corresponding *sales-to-exports ratio* from non-tax-haven countries is 1.9. In Panel B and C, we show that most of the deviation is triggered by transactions within U.S. multinational firms as the ratio is close to unity for transaction with unaffiliated party.[16]

[16] A positive U.S. foreign affiliates sales to exports ratio is also observed for transactions with unaffiliated parties. This may be due to the definition of the unaffiliated party which includes minority-owned affiliates and the difficulty of BEA to define the ultimate beneficial owner of the affiliate.

These facts suggest that U.S. parents are shifting sales from affiliates located in non-tax haven countries to affiliates located in tax-haven countries. It is worth stressing that most of these shifts is taking place within multinational firms. As argued by Gravelle (2015), low-tax countries may not be the desirable location to actually manufacture and sell the product. Instead the affiliates in tax havens may contract with a firm in an other country as a *contract manufacturer*, who will produce the good for cost plus a fixed mark-up that could involve transfer mis-pricing (as suggested by Levin, 2014 and Levin, 2013 in the cases of Caterpillar and Apple). Subpart F regulations should impede this type of contracts, but these arrangements can involve hybrid entities that allows firms to defer their US tax bill through the check-the-box loophole. Indeed, over the period 97-04, 25% of US MNE foreign income was located in affiliates that used the check-the-box exception (see Grubert, 2012).[17]

Facts 4. Profits of U.S. foreign affiliates in tax haven countries If multinational firms can artificially shift profits from high-tax to low-tax jurisdictions, then the profit per employee should be relatively larger in low-tax countries compared to other countries. It is not surprising that the profit reported in tax havens is larger than in other countries. As we see below, the order of magnitude is however striking.

There are many reasons why profits per employee differ across countries. This might be due to difference in country-specific performances or sector-specific shocks. In order to compare the relative profit per employee across different countries, we estimate equation 3 where we regress the aggregate profit per employee on sector $\times$ year and country-specific effects.

$$\frac{Profit_{ikt}}{Employment_{ikt}} = \mu_t + \mu_i + \mu_{kt} + \epsilon_{ikt}$$

where $\frac{Profit_{ikt}}{Employment_{ikt}}$ is the profit per employee of the affiliates registered in sector k, located in country i at time t. μ_t is a parametric trend that accounts for global business cycles. μ_{kt} are sector $\times$ year fixed effects which allow us to control for unobserved shocks at sector level that vary across time. μ_i are the set of country-specific effects. We compute the predictions of this equation which gives us the country-specific influences net of other sector or year determinants. For each country, we compute the ratio of the prediction to the predicted average of non-tax haven countries. In Figure 5, we rank countries according to the size of the deviation.

[17] According to Grubert (2012) in 2004, 38% of the aggregate net income of U.S. MNEs was located in tax havens. Considering that the majority of hybrid entities are located in tax havens, it suggests that a large share of income at this period was under the check-the-box regime.

— Figure 5 about here —

We show a large positive deviation from the average (*predicted*) profit per employee for most tax haven countries. Among the tax haven countries, Virgin British Island, Bermuda and Barbados close to the U.S.A. and Ireland and Switzerland located in Europe are reporting profit per employee that are 12 to 250 times larger than the average. Notice that other low-tax jurisdictions such as Canada, the Netherlands or the United Kingdom identified as sharing tax haven characteristics (Gravelle, 2015) also display large positive deviations from the average profit per-employee.

4 Theoretical Framework

The facts described above show how the tax environment strongly influence the geographical location and activities of U.S. multinational firms. In particular, we show that U.S. multinationals organize their affiliates' network to concentrate their sales and profits among foreign sales platforms located in tax havens. At these locations, the foreign market access plays a lesser role. In this section, we present a stylized theoretical framework that illustrates these facts. It shows how the foreign market access and the tax environment of the host countries shape the geographic distribution of foreign affiliates. The host country tax environment is characterized by the local corporate tax rate, by the degree of compliance of the host country tax rules to the rules applied in the U.S and by the tax haven status of the host country. This stylized framework is borrowed from Head and Mayer (2004) who develop a straightforward locational model where firms face monopolistic competition. In their framework, firms deliver a *local* and a *non-local* demand. We call these firms "*foreign sales platforms*" as they sell in domestic and foreign countries with foreign sales discounted by bilateral trade costs. These foreign sales platforms also pay domestic taxes. As in Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016), they may want to shift part of their total sales to a tax haven. This strategy comes however at a cost that we will detail below. For ease of exposition, we assume that the multinational firm has at least one affiliate in a tax haven. In our stylized framework, the firm has always the possibility to shift sales to tax havens.

The tax environment of multinationals. The multinational can invest in a range of countries $i = 0, \cdots, n$ including a tax haven, which is denoted as country 0. As in Hines and Rice (1994), we denote ρ_i the before-tax profits earned in country i by the foreign sales platforms once it is set up. 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 country has a corporate tax rate which is assumed to be 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 in country i to the tax haven country. By shifting profit, the firm incurs a reallocation cost that is increasingly expensive as the amount shifted increase relative to the amount earned in country i. These costs are incurred in the country from which the income is shifted and assumed to be $\left(a^{1/\gamma_i}/2\right)(\Psi^2/\rho_i)$. The parameter $a \in]0, \infty[$ captures how much the cost of income reallocation increases with the amount reallocated. In contrast with Hines and Rice (1994) and Gumpert, Hines and Schnitzer (2016), we assume this cost to be a function of the degree of transparency of the tax environment in the host country. The parameter $\gamma_i \in (1, \infty)$ reduces with the degree of transparency of the tax environment of the host country i. Transparency requires U.S. and local authorities to have access to information regarding the ownership of the affiliates but also to bank information that may be relevant to criminal and civil tax matters (OECD, 2001). The degree of transparency depends therefore on the exchange of informations between the host countries and the U.S. Given the ability of firms to shift profit in the tax haven location, the reported profit in country i has thus a fixed and a mobile component and can be written as

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

Considering the behavior of a multinational that reallocates income, such firm chooses its income transfers (Ψ_i) to maximise after-tax profits, taking as given the fixed profits earned (ρ_i). As in Gumpert, Hines and Schnitzer (2016), and assuming the existence of a tax haven affiliate, we derive the optimal amount of income, Ψ_i^*, that is 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 E.

The profit equation for foreign sales platforms. We now turn to the formal definition of ρ_i. The fixed component of the foreign sales platform's profit function in each potential location i is the aggregation of the after tax gross profit earned in each destination j.

Let E_j denote expenditure in a representative industry in country j. Consumers allocate their expenditures across differentiated varieties in the representative industry. The utility

function of consumers is a subutility function of the CES type: the elasticity of substitution between varieties, σ, is the same for any pair of product and larger than one. Maximizing this sub-utility function subject to expenditure, E_j, and the delivered prices from all possible product origins, we obtain the demand curve for the representative variety in the representative industry as

$$q_{ij} = \frac{p_{ij}^{-\sigma}}{\sum_r n_r p_{rj}^{1-\sigma}} E_j \tag{3}$$

where p_{ij} is the delivered price faced by consumers at destination country j for products from origin country i. p_{ij} is the product of the mill price p_j and iceberg trade costs τ_{ij} between the pair of countries $p_{ij} = p_j \tau_{ij}$. Assuming monopolistic competition, the price of a variety is a constant mark-up over marginal cost. We can therefore derive the sales of a firm from country i in country j:

$$q_{ij} = \frac{\sigma - 1}{\sigma} \frac{(c_i \tau_{ij})^{-\sigma}}{G_j} E_j \tag{4}$$

where c_i is the marginal cost in country i and $G_j = \sum_r n_r p_{rj}^{1-\sigma}$.

The fixed component of the profit function of the foreign affiliate in each potential location i is the composite of each after-tax gross profit earned in each destination j. It can be written as

$$\begin{aligned} \rho_i = \sum_j \rho_{ij} &= \sum_j (p_i - c_i)\, \tau_{ij} q_{ij} \\ \rho_i &= \frac{c_i^{1-\sigma}}{\sigma} \sum_j \Phi_{ij} \frac{E_j}{G_j} \end{aligned}$$

where $\Phi_{ij} = \tau_{ij}^{1-\sigma}$ is a measure of the access of affiliates from i to market j. Denoting $M_i = \sum_j \Phi_{ij} \frac{E_j}{G_j}$ the market access of country i, we can rewrite the fixed component of the profit function as

$$\rho_i = \frac{c_i^{1-\sigma}}{\sigma} M_i \tag{5}$$

In line with Head and Mayer (2004), equation 5 shows that the fixed component of profits is decreasing in country's i production costs and increasing in its access to foreign markets.

The total after-tax profit of the foreign sales platform in country i does not simply depends on the fixed component ρ_i but is also a function of the amounts of income shifted

across countries. Given the optimal amount of income shifted worldwide and assuming a tax rate equals to zero in the tax haven, the reported profit of the tax haven affiliate can be written as[18]

$$\begin{aligned}\Pi_i^{th} &= \rho_i + \sum_j \Psi_j^* - F_i \\ &= \frac{c_i^{1-\sigma}}{\sigma} M_i + \sum_j \frac{1}{a^{1/\gamma_j}} \frac{c_j^{1-\sigma} M_j}{\sigma} t_j - F_i \end{aligned} \tag{6}$$

The first term on the right-hand side of equation 6 is the profit of the firm earned in the tax-haven location as defined in Head and Mayer (2004). It suggests that firms face a trade-off between low production costs and high market potential. The second term gives the effect of corporate taxes and the transparency of the tax environment on the amount of profit shifted from the non-haven countries to the tax haven. The degree of transparency in each country j decreases the amount of profits that is shifted to the tax-haven country. The level of corporate tax rate increases the amount of profit shifted to the tax haven.

