Territoriality, Worldwide Principle, and Competitiveness of Multinationals: A Firm-level Analysis of Tax Burdens

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Abstract

Using consolidated firm-level accounting data for about 3,400 companies in 15 OECD countries from ORBIS (2003–2007), this paper compares the tax burden of companies headquartered in worldwide countries with that of companies headquartered in territorial countries. The tax burden is measured by a marginal effective tax rate (METR) and, employing a new methodology, by a marginal effective tax base (METB) which controls for statutory corporate tax rates. A higher METR for entities headquartered in worldwide jurisdictions is explained by higher corporate statutory tax rates rather than by the difference in the taxation of foreign profits. The METB of companies headquartered in worldwide countries is not statistically different from that of companies headquartered in territorial countries. Using corporate presence in tax havens, the paper also investigates the vulnerability of territorial jurisdictions to tax avoidance. The results show that offshore low-tax operations reduce the METR and the METB of multinationals more in territorial systems than in worldwide systems.

Keywords: Corporation Income Tax; Multinationals; Territoriality; Worldwide Principle; Profit Shifting; Tax Avoidance; Tax Havens

JEL codes: F23; H25; H32

1 Introduction

Since Japan and the United Kingdom adopted a territorial system in 2009, the United States remains the only major country with a worldwide taxation system for corporate income. Under a territorial system which exempts foreign profits, companies have an incentive to maximise overall group profit by locating their real activities, and by shifting some of their earnings, into low-tax jurisdictions. Under a worldwide system of taxation, this incentive is smaller as foreign profits are taxed at the same rate as domestic profits when and if they are repatriated. This could imply a higher tax burden for companies headquartered in worldwide countries. In US academic and policy circles, the advantages and disadvantages of a worldwide system (versus a territorial one) are at the centre of a lively debate on fundamental tax reforms of the US tax system (Shaviro [2011]). For example, in September 2011, Avi-Yonah [2011] and Hines [2011] testified before the US Senate Finance committee on tax reform options, respectively suggesting a reduction in the statutory corporate tax rate (together with the abolition of deferral) and the adoption of the territorial system. At the heart of this discussion lies the concern that the current tax system hampers the competitiveness of US multinationals (Dyreng and Lindsey [2009] and Markle and Shackelford [2011]).

Using a firm-level panel for 15 OECD countries, this paper systematically compares the tax burden of corporate groups headquartered in worldwide countries with that of groups headquartered in territorial countries. Tax burdens are measured in two ways. First, the paper estimates a marginal effective tax rate (METR) which measures the increase in group tax liabilities when accounting profits increase by one US dollar. Second, using a new approach, the paper estimates a marginal effective tax base (METB) which measures the increase in the tax base for an additional dollar of accounting profit. The METB is able to isolate the effect of national corporate statutory rates on tax burdens and it allows an assessment of whether a higher tax burden is the result of a high statutory rate or of a large tax base. The distinction is fundamental when comparing the worldwide and the territorial systems. This

paper also investigates whether the territorial system is more vulnerable to tax avoidance through the use of tax havens. It tests whether tax haven operations lower the tax burden more in a corporate group headquartered in a territorial jurisdiction than in a corporation headquartered in a country adopting a worldwide system.

This is the first paper to introduce and estimate the METB which assesses firms effective tax burdens in isolation from statutory corporate tax rates. The use of the METB allows to identify that a higher tax burden in worldwide jurisdictions such as the UK and the US is due to high corporate statutory tax rates and not to the system of taxation of foreign profits. A further original contribution of the paper is that it compares estimated METRs and METBs across different jurisdictions whilst considering and dealing with crucial statistical issues such as endogeneity. Finally, the analysis relies on a new dataset constructed by merging two cross-countries firm-level databases, ORBIS and ZEPHYR, respectively containing financial information and ownership changes. This is the first dataset used for the comparison of tax burdens across jurisdictions which both spans cross-country and also contains a time-varying indicator of corporate groups' presence in tax havens. The structure of the dataset permits the comparison of the effect of tax haven operations across different home countries whilst controlling for endogeneity.