In the other countries, the combined after-tax profit is given by

$$\Pi_i^{nth} = \frac{c_i^{1-\sigma}}{\sigma} M_i \left(1 - \frac{t_i}{a^{1/\gamma_i}} \left(1 + \frac{t_i}{2}\right)\right) - F_i \tag{7}$$

Similarly, equation 7 shows that the after tax profit of the firm earned in the other locations. It is determined by the market access and the production costs of host country but depends also on the amount of sales that is shifted to the tax haven country. This amount depends on the host country production costs, its market access but also on its corporate tax rate and the degree of transparency of its tax environment.

The main focus of this paper is to determine the impact of market access and of the host country tax environment on the location of foreign sales platforms. Proposition 1 describes how a change in the corporate tax rate and in the degree of transparency of the host country will change the profits of foreign sales platforms. From equations 6 and 7, we can easily show the following propositions.

Proposition 1. The amount of reported profit reduces with the level of corporate taxes in the host country and with the degree of compliance of the host country tax environment with the U.S.

The amount of profit that is shifted to the tax-haven country depends positively on the level of corporate tax rate in other (non tax haven) countries. This amount decreases with

[18]For ease of exposition, we drop the index th and ^{nth} from the market access and production costs variables.

the degree of transparency of the tax environment, in particular the exchange of relevant tax information between the tax-haven country and the U.S.

In this framework, the introduction of the tax environment modifies substantially the incentives to locate foreign sales platforms across countries. In Head and Mayer (2004), the market access elasticity should be equal to unit value. In our framework, this elasticity is moderated by the possibility to shift sales to the tax haven country. Proposition 2 describes how a change in the host country market access affect the location of foreign affiliates.

Proposition 2. The existence of a tax haven country reduces the effect of market access on the profits of foreign sales platforms in the tax haven and has no effect on the profits in other countries. It reduces therefore the average influence of market access on the incentives to locate affiliates in host countries. **Proof**. See the Appendix F.

Intuitively, the possibility to shift sales from non-tax-haven countries to the tax-haven affiliate reduces the importance of the market access determinants in the tax-haven location and therefore reduces the *average* impact of market access on the location of foreign affiliates.

5 Econometric analysis

The stylized model delivers several testable predictions. Propositions 1 & 2 characterize the influence of market access and the tax environment on the incentive to locate foreign sales platforms in host countries and the ability of these firms to shift profits to tax haven locations.

In this section, we investigate the empirical relevance of the theoretical insights and conduct a series of sensitivity exercises to explore the robustness of the baseline findings. Our econometric methodology follows two steps. We first examine the determinants of U.S. multinationals' foreign sales platforms locations and production decisions. U.S. multinationals may use these foreign affiliates to both serve the market of the host country and other markets outside the host country. We examine the effects of the market access and the tax environment of the host country on the location of foreign sales platforms controlling for a large set of other important determinants that have been used in the literature. We then analyse the profit of U.S. multinationals firms with a particular focus on the role of foreign sales platforms and on the impact of tax havens. The profit equation will enable us to quantify the profit shifted by U.S. multinational firms and determine the contribution of foreign sales platforms.

Determinants of the foreign sales platforms locations. The distribution of the foreign sales platforms is analysed by estimating the determinants of the foreign-to-total-sales ratio, FS_{ikt} for each sector k of country i in year t as in equation (8).

$$\begin{aligned} FS_{ikt} &= \beta_0 + \beta_1 FMA_{it} + \beta_2 Tax_{it} + \beta_3 Treaties_{it} + \beta_4 Haven_i \\ &+ \beta_5 X_{ikt} + \beta_6 DMA_{it} + \mu_{kt} + \epsilon_{ikt} \end{aligned} \tag{8}$$

The baseline explanatory variables of interest are FMA_{it}, the foreign market access as defined in section 2.3, Tax_{it} the host country statutory tax rate, $Treaties_{it}$ a vector of dummy variables that control for the enforcement of specific tax treaties between the host country and the U.S. $Haven_i$ a dummy variable that takes the value of one if the country is classified as a tax haven as in Dharmapala and Hines (2009) and zero otherwise.[19]

X_{ikt} is a vector of sector- and country-specific controls that vary over time. It includes total employment and total productive assets of foreign affiliates in each industry of country i. Total employment and total productive assets allow us scaling the size of the activity.[20] We include the domestic market access DMA_{it} measured by the GDP of the host country.

μ_{kt} controls for sector-specific shocks that are varying across years. ϵ_{ikt} is the disturbance term. Standard errors are clustered at the country level.[21]

Since the foreign sales ratio is a fractional variable bounded between zero and one, and 79.5% of the ratio lies between 0 and 1 (excluded), we use fractional logit as our estimation method rather than standard logit, which expects a truly binary dependent variable (Papke and Wooldridge, 1996). We report the marginal effects that are evaluated at sample means. In the appendix, we provide a robustness table where we use a linear estimator.

Foreign platforms, tax haven and profits. We analyse the profit of foreign affiliates and compute the premia that results from locating foreign sales platforms in tax havens. To study their role in shifting U.S. profit to tax havens, we consider the interaction between the ratio of foreign sales to total sales, $FS_{ikt} \times Haven_i$ which takes values that are positive if the country has a tax haven status and zero otherwise. The empirical strategy involves estimating the effects of tax havens and the foreign-sales ratio on profit 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; Clausing, 2016 or Dowd, Landefeld and Moore, 2017)

[19] We use the average tax rate as an alternative measure of the tax rate. The results are comparable and presented in the online appendix

[20] Plant, property and equipment assets of the affiliates are less subject to distortion by the tax-planning strategies of an MNE (Schwarz (2009)).

[21] As shown in the online appendix, the results are robust to clustering at *sector* × *country* level.

$$\begin{aligned}\Pi_{ikt} &= \alpha_0 + \alpha_1 FMA_{it} + \alpha_2 FS_{ikt} + \alpha_3 Haven_i + \alpha_4 \left(FS_{ikt} \times Haven_i\right) + \alpha_5 Tax_{it} \\ &+ \alpha_6 Treaties_{it} + \alpha_7 X_{ikt} + \alpha_8 DMA_{it} + \nu_{kt} + \xi_{ikt}\end{aligned}$$

Π_{it} is the logarithm of the profits defined before income taxes and which also exclude non-operating items and income from equity investments. In subsequent specifications reported in the online appendix, we also present the results using net income as an alternative dependent variable. The other control variables are defined as before. ν_{kt} is a set of $sector \times year$ fixed effects and ξ_{ikt} is the disturbance term. The model is estimated using OLS. Standard errors are clustered at the country level.[22]

The descriptive statistics on the variables of interest are reported in Table 1.

6 Results

The location of U.S. multinationals' foreign sales platforms. As a first step, Table 2 reports the results of the fractional logit regressions that study the location of foreign sales platforms using the ratio of foreign sales to total sales. Marginal effects at the mean value are reported.[23]

— Table 2 about here —

The results in column (1) document a large effect of the host country foreign market access on the likelihood to locate a foreign sales platform. This result is in line with the finding of Hanson, Mataloni and Slaughter (2001) and Tintelnot (2017) who show that U.S. multinational firms set up foreign sales platforms to sell in nearby countries and beyond. Column (2) adds the level of corporate taxes as an additional variable. We show that the level of corporate taxes impacts negatively the incentive to locate foreign sales platforms. The marginal effect is significant at the 95 percent confidence level. The coefficient is stable when we include the information concerning tax agreements between the location of the foreign sales platform and the U.S in Column (3). There is no impact of double taxation agreements on the likelihood to locate foreign sales platforms, while we find a negative and significant effect when the tax treaty promote the exchange of tax information.

The negative effect of corporate taxes on the location of foreign sales platforms vanishes when we control for the tax haven dummy variable in Column (4). The marginal effect of

[22] As shown in the online appendix, the results are robust to clustering at $sector \times country$ level and to a larger set of controls.

[23] In the online appendix, we reproduce the analysis using a linear model. Our findings remain.

the tax haven dummy variable is positive and significant at the 99 percent confidence level. The inclusion of the tax haven dummy variable reduces slightly the effect of the treaty of information exchange on the likelihood to locate a foreign sales platform. As tax havens not only have low taxes but often provide other mechanisms such as the limited exchange of information between tax authorities, this suggests that the results in Column (3) were biased due to a failure to control for the tax haven status. The correlation between the tax haven and the double taxation treaty dummy variables is about 0.17 and between the tax haven and the treaty of information exchange dummy variables is around 0.16. As mentioned above, half the tax haven countries in our estimation sample did not sign or enforce a TIEA with the U.S.[24] In line with the prediction of our stylized model, Column (4) shows that the location of U.S. multinational foreign sales platforms is strongly influenced by the tax environment of the home country.

The detailed characterization of the country's tax environment reduces however the relevance of the foreign market access variable along the prediction of our stylized model. The marginal effect of the FMA variable is now statistically significant at the 90 percent confidence level. The foreign market access variable has no effect on the location of U.S foreign sales platforms in Column (5) once we also consider the Netherlands as a tax haven (as in Zucman, 2014 for instance).

In columns (6) and (7), we split the sample according to the broad classification of industries and study the effects of the foreign market access and the tax environment on the manufacturing and services sectors. Compared to the aggregate analysis, exploiting the broad industry classification informs on the specific effects of foreign market access and the tax environment on the location of foreign sales platforms across industries. These estimations imply a reduction in the number of observations and the marginal effects might be estimated with a lesser degree of confidence than when examining the aggregate sample.

We find a positive impact of the foreign market access on the location of U.S. multinationals' foreign sales platform in the manufacturing industries. The effect is statistically significant at the 90 percent confidence level. The foreign market access has no effect on the location of foreign sales platforms in services. This finding suggests that U.S. multinational firms do not locate their foreign affiliates in services sectors to gain primarily access to market demand in neighbouring countries. In these sectors, we however find a positive and significant effect of the tax haven dummy variable on the location of U.S. multinationals' foreign sales platform. Overall, the examination of the location of foreign sales platform across

[24]Bermuda, Bahamas, Panama and British Virgin Islands are the haven countries that enforced the exchange of tax information with the U.S.

industries suggests that the tax haven effects found earlier are driven by the service sectors, while the foreign market access remains a determinant of the location of U.S. multinational firms' platforms in manufacturing industries.