The results show that corporate groups whose ultimate owner is resident in jurisdictions applying the worldwide principle are characterized by a higher METR. In particular, companies headquartered in the United States display the highest METR (between 33.7 and 36.7 per cent) and companies headquartered in the United Kingdom[1] the second highest METR (between 28.6 and 29.8 per cent). On average corporate groups headquartered in territorial jurisdictions feature a much lower METR of between 16.5 and 21.9 per cent. However, when controlling for the statutory national corporate tax rates, and therefore comparing METBs,

[1]UK data in the sample used here precede the reform by which the UK has adopted the territoriality principle in 2009.

the difference between worldwide and territorial jurisdictions is not statistically significant. Depending on the specification, an additional dollar of accounting profit increases the tax base by between 80 and 84 cents. This holds for all firms, irrespective of where they are resident. This indicates that a higher burden is mainly the consequence of high statutory rates in the home country, rather than the consequence of the difference in how foreign profits are taxed.

The analysis produces further evidence consistent with tax haven subsidiaries lowering the tax burden (measured by both the METR and the METB) more in territorial jurisdictions. With low-tax operations, international companies resident in territorial countries are able to reduce their METR and their METB more than corporate groups resident in worldwide countries.

The study is organised as follows. Section 2 describes the literature. Section 3 presents the data used in the empirical section. Section 4 develops the empirical model and discusses various econometric issues. Section 5 presents the results. Section 6 concludes.

2 Literature

Despite a lively debate in the policy arena, there is very little empirical evidence on the difference in tax burdens between groups headquartered in worldwide countries and groups headquartered in territorial countries. Only two contributions relate directly to the work presented here: Dyreng and Lindsey [2009], who examine US-headquartered multinationals, and Markle and Shackelford [2011], who investigate firms headquartered in different countries.[2]

[2]A much wider literature investigates firm-level tax payments and corporate avoidance activities. Such literature mainly concentrates on profit-shifting to low-tax jurisdictions through manipulation of transfer-prices and (or) debt financing. For contributions that report findings of direct evidence of transfer-pricing activities among US multinationals, see Swenson [2001]; Clausing [2003]; Bernard et al. [2006]. Altshuler and Grubert [2002] and Desai et al. [2004], among others, find direct evidence of debt shifting with US data. Huizinga et al. [2008] report evidence of debt shifting using European data from AMADEUS. Maffini and Mokkas [2011] find evidence of transfer-pricing activities using a similar dataset. Several researchers find

Dyreng and Lindsey [2009] estimate the worldwide, federal, and foreign METR on the corresponding worldwide, domestic, and foreign incomes of US-headquartered multinationals. They use a panel of consolidated US accounting data from Compustat for the period 1995 to 2007. The time-varying presence of a corporate group in low-tax jurisdictions is derived from Exhibit 21 of form 10-K submitted to the US Security and Exchange Commission. Using an OLS estimator, the authors find that the worldwide METR (inclusive of US state taxes) for US multinationals is about 36 per cent. Despite using different data (Compustat versus ORBIS), different time periods, and different estimators (OLS versus a Generalised Method of Moments), the estimated worldwide METR in Dyreng and Lindsey [2009] is very close to the findings in this paper for US multinationals (without tax haven operations). Both papers employ consolidated accounting data and estimate the METR.

Dyreng and Lindsey [2009] focus primarily on the effect of tax haven operations. They find that the effect of tax haven operations on the worldwide tax charges of US multinationals is small: for groups with at least one subsidiary in a low-tax jurisdiction, the METR is one and a half percentage points lower than the METR of other MNCs.

Markle and Shackelford [2011] compute average effective tax rates (AETRs) between 1988 and 2007 for companies headquartered in 85 countries. They employ consolidated accounting data from OSIRIS[3] which contains ownership information, including the location of the headquarters and the presence of tax haven subsidiaries. Given the time-invariant nature of the ownership information, the research employs a pooled OLS. Markle and Shackelford [2011] calculate the AETR as the ratio of book total tax expenses divided by net income before taxes (NIBT). They employ only companies with positive NIBT and positive tax charges. The selection of only profitable companies can bias the estimations towards finding

direct evidence of debt shifting using the German Bundesbank MiDi dataset (see Mintz and Weichenrieder [2005]; Buettner et al. [2006]; Buettner and Wamser [2009]).