Apart from market and tax determinants, the amount of productive assets (plant, property and equipment assets), is the variable of the production function that has a positive and significant impact in all regressions except in column 7 for affiliates in service industries.

The location of U.S foreign sales platforms in large and Caribbean tax havens. The sample has information on 9 tax havens which are very different in terms of economic size or population as noted by Hines and Rice (1994) but also in terms of their degree of transparency. We classify the tax haven countries into two groups that include the Caribbean havens–Barbados, Bermuda, British Virgin Islands and Panama, and larger havens–Hong Kong, Ireland, Luxembourg, Singapore and Switzerland. The dichotomization of the tax haven dummy variable is justified by geographical considerations and technology rather than size of their respective population only as in Hines and Rice (1994). Following anecdotal evidences, it is likely that the tax avoidance strategies of U.S. multinational firms depends on the location of the tax haven country. As we will show later on, the Caribbean islands and Panama which are closer to the U.S. fuel the profit shifting strategy of U.S firms' foreign sales platforms in services industry, while tax havens that are bigger and located in more distant areas (Europe or Asia) help shifting profits in manufacturing sectors. Regarding their technology, the average employment of U.S foreign affiliates in large tax havens is 14 times larger than in Caribbean havens while the average amount of productive equipments is almost 4 times larger.

— Table 3 about here —

The results reported in Columns (1) and (2) of Table 3 show that the effect of tax havens found earlier is mostly driven by the group of large tax haven countries. The foreign market access variable does not determine the location of U.S foreign sales platforms while the domestic access has the expected sign and remains highly significant. Interestingly, the exchange of relevant tax information becomes a significant determinant of the location of U.S. foreign sales platforms once Netherlands belongs to the group of tax havens. In Columns (3) and (4), we examine whether the determinants of the location of U.S. multinationals' foreign sales platforms are different across sectors. In manufacturing sectors, large havens have a positive influence on the likelihood of locating U.S. multinationals' foreign sales platforms (the point estimate is positive but not significantly different from zero, probably because of the sample reduction), while the Caribbean havens reduces this probability. In

services sectors, both type of tax haven countries attract U.S. multinationals' foreign sales platforms. This confirms previous evidence of the heterogeneity of tax havens use (Desai, Foley and Hines, 2006; Garcia-Bernardo et al., 2017).

Foreign platforms and U.S. multinationals profits. The findings in Table 2 show a correlation between the U.S. multinational firms foreign sales platforms location and the foreign market access. We examine now the influence of the location of U.S. multinationals foreign sales platforms on the profit of U.S. multinational firms at aggregate and sectoral level. The specifications analyse the profit before income taxes in logarithm and include *sector* × *year* specific effects in order to control for sector specific shocks that vary over time.[25] Table 4 reports the results.

— Table 4 about here —

Column (1) presents the effects of the market access and the tax environment on the profit of U.S. foreign affiliates. The relevant drivers of profits are significant. In particular, we find that both the foreign market access and the GDP variable have important effects in terms of magnitudes and explain positively the profits of foreign affiliates. Both variables are statistically significant at the 95 percent confidence level. The result concerning the tax haven dummy is not surprising. Profits are larger in tax havens. Yet, we find that the profits in tax-haven countries are almost 140% larger than in non-haven countries after having controlled for domestic and foreign market access and other factors (see Kennedy, 1981 for how we compute this effect).[26]

Column (2) extends the specification by introducing the ratio of foreign sales to total sales. This ratio is our measure of the activity of U.S. foreign sales platforms. By introducing this measure, we examine the relative importance of foreign sales platforms on reported profits. The magnitude of the estimated marginal effects of the different variables are almost not affected by controlling for foreign sales platforms. However, the effect of foreign market access vanishes while the one of the local demand approximated by the host country GDP variable is still an important determinant of profits. The coefficient of the foreign sales ratio is statistically significant at the 99 percent confidence level. The introduction of our measure for foreign sales platforms reduces slightly the effect of tax havens on the profit of U.S. firms. But, the tax-haven dummy variable is still estimated with a high degree of

[25] In the online appendix, we show the robustness of our results to including country fixed effects.

[26] We follow Kennedy, 1981 about the interpretation of dummy variables in semi-logarithmic equations. With g the percentage impact of the dummy variable and c the coefficient on the dummy variable: $g^* = exp(\hat{c} - \frac{1}{2}\hat{V}(\hat{c})) - 1$

precision and its magnitude remains large. The results concerning the foreign market access and the tax haven dummy variable confirm the positive correlation between these variables and the foreign sales ratio found earlier on in Table 2.

Column (3) sheds light on the important role of U.S. multinational firms' platforms in shifting profits in particular to tax-haven countries. In this specification, we interact the tax haven dummy variable with the foreign sales ratio. The introduction of the interaction term turns the coefficient of the foreign market access variable to be significant but only at the 90 percent confidence level. This somehow confirms that U.S. multinational firms do not only choose tax haven countries because of their proximity to the neighbouring demand. Most importantly, the tax-haven variable turns insignificant for the first time in the analysis. The direct effect of the foreign sales ratio drops also now below the conventional level of statistical significance. The interaction term coefficient is however statistically positive. If we look at the standardized "beta coefficients" (Goldberger, 1964, pp. 197–200), the coefficient of the interaction term (0.10) is more than two times larger than the coefficient of the foreign market access variable (0.04).

The coefficient of both tax agreements variables are never statistically significant across specifications. While the exchange of information between the U.S. and the host country is a strong predictor of the likelihood of the location of the U.S. multinationals' foreign sales platforms, it does not affect the after tax profits of foreign affiliates.

Columns (4) and (5) examine the effect of the tax environment and the market access variables on the U.S. foreign affiliates across manufacturing and services sector. The country specific statutory tax rate, its haven status and the bilateral tax treaties with the U.S. are insignificant. As in column (3), the foreign sales ratio variable is also statistically insignificant. However, a comparison of columns (4) and (5) show important differences across manufacturing and services sectors which concern primarily the market access variables and the interaction term between the foreign sales ratio and the tax haven variables. In particular, the profit of U.S. affiliates in manufacturing sectors is primarily determined by domestic market access and the average productive capacity. We also find a significant and sizeable effect of the foreign sales platforms located in tax havens on profits in the services sectors. In these sectors, the domestic market does not have an influence on the profits of U.S. affiliates, it is primarily driven by the demand of neighbouring countries. The coefficients of the foreign market access variable and of the interaction term are both estimated very precisely at the 99 percent confidence level.

In line with the previous literature on profit shifting, we find a robust and significant impact of productive assets on the profit of U.S. affiliates (Hines and Rice, 1994; Clausing,

2016). We however find invariably no effect of the tax rates on profits (contrary to Hines and Rice, 1994; Clausing, 2016 that do not control for the tax haven dummy).

In table 5, we extend the analysis by examining the effect of large and Caribbean tax havens on profits.

— Table 5 about here —

Columns (1) to (3), show that the positive effect of tax havens on profits is mostly driven by the activities of foreign affiliates located in large tax havens and dominated by the activity of U.S. multinationals foreign sales platforms. In Columns (4) and (5), we reproduce the results for the manufacturing and services industries. Focusing on the interaction terms between the havens dummy variables and the foreign sales ratios helps understanding the specific roles that different tax havens have on U.S. multinationals profit shifting strategies. In manufacturing sectors, the coefficient of the interaction term is positive (but not significantly different from 0, probably due to the reduction in sample size) when the activities concern U.S. multinationals' foreign sales platforms located in large tax havens. The interaction terms between the Caribbean havens and the foreign sales ratio is negative (even if not statistically significant). In services sectors, only the coefficient of the interaction variable for Caribbean tax havens is statistically significant (at 99 percent level of significance). These results suggest that large tax havens are specialized in channelling profit shifting through the activities of U.S. multinational platforms in manufacturing sectors while Caribbean havens are relatively more specialized in channelling profit shifting through the activities of U.S. multinational platforms in services sectors. The pattern of specialization is easily understandable in light of the geographic and economic characteristics of each group of countries. Caribbean havens are smaller countries, most often islands with relatively smaller foreign affiliates in terms of employment and productive assets. The logistic costs may also be higher in Caribbean havens explaining their specialization in services activities.

Robustness tests In our supplementary materials, we proceed to several robustness tests. We show that our results are robust to several tests : replacing the tax haven variable by a placebo, using a dummy for foreign sales platforms instead of a continuous variable, using an alternative standard error clustering strategy, using a linear estimator instead of GLM, including all sectors, using country fixed effects in the profit equation, using an alternative specifications of the profit variable and using an alternative way to compute the foreign-to-total-sales ratio.

Interestingly, our results are robust to a placebo definition of tax havens when the placebo group contains the observations of countries having a statutory tax rate lower than the first

quintile (and not being tax havens). This placebo group of havens does not have a positive impact on the location of foreign sales platforms meaning that our effect is primarily driven by the tax haven status of countries. We do not find any significant effect of the interaction between the placebo group and the foreign sales ratio.

In another robustness table, we create a dummy equals to one if the foreign sales ratio is in the top 10% of the sample. By doing so, we only consider as foreign sales platforms foreign affiliates really involved in foreign sales. The tax haven status is still an important determinant of the location of foreign sales platforms while the effect of the foreign market access totally disappears, both in terms of magnitude and significance. This means that tax havens are situated in the top of the distribution of the foreign sales ratios, confirming our previous results and the strong effect of tax havens on the U.S. MNEs organization.

7 Back-of-the-envelope estimation

In order to determine the global impact of the organization of U.S. firms in tax havens in the worldwide repartition of profits, we proceed to a back-of-the-envelope computation. We use a simple method based on both the deviations of profits in tax havens (controlling for the production function) and the deviation of the foreign sales ratio in these countries. More precisely our estimation is based on Column (3) of table 4. We interpret every deviations of profits in tax havens due to the foreign sales ratio as platform-based profit shifting.

We estimate the following equation:

$$\begin{aligned} ln(\Pi_{ikt}) &= \alpha_1 FMA_{it} + \alpha_2 GS_{ikt} + \alpha_3 \left(GS_{ikt} \times Haven_i\right) + \alpha_4 Haven_i + \alpha_5 Tax_{it} \\ &+ \zeta_1 X_{ikt} + \zeta_2 X_{it} + \mu_{kt} + \xi_{ikt} \end{aligned} \quad (9)$$

and we predict what would have been the profits if the tax havens had not channeled profit shifting through foreign sales platforms (we omit the impact of α_3):

$$\widehat{ln(\Pi_{ikt})} = \widehat{\alpha_1} FMA_{it} + \widehat{\alpha_2} GS_{ikt} + \widehat{\alpha_4} Haven_i + \widehat{\alpha_5} Tax_{it} + \widehat{\zeta_1} X_{ikt} + \widehat{\zeta_2} X_{it} + \widehat{\mu_{kt}} \quad (10)$$

Our estimation of profit shifted per country corresponds to $\Pi_{ikt}^{shifted} = \Pi_{ikt} - \exp(\widehat{ln(\Pi_{ikt})})$. This strategy is close to Clausing (2016), that sets to zero any tax difference between countries based on a profit shifting equation similar to Hines and Rice (1994). Torslov, Wier and Zucman (2018) uses the deviations from the average profits per unit of wage to estimate the profit shifting. Our strategy is more restrictive than theirs for several reasons. First our

tax haven definition is stricter, for instance we do not consider the Netherlands as a tax haven. Besides, we exclude financial affiliates in order to obtain a consistent dataset over years. Finally we only consider profit shifted routed through global sellers while Clausing (2016) and Torslov, Wier and Zucman (2018) have a more general approach that includes all possible channels of profit shifting.

We display results in Figure 6. Profit shifting to tax havens affiliates of U.S. MNEs rose from \$16 bn to \$83 bn between 1999 and 2013. As expected the growth of profit shifting is reduced during crisis episodes. In terms of total profits of U.S. MNEs in the considered sectors and including financial profits, it represents an average share of 25% of all profits over the period and 32% in 2013.

— Figure 6 about here —

8 Conclusion and Discussion

In this paper, we document the impact of tax havens on multinational firm's geographical organisation and trade. We shed lights on the concentration of U.S. worldwide sales revenues in tax havens and highlight the relative specialization of these countries in services or manufacturing activities. Our empirical exercise is rationalized by a simple stylized model of affiliates' location that includes profit shifting incentives. The econometric analysis confirms that the tax environment has a preponderant impact on the location of U.S. foreign sales platforms. The conventional market access has a weaker impact on determining the location of sales platforms when the country haven status and the degree of transparency of the tax environment vis-à-vis the U.S are controlled for. We compute the amount of profit shifted through foreign sales platforms. The back-of-the-envelope calculation estimates to \$83bn the amount of profit shifted through foreign sales platforms in 2013 which constitutes a substantial amount of the total profit shifting of U.S. firms.

Our results support the evidence that a large share of firms profit shifting occurs through foreign sales platforms. This is shown in Table 4 by comparing the coefficient on the tax haven dummy and the coefficient and the interaction variable. One of our contributions is to propose an organizational channel to profit shifting. Our results suggest that firms organize their worldwide activities in order to register sales where it is optimal to do it without taking into account the production location. This result is important both for international trade and public economics. It supports the fact that tax avoidance behavior affects trade patterns and has implications for the design of global value chain at firm-level. The use of contract manufacturing agreements is a mean to disconnect production, sales and exports as well as

the strategic relocation of intangible assets in tax havens (see for instance Dischinger and Riedel, 2011).

This study helps providing new insights for the design of international taxation of profits. As multinational firms concentrate their worldwide sales in low tax jurisdictions, the rules to calculate firm's taxable profits in the European Union proposed by the European Commission might be challenged (these sets of rules are know under the Common Consolidated Corporate Tax Base – CCCTB hereafter –). Under the current proposed rule, the consolidated taxable profits will be shared between the Member States in which the group is active, using an apportionment formula. Each Member State will then tax its share of the profits at its own national tax rate. The proportion of the company's base that a Member State can tax will be decided based on 3 equally weighted factors (capital, employment and sales).[27] Zucman (2014) suggests that because capital and employment could be still allocated to low-tax countries, only sales should be taken into account since it is less subject to manipulation. Our results suggest that multinational firms organize their sales at a worldwide scale via the use of contract manufacturing. These types of contracts allow for instance Apple to locate its worldwide sales in Ireland through the import of services (the service of producing goods).[28] A rule that would only take sales into account would overweight the Apple's Irish affiliate compared to others in the E.U.

[27] The tax bill of firm f in country i would be computed 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 employment and S^f the level of sales of firm f. Subscript W refers to the worldwide value of the variable for firm f.

[28] One can argue that when an Apple product is bought, the transaction happens in the location country of the customer. However a sale is still reported between Ireland and the country of destination.

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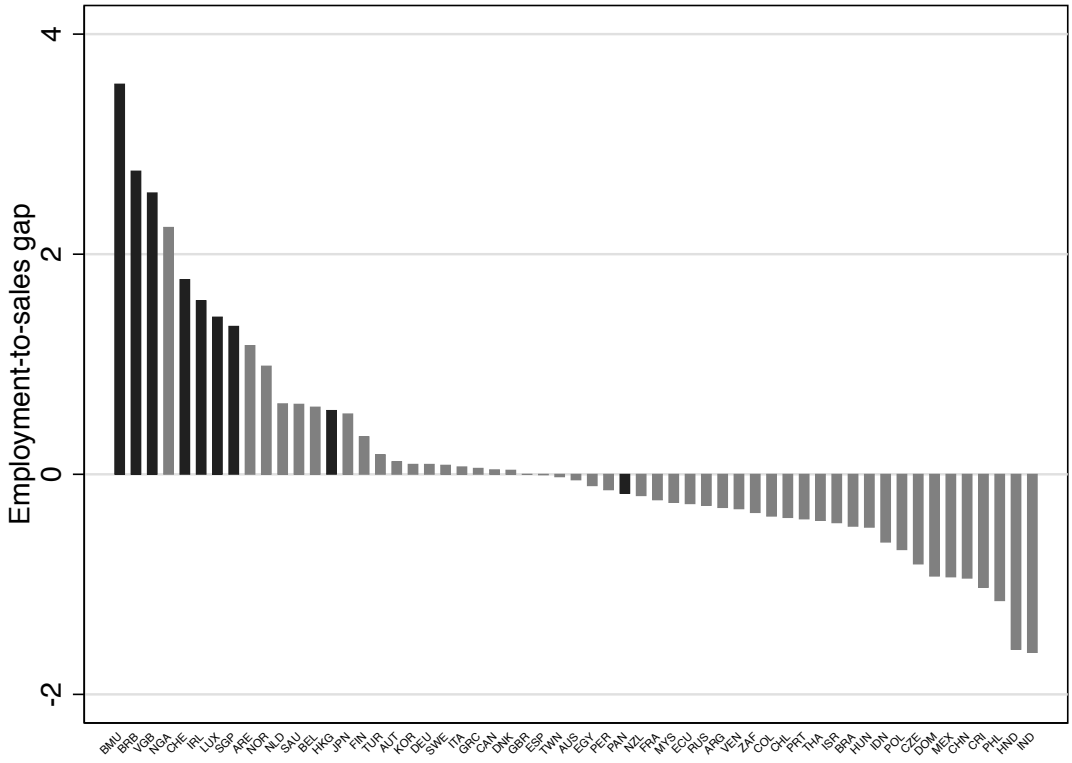
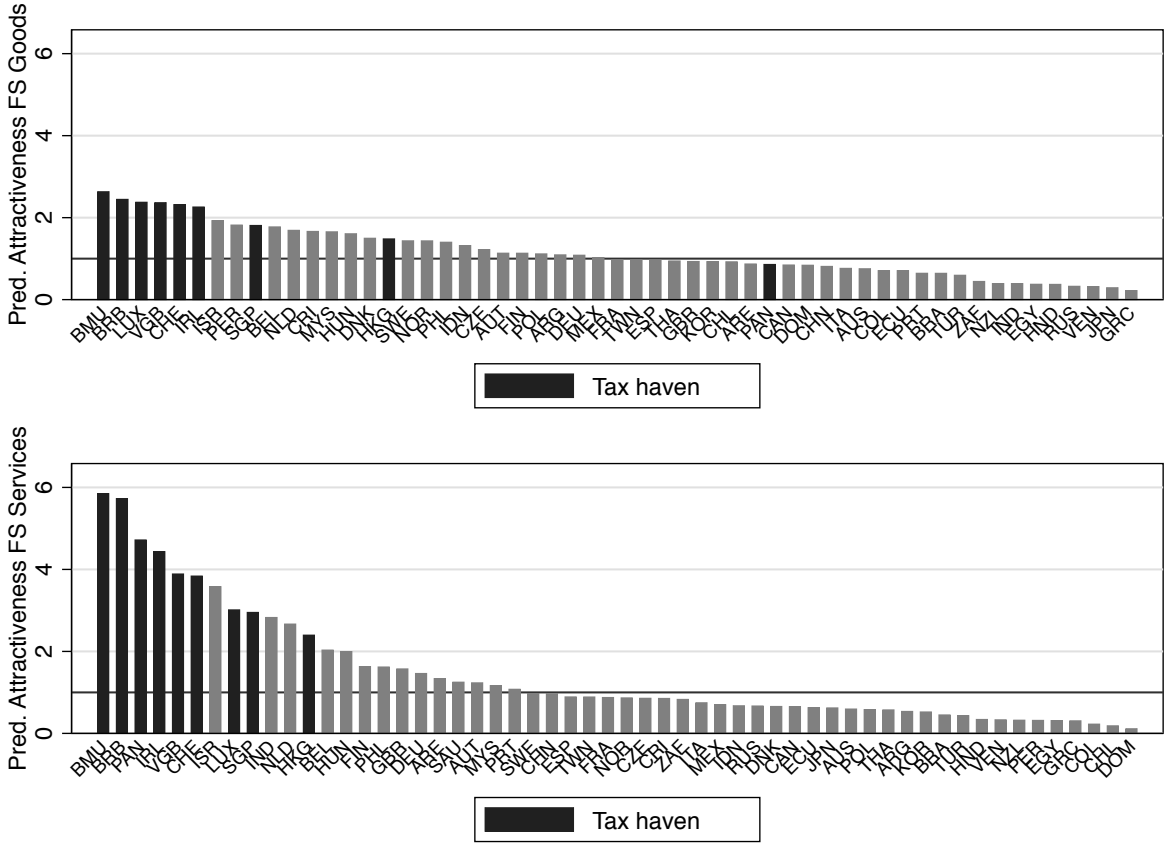
Figures and Tables