[3]OSIRIS is produced by Bureau van Dijk, as ORBIS. It contains financial information for listed companies, listed banks, and listed insurance companies around the world.

a negative effect of tax haven subsidiaries on tax liabilities as profitable firms have a greater incentive to locate part of their operations in offshore low-tax jurisdictions whilst non profitable firms have a lower incentive to hold tax haven subsidiaries. Regressing the AETR on a set of country dummies identifying the location of the ultimate owner and of its subsidiaries, Markle and Shackelford [2011] investigate whether companies headquartered in worldwide countries have a higher AETR than companies headquartered in territorial countries. They find a counterintuitive result: on average, firms resident in a worldwide jurisdiction face a lower AETR (-1.4 per cent). The authors also find that on average the AETR of corporate groups with tax haven affiliates is 0.5 percentage points lower than the AETR of the ultimate owners without low-tax offshore operations.[4]

The presence in tax havens could be proxying some other characteristics such as the observable size and profitability of the company or the unobserved ability of the tax department to reduce the fiscal burden of the group effectively. If the observed and unobserved characteristics of the firm are not controlled for, one would attribute a lower tax bill to the presence in tax havens when in fact, the ability of the tax department determines both the tax bill and the decision to locate some operations offshore. Also, the presence in tax havens could be determined at the same time as the tax burden. In this context one has to control for the heterogeneity of observable characteristics such as profitability, intangibles intensity, and size and for unobservable characteristics such as the aggressiveness of the tax department. To this aim, this paper employs a time-varying ownership structure together with a difference generalised method of moments (GMM-diff). This controls for the unobservable group-level fixed effects and for unobservable shocks which affect both the dependent and the independent variables.

As in Markle and Shackelford [2011], this paper finds that the domicile is very important in

[4]The only exception is Japan.

determining the tax burden of a company. In particular, US companies display a very high tax burden in both studies and very close to the estimates in Dyreng and Lindsey [2009]. The analysis presented here qualifies and extends these results finding that a high burden is likely to be the consequence of a high statutory tax rate and not of the system of taxation of profits (worldwide versus territorial).

The results imply also that in worldwide systems, lower tax rates on foreign income are compensated by higher national tax rates on the same foreign income. This is consistent with Dyreng and Lindsey [2009] who find that for US multinationals, locating material operations in certain low-tax jurisdictions is associated with both low foreign tax rates on foreign income and high federal tax rates on foreign income.

The paper introduces a new method which could shed some light on a number of findings of the previous literature. In particular, the findings on the METB might explain the counter-intuitive result in Markle and Shackelford [2011]: AETRs and METRs are not sufficient tools for the comparison of the tax burden in worldwide and territorial systems, as they depend on statutory rates. If countries with a low statutory tax rate and a worldwide taxation system are overrepresented (for example, Ireland), the AETRs and the METRs could be driven by low statutory tax rates.

3 Data

The tax burdens and effects of tax haven operations on group tax payments are investigated using ORBIS, a database recording balance sheet and profit and loss (P&L) account items for companies all over the world. The dataset is created by Bureau van Dijk and is based on the mandatory information from filed and publicly available accounts. The online version of

ORBIS used here[5] includes only large and very large companies.[6] The unit of observation is a group of companies filing consolidated accounts together, under the name of a parent company, called the global ultimate owner (GUO).[7]

This paper employs consolidated accounts and therefore it identifies the determinants of the tax liabilities of the group instead of the single affiliate.[8]

The sample consists of 3,389 industrial corporate groups up to five years (2003–2007) for a total of 12,876 observations distributed across 15 OECD countries (tables 1 and 2). GUOs are classified as multinationals (MNCs) if they own foreign subsidiaries (with more than 50 per cent of their capital). The rest of the companies are classified as domestic. For descriptive purposes, multinationals are then classified further into two groups: those with at least one subsidiary in tax havens (TH) and those without any operations in offshore centres. There are large differences in the number of companies reported for each country (see Table 1). Differences are due to different reporting requirements and different industrial structures. For example, France, the United Kingdom, and the United States have large multinationals, whilst countries such as Spain are characterised by smaller and less international groups. US and UK global ultimate owners represent about 55 per cent and 19 per cent of the sample respectively, together forming a total of almost 75 per cent. More than half of the remaining quarter are German, French, and Swedish groups. The distribution of the observations across years is shown in Table 2.