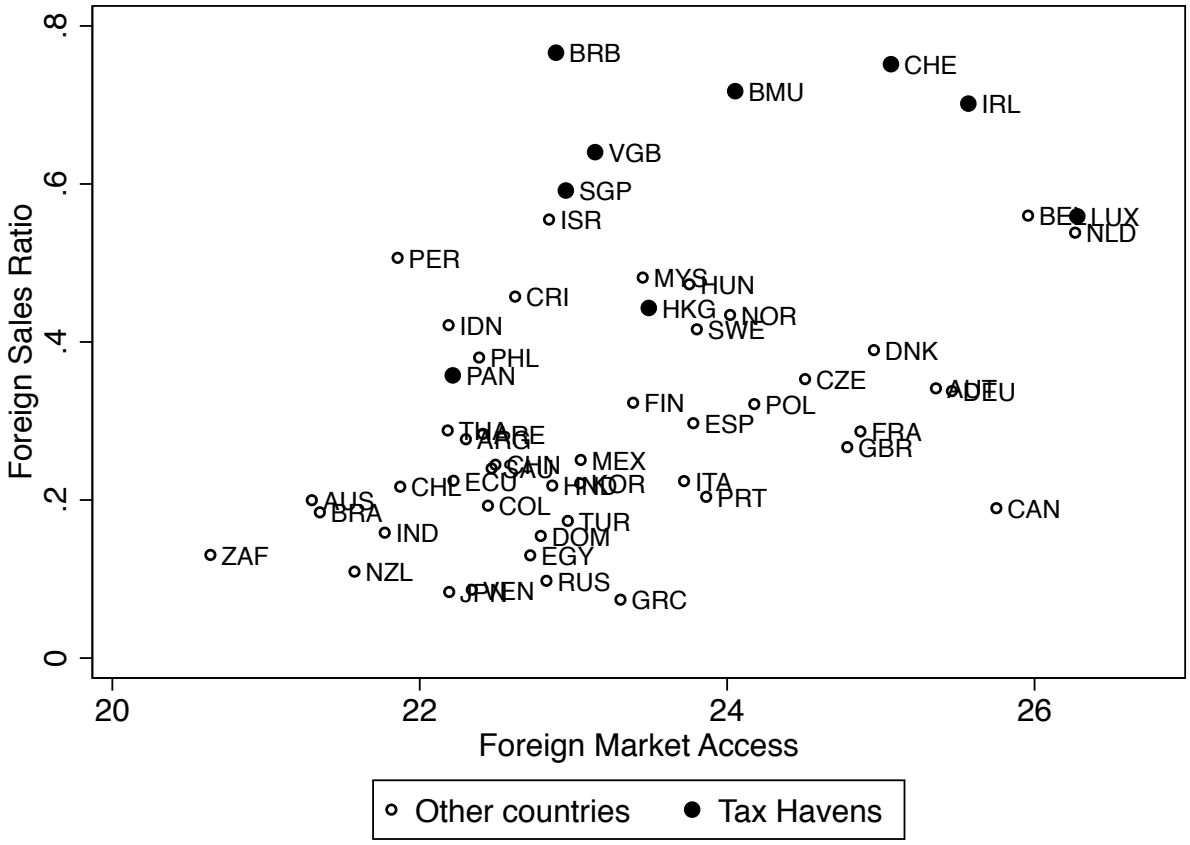
Note: Figure 1 visualizes the worldwide organization of U.S. multinational firms. For each country, it displays the employment-to-sales gap defined as the average log difference between the share of total sales and the share of total employment of U.S. affiliates for the years 1999 to 2013. The Figure shows large discrepancies between both shares after accounting for country-level productivity differences.[29] This suggests that U.S. multinationals register their worldwide sales in low tax jurisdictions (black in the figure) and produce in other countries (on the right-hand side of the figure)

Figure 1 – The geography of the organization of U.S. firms



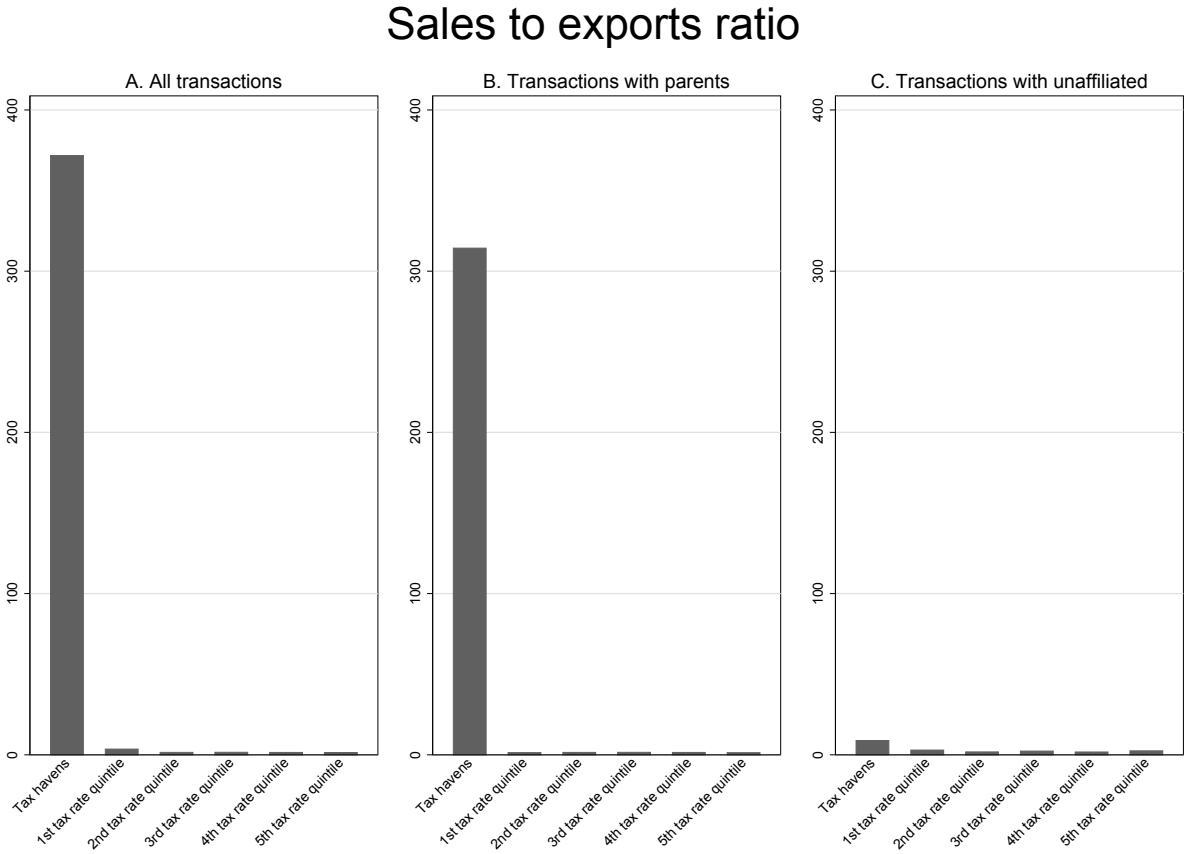
Note: This figure displays the relative attractiveness for foreign sales platforms of each country in our sample. Upper panel displays it for the trade of goods and lower panel, for the trade of services. The black line corresponds to the non-haven average normalized to one. Sectors are pooled. Tax havens are in black.

Figure 2 – U.S. multinational firms' foreign sales platforms across countries.



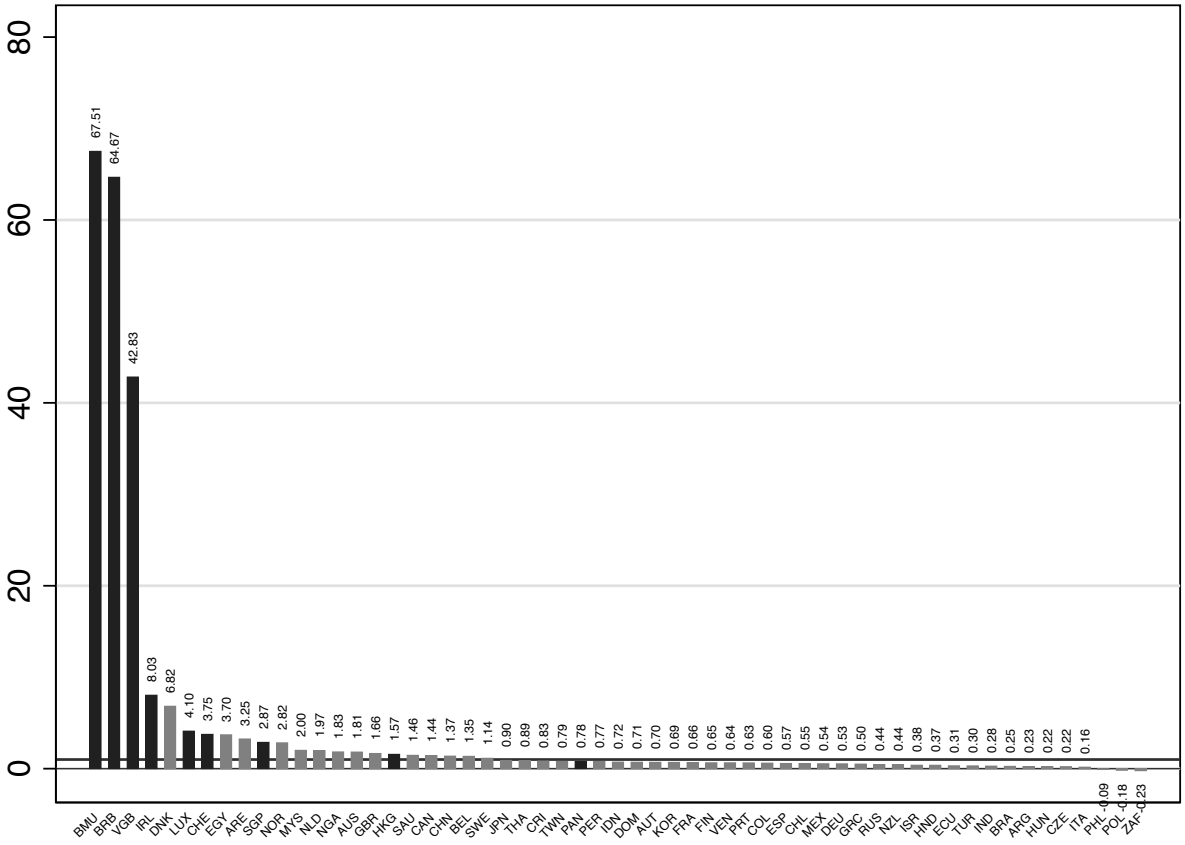
Note: This figure displays the foreign market access and the foreign sales ratio of all countries in the sample. Sectors are pooled. Tax havens are in black.

Figure 3 – U.S. multinationals' Platforms and Foreign Market Access



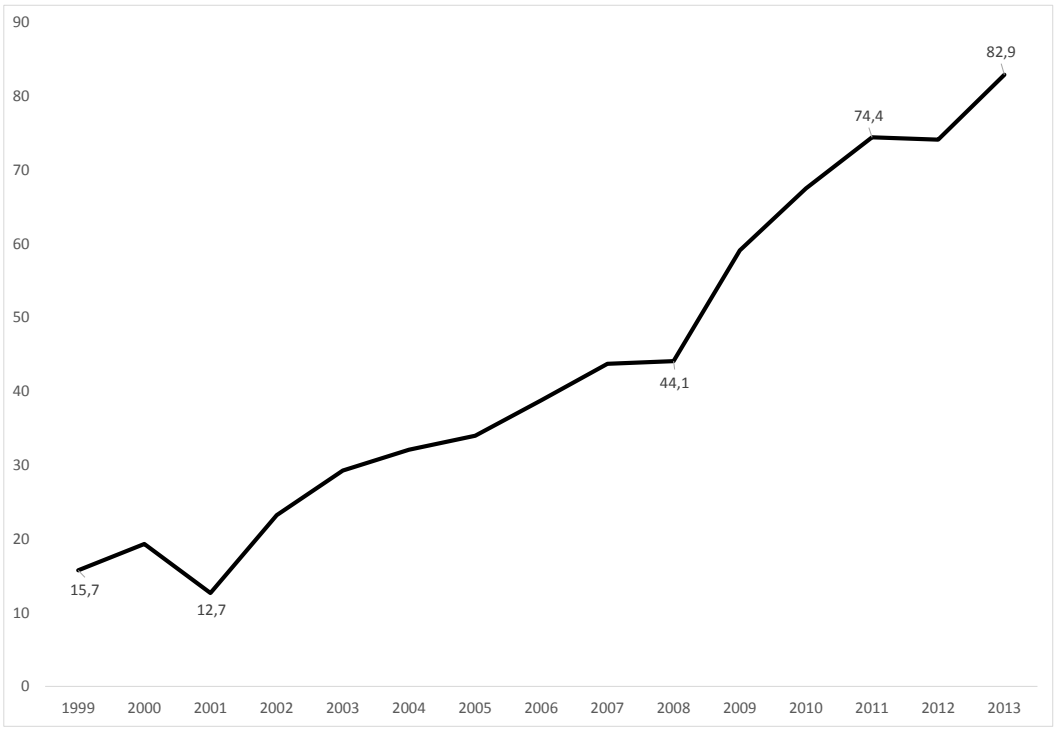
Note: This figure displays the foreign sales to export ratio for transactions with the U.S. On the x-axis, the first bar correspond to tax havens and the other bars corresponds to tax rate quintiles, excluding tax havens. The left panel is for all transactions, the middle panel for relations with the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

Figure 4 – A hint on contract manufacturers.



Note: This figure displays the relative attractiveness of each country in the sample in terms of profits per employee. The black line corresponds to the non-haven average that is standardized to one. Tax haven countries are in black.

Figure 5 – Profits of U.S. foreign affiliates across countries



Note: This figure displays the estimated amount of profit shifted from tax havens to the U.S between 1999 and 2013.

Figure 6 – Evolution of Shifted Profits (1999-2013)

Table 1 – Descriptive Statistics

	Samples (56 countries)			
	Foreign platforms (6,177 obs.)		Profit (4,635 obs.)	
	Mean	Std. Dev.	Mean	Std. Dev.
Foreign Sales ratio	0.244	0.258	0.281	0.26
ln(Foreign Market Acc.)	23.437	1.367	23.48	1.397
Tax rate	0.282	0.084	0.289	0.074
Tax Haven	0.161	0.367	0.134	0.341
ln(GDP)	12.905	1.707	13.191	1.476
ln(1 + Employment)	1.581	1.292	1.814	1.246
ln(1 + Productive Assets)	4.566	2.641	5.152	2.3
Double taxation agreement	0.684	0.465	0.715	0.452
Treaty of information exchange	0.132	0.338	0.089	0.285

Table 2 – The Location of U.S. Foreign Platforms - (GLM – Aggregate Results)

Dep. Variable	Foreign To Total Sales Ratio						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln(Foreign Market Acc.)	0.022***	0.022***	0.020**	0.017*	0.013	0.018*	0.018
	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.012)
Tax rate		-0.347**	-0.338**	-0.194	-0.205	-0.279	-0.072
		(0.168)	(0.165)	(0.163)	(0.153)	(0.203)	(0.168)
Tax Haven				0.083**	0.080***	0.027	0.173***
				(0.033)	(0.030)	(0.045)	(0.029)
Treaty of information exchange			-0.074**	-0.066*	-0.068**	-0.092*	-0.020
			(0.035)	(0.034)	(0.034)	(0.048)	(0.027)
Double taxation agreement			-0.004	0.007	0.006	-0.003	0.030
			(0.023)	(0.020)	(0.020)	(0.023)	(0.027)
ln(GDP)	-0.043***	-0.031***	-0.038***	-0.030***	-0.031***	-0.032**	-0.025***
	(0.008)	(0.009)	(0.011)	(0.011)	(0.011)	(0.015)	(0.009)
ln(1 + Employment)	-0.034*	-0.034*	-0.025	-0.025	-0.025	-0.029	0.025
	(0.018)	(0.018)	(0.020)	(0.018)	(0.018)	(0.020)	(0.018)
ln(1 + Productive Assets)	0.077***	0.076***	0.072***	0.071***	0.071***	0.078***	0.014
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	NLD ∈TH	Manuf.	Services
Observations	6,177	6,177	6,177	6,177	6,177	4,326	1,851
R2	0.439	0.448	0.450	0.460	0.461	0.462	0.487
Corr. Obs/Pred	0.662	0.669	0.671	0.678	0.679	0.680	0.698

Dependent variable, GS_{ikt}, is the foreign to total sales ratio 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. 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, Appliance and Components (8) Transportation Equipment. **Services:** (9) Wholesale trade, (10) Information, (11) Professional, Scientific and technical Services. Standard errors are in parentheses. ***, **, * significantly different from 0 at 1%, 5%, and 10% levels, respectively.

Table 3 – The Location of U.S. Foreign Platforms: Large and Caribbean Tax Havens - (GLM – Aggregate Results)

Dep. Variable	Foreign To Total Sales Ratio			
	(1)	(2)	(3)	(4)
ln(Foreign Market Acc.)	0.013	0.009	0.012	0.019
	(0.009)	(0.010)	(0.010)	(0.012)
Tax rate	-0.208	-0.192	-0.338	-0.072
	(0.175)	(0.167)	(0.220)	(0.167)
Large havens	0.104***	0.107***	0.060	0.172***
	(0.035)	(0.035)	(0.046)	(0.029)
Caribbean havens	-0.047	0.003	-0.240**	0.176***
	(0.055)	(0.037)	(0.103)	(0.056)
Treaty of information exchange	-0.045	-0.052*	-0.068**	-0.021
	(0.029)	(0.031)	(0.034)	(0.029)
Double taxation agreement	0.014	0.013	0.009	0.030
	(0.021)	(0.021)	(0.023)	(0.028)
ln(GDP)	-0.042***	-0.038***	-0.051***	-0.024**
	(0.012)	(0.010)	(0.014)	(0.011)
ln(1 + Employment)	-0.016	-0.018	-0.009	0.025
	(0.018)	(0.017)	(0.018)	(0.018)
ln(1 + Productive Assets)	0.068***	0.068***	0.071***	0.014
	(0.009)	(0.009)	(0.009)	(0.009)
Sector x Year FE	Yes	Yes	Yes	Yes
Sample	Full	NLD ∈largeTH	Manuf.	Services
Observations	6,177	6,177	4,326	1,851
R2	0.474	0.472	0.497	0.487
Corr. Obs/Pred	0.688	0.687	0.705	0.698

Dependent variable, GS_{ikt}, is the foreign to total sales ratio 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. 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, Appliance and Components (8) Transportation Equipment. **Services:** (9) Wholesale trade, (10) Information, (11) Professional, Scientific and technical Services. **Large havens:** Hong Kong, Ireland, Luxembourg, Singapore and Switzerland. **Caribbean havens:** Barbados, Bermuda, Panama, British Virgin Islands. Standard errors are in parentheses. ***, **, * significantly different from 0 at 1%, 5%, and 10% levels, respectively.

Table 4 – U.S. Foreign Affiliates' Profits - (OLS – Aggregate And Sectoral Results)

Dep. Variable	Profits before income taxes (Logarithm)				
	(1)	(2)	(3)	(4)	(5)
ln(Foreign Market Acc.)	0.077**	0.062	0.068*	0.050	0.133**
	(0.037)	(0.040)	(0.039)	(0.043)	(0.050)
Tax rate	-0.177	-0.010	0.272	1.089	-1.528
	(1.001)	(0.962)	(0.906)	(1.087)	(1.361)
Tax Haven	0.878***	0.796***	0.262	0.545	-0.218
	(0.215)	(0.212)	(0.256)	(0.371)	(0.264)
Foreign Sales Ratio		0.608***	0.282	0.065	0.629*
		(0.196)	(0.177)	(0.201)	(0.325)
Foreign sales ratio × haven			1.284***	0.707	2.200***
			(0.371)	(0.516)	(0.741)
Treaty of information exchange	0.011	0.038	0.002	0.141	-0.179
	(0.162)	(0.165)	(0.159)	(0.170)	(0.250)
Double taxation agreement	0.053	0.050	0.044	-0.011	0.110
	(0.109)	(0.108)	(0.110)	(0.125)	(0.162)
ln(GDP)	0.129**	0.159***	0.133**	0.125**	0.132
	(0.057)	(0.060)	(0.056)	(0.055)	(0.102)
ln(1 + Employment)	0.106	0.098	0.138*	-0.063	0.590***
	(0.072)	(0.075)	(0.074)	(0.086)	(0.130)
ln(1 + Productive Assets)	0.780***	0.750***	0.739***	0.865***	0.416***
	(0.044)	(0.043)	(0.043)	(0.049)	(0.074)
Sector x Year FE	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Manuf.	Services
Observations	4,635	4,635	4,635	3,178	1,457
Adj. R2	0.754	0.757	0.759	0.771	0.751
Number of countries	56	56	56	56	56

Dependent variable in columns (1-3), Π_{ikt}, is the logarithm of the profit before income taxes in sector k of country i in year t. Panel data at yearly frequencies. **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. Standard errors clustered at the country level are in parentheses. ***, **, * significantly different from 0 at 1%, 5%, and 10% levels, respectively.

Table 5 – U.S. Foreign Affiliates' Profits: Large and Caribbean Tax Havens - (OLS – Aggregate And Sectoral Results)

Dep Var.	ln(Profits)				
	(1)	(2)	(3)	(4)	(5)
ln(Foreign Market Acc.)	0.069*	0.056	0.066*	0.039	0.151***
	(0.034)	(0.037)	(0.037)	(0.041)	(0.047)
Tax rate	-0.052	0.091	0.283	1.201	-1.604
	(0.989)	(0.948)	(0.922)	(1.039)	(1.353)
Large havens	0.970***	0.877***	0.239	0.555	-0.220
	(0.199)	(0.204)	(0.439)	(0.590)	(0.516)
Caribbean havens	0.566	0.533	0.226	0.229	0.045
	(0.452)	(0.452)	(0.347)	(0.407)	(0.368)
Foreign sales ratio		0.589***	0.291	0.096	0.578*
		(0.206)	(0.175)	(0.195)	(0.321)
Foreign sale ratio × Large havens			1.372**	0.956	1.908
			(0.601)	(0.769)	(1.249)
Foreign sale ratio × Caribbean havens			1.062	-0.818	2.754***
			(0.680)	(0.557)	(0.583)
Treaty of information exchange	0.042	0.063	0.017	0.211	-0.248
	(0.173)	(0.175)	(0.169)	(0.145)	(0.230)
Double taxation agreement	0.074	0.068	0.051	0.014	0.060
	(0.112)	(0.111)	(0.113)	(0.123)	(0.147)
ln(GDP)	0.107*	0.139**	0.126**	0.090	0.177*
	(0.058)	(0.062)	(0.058)	(0.063)	(0.093)
ln(1 + Employment)	0.123	0.113	0.141*	-0.027	0.570***
	(0.075)	(0.078)	(0.076)	(0.090)	(0.128)
ln(1 + Productive Assets)	0.773***	0.745***	0.737***	0.847***	0.423***
	(0.045)	(0.044)	(0.044)	(0.048)	(0.076)
Sector x Year FE	Yes	Yes	Yes	Yes	Yes
Sample	Whole	Whole	Whole	Manuf.	Services
Observations	4,635	4,635	4,635	3,178	1,457
Adj. R2	0.755	0.757	0.759	0.774	0.753
Number of countries	56	56	56	56	56

Dependent variable, $ln(Profits)_{ikt}$, is the profit-type profit in sector k of country i in year t. Panel data at yearly frequencies. Robust standard errors adjusted for clustering by country. **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. textbfLarge havens: Hong Kong, Ireland, Luxembourg, Singapore and Switzerland. **Caribbean havens:** Barbados, Bermuda, Panama, British Virgin Islands. Standard errors clustered at the country level are in parentheses. ***, **, * significantly different from 0 at 1%, 5%, and 10% levels, respectively.

A Data Description

Sectors: *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.

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

British Islands, Caribbean includes British Virgin Islands, Cayman Islands, Montserrat and Turks and Caicos Islands.

B Empirical Justification of Tax Havens

There does not exist a commonly accepted definition of tax havens. 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 null level of taxes, reinforced bank secrecy, extended professional secrecy, easy and fast registration procedure for firms, total free movement of capital, political and economic stability, 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 individuals and firms which utilize it. It is important to note that tax havens are not only low-tax countries or non-transparent countries.

The OECD (OECD, 2000) also draws some features of a tax haven. It is a country with no or only nominal taxes, a lack of effective exchange of information[30] and no substantial activities (meaning that investment and transactions are mainly driven by tax incentives). In the OECD's list, Ireland, Luxembourg, Honk-Kong and Singapore are not considered as tax havens.

In the academic literature, the definition of Hines and Rice (1994) based on the one of the U.S Internal Revenue Service (IRS) is close to the OECD's definition: low tax rate, business and banking secrecy, good communication network and self-promotion as tax haven. In this paper we use the list of Dharmapala and Hines (2009) that fills in the discrepancies of the OECD's list by adding countries considered as 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 in our list are listed in many different tax havens classifications. Based on the counting proposed by Chavagneux, Palan and Murphy (2010), our tax havens are included in at least 8 other lists (among eleven): Bermuda (11), Panama (11), Barbados (10), British Virgin Islands (10), Hong-Kong (9), Singapore (9), Switzerland (9), Ireland (8), Luxembourg (8).

We can also motivate empirically this list by simply looking at taxes bills of US affiliates in foreign countries. As noted by Kleinbard (2011), the ability to generate stateless income will affect the US tax bill as well as the local tax bill. This explains why Google only paid a 2.9% tax rate on its 2009 profits which is well above the average statutory tax rate it should have paid. In figure 7 we plot the effective tax rate paid by US MNEs in tax havens and

[30] A literature is developing in order to show that tax agreements are not really effective in hindering harmful tax practices, see Bilicka and Fuest (2014) or Johannesen and Zucman (2014).

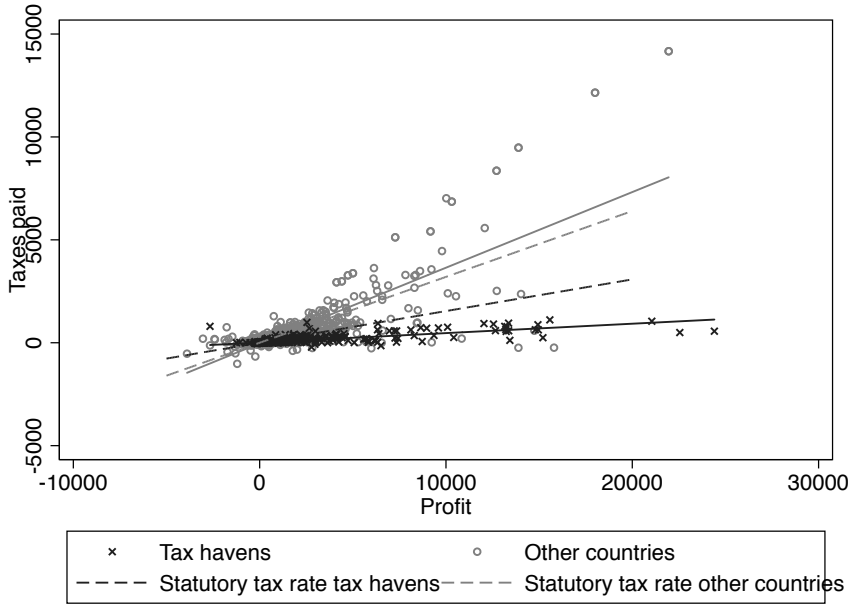


Figure 7 – Statutory and effective tax rate.

non-tax-havens and we compare it to the (weighted) statutory tax rate. Concerning non-tax-haven countries, the average effective tax rate is almost equal to the weighted statutory tax rate. We observe, however, a large dispersion around this average. For tax havens, the effective foreign tax rate line is almost flat and lower than the statutory line by a large amount, suggesting specific legislative dispositions that enable firms to lower their tax bill. The dispersion of points is less important and more concentrated around the effective tax rate line.

C Descriptive statistics

Figure 6 shows further descriptive statistics. We present basic indicators of economic activity and compare them for tax havens and for other countries. The direct investment position of the U.S. in 2013 is, as expected, larger in other countries than in tax havens. However, when we scale these figures by the number of countries in each group we find that the average country-level direct investment position is a bit larger in tax havens capacities. The average foreign direct investment position per 1000 employees is almost 8 times larger in tax havens than in other countries. This reveals that the investment in tax havens is potentially determined by other variables than the production capabilities only. This fact is mainly due to comparable level of direct investment position in tax havens and in other countries ($23504 million against $18559 million) for a largely more important number of employees in non-haven countries.

We do a similar exercise for the level of sales and (non-financial) profits. Tax havens display a larger average sales by country compared to other countries. The difference between these two groups of countries is more striking when we compare the level of sales to the level of employment. The average amount of sales for 1000 employees in tax havens is $5241 millions while it is only $454 millions in other countries (it corresponds to a factor of 11.5).

The observations are similar for (non-financial) profits where the profits generated by 1000 employees are 14.4 times larger in tax havens than in other countries. It is worth noting that all these statistics are computed on the regression sample that exclude financial affiliates.

Table 6 – Descriptive Statistics (56 countries)

	Tax Haven	Other countries
Direct Investment position (2013) :		
Total DI position	211534	890817
Average yearly DI position	23504	18559
Average DI per 1000 employees	1383	177
Employment:		
Average Employment	28	107
Sales (in million):		
Average yearly sales	67494	45157
Average sales per 1000 employees	5241	454
Profits (in million):		
Average yearly profit	5781	3072
Profits per 1000 employees	661	46

Figures are given at the country level. All years and sectors in the sample are pooled except for the direct investment position that is given only in 2013. Profits corresponds to the pre-tax profits excluding financial items.

D Apple Tax Avoidance Strategy in Ireland

The case of Apple may help to fix the ideas about an actual foreign sale platform. Based on the declarations of Apple's official to the Permanent Subcommittee on Investigation of the U.S. Senate, we are able to describe how Apple Inc. organizes its activities to register 64% of its profits in Ireland despite having there only 3% of its employees and 1% of its consumers (in 2011). According to Apple's officials declarations this scheme allowed the firm to avoid $12.5bn of taxes in 2011 and 2012.

In figure 8, we present a simplified version of the structure used by Apple in Ireland. Apple Operations International (AOI) is owned (100%) by Apple Incorporation 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 a loophole in the Irish and U.S. tax laws that consists in a different definition of the tax residency.[31] Because of the differences between definitions, AOI is a *stateless* entity (Kleinbard, 2011). AOI owns Apple Operations Europe (AOE) that owns Apple Sales International (ASI). While the two first entities are holding companies, ASI will be the affiliate that play the role of the sale platform. Similarly to AOI, it has no tax residency. ASI and AOE are part of a cost-sharing agreement with Apple Inc. According to the Senate report, Apple mainly applies two strategies in order to shift its profits to Ireland. The first one consists in setting a 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 localize a large share of Apple intangible assets in Ireland. The report of the Senate insists on the fact that this agreement is not economically justified and that it is only justified by aggressive tax optimization rationales. Most importantly, ASI will play its role of foreign sales platform by concentrating the worldwide sales of the whole group.

The distribution structure chosen by Apple is at the hearth of its profit shifting strategy. ASI, the foreign sale platform, will engage in contract manufacturing. Concretely it will contract with a manufacturing affiliate located in China in order to outsource the service of producing. The goods are produced by the manufacturing affiliate but are always owned by ASI. In terms of trade statistics such transactions should be registered as an import of service by ASI. When a customer buys an Apple product in a retail store or on the Internet, the product is directly sent from China to the customer place. Despite being owned by ASI in Ireland the goods generally never cross the Irish border. However, the financial transaction happens between the owner of the good and the final customer. In this case,

[31] Irish tax residency principle is based on the place where the management and control is realized. In the case of ASI this corresponds to the U.S. On the contrary, the U.S. residency principle is based on the place of formation, that is Ireland.

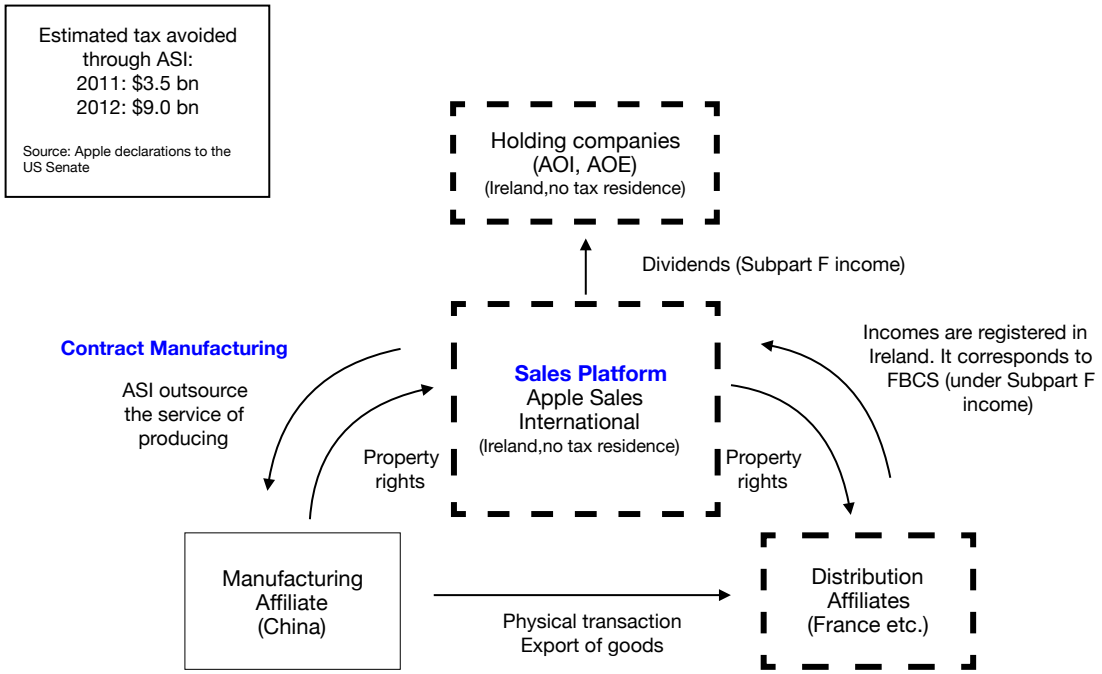


Figure 8 – Apple simplified structure in Ireland

the financial transaction will occur between the retail store and Ireland. One may note a discrepancy between the physical transaction and the financial transaction. Usually, it is almost impossible to identify both types of transactions. However BEA data allows us to do so for some specific transactions. In terms of trade statistics, the Customs will register an export of goods from China to the retail store's country while the balance of payments should register an export from Ireland to the retail store country.[32] Finally the revenues from the sales are sent through dividends to upper-tier subsidiaries AOE and AOI.

To avoid the transfer of incomes to tax havens, the U.S. enacted a law (called the Subpart F regulation) in 1962 in order to always tax transactions of passive income (income that results from a passive activity e.g. dividends, interest, royalties, etc.). The principle of the law is that the worldwide principle of taxation may encourage to relocate incomes in tax havens and to defer the repatriation of this income in order to pay no taxes. This type of income is commonly used in firm's tax avoidance strategies. Under the Subpart F regulation, the transactions between the retail affiliate and ASI and the transactions between ASI and the upper-tier affiliates should have been taxed. In the first case, it corresponds to Foreign Base Company Sales (FBCS, sales of products that have been produced by an affiliate in an other country) and in the second case it corresponds to Foreign Personal Holding Company

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

income (FPHC, that includes dividends, interest, rents and royalties).

Nevertheless, the check-the-box regulations enacted in 1997 are used to circumvent the Subpart F regulations. These regulations allows Apple to make the lower-tier affiliates (AOE, ASI and the distribution and retail affiliates) disregarded by the IRS only for tax purposes. According to the IRS the three entities with the doted frame are considered as a single one. Because the IRS does not look at what happens within a firm, it cannot tax the transactions of passive income.

Overall, ASI plays the role of the foreign sales platform since it concentrates and manage the worldwide sales of Apple.

E Optimal profit shifting computation

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

$$\rho_i - \frac{T_i}{1-T_i}\frac{\rho_i}{a^{1/\gamma_i}} - \frac{T_i^2}{(1-T_i)^2}\frac{\rho_i}{2a^{1/\gamma_i}} \geq 0 \tag{11}$$

$$\Leftrightarrow \quad T_i \leq 1 - \sqrt{\frac{1}{2a^{1/\gamma_i}+1}} \tag{12}$$

F Proof of Proposition 1

Without loss of generality, we assume $M_j^{nth} = \eta M_i^{th}$ to show that the elasticity of profit with respect to market access in the tax haven country is smaller than unity. Given equation 6, the elasticity can be written as:

$$\frac{\partial \Pi_i^{th}}{\partial M_i^{th}}\frac{M_i^{th}}{\Pi_i^{th}} = \frac{1}{\eta \sum_j \frac{1}{a^{1/\gamma_j}}\frac{c_j^{1-\sigma}}{\sigma} t_j} < 1$$

In non-tax-haven countries, we use equation 7 to show that:

$$\frac{\partial \Pi_i^{nth}}{\partial M_i^{nth}} \frac{M_i^{nth}}{\Pi_i^{nth}} = 1$$

The average (pooled) elasticity of profit with respect to market access can be written as:

$$\frac{\partial \Pi_i}{\partial M_i} \frac{M_i}{\Pi_i} = \omega_{th} \frac{\partial \Pi_i^{th}}{\partial M_i^{th}} \frac{M_i^{th}}{\Pi_i^{th}} + \omega_{nth} \frac{\partial \Pi_i^{nth}}{\partial M_i^{nth}} \frac{M_i^{nth}}{\Pi_i^{nth}} < 1$$

where $\omega_i,\ i = th, nth$ are the weights associated to the type of countries and $\sum_i \omega_i = 1$.