All countries in the sample exempt foreign profits except Ireland, the United Kingdom, and the United States. The United Kingdom adopted a territorial system in 2009 and the new

[5]The version of ORBIS used in this paper was accessed on 16 October 2008.

[6]Bureau van Dijk defines large and very large companies as those having operating revenue greater than 13 million $US (10 million EUR) or total assets greater than 26 million $US (20 million EUR) or a number of employees greater then 150 headcounts.

[7]For more details on the sample construction, see Appendix A.

[8]For more details on why consolidated accounts are used, see Appendix B.

rules apply from the fiscal year 2009–2010 (not included in the sample used here). The statutory corporate tax rates which include local taxes as well are reported in Table 3.

Following Desai et al. [2006], we define tax havens as countries with both a low or zero corporate income tax rate and a very business oriented legislation which often features bank secrecy. In this way, 38 countries are classified as tax havens and divided between large and small low-tax jurisdictions (see Table 4). Among others, the former group includes two OECD countries (Ireland and Switzerland) and two Asian tigers (Hong Kong and Singapore). Small tax havens include differing jurisdictions ranging from Caribbean islands such as the Bahamas and the Cayman Islands to archipelagos in the Indian Ocean such as Mauritius and the Seychelles, through to European small countries such as Liechtenstein, Luxembourg, and Malta.[9] In the sample, the most popular low-tax jurisdictions are large countries such as Switzerland, Singapore, Ireland, and Hong Kong reflecting the wider opportunities of their larger and more developed economies (see Table 5). Ultimate owners of all 15 countries are present in the four large low-tax jurisdictions. More specifically, Switzerland is the most popular low-tax location for Austrian, German, Danish, Finnish, French, Dutch, and Swedish companies. Ireland is the favourite destination of UK companies whilst Singapore is the prevailing choice for US multinationals, followed by Hong Kong and Ireland. For US global ultimate owners, the pattern of tax haven operations is similar to the one in Dyreng and Lindsey [2009] who find that US companies locate their low-tax subsidiaries mainly in Singapore, Hong Kong, Switzerland, Ireland, Barbados, Bermuda, and the Cayman Islands (see Table 5). In the sample used here, among small tax havens, the most popular is Luxembourg. It is the first destination for Belgian GUOs whilst remaining important for Spanish, Greek (second destination), French, and Swiss companies (third destination). Bermuda, the Cayman Islands, the British Virgin Islands, and Barbados are also prominent small tax

[9]Table 4 does not provide an exhaustive list of low-tax jurisdictions. Some tax havens such as the Maldives, the Isle of Man, and the Channel Islands are not included. Table 4 includes only the offshore fiscal centres in which the ultimate owners in the sample own a subsidiary.

havens. Bermuda, the Cayman Islands, and Barbados are strongly dominated by US companies whilst about one fourth of the subsidiaries in the British Virgin Islands are UK-owned.

The identification strategy of some of the regressions in this paper rely on measuring the change in the consolidated tax bill after tax haven operations have been expanded or reduced: groups with more extensive offshore operations are expected to have a lower tax bill. To implement this strategy, the extent of tax haven operations of each group must be identified. This can be done in ORBIS as it provides information on the country of residence of the immediate subsidiaries of the ultimate owner filing the consolidated accounts.[10] Unfortunately, ORBIS contains only time-invariant information on the ownership structure.[11] To create a time-varying variable recording the number of subsidiaries in offshore low-tax centres, the dataset is merged with ZEPHYR. To my knowledge, this is the first publicly available cross-country dataset with time-varying ownership of low-tax off-shore jurisdictions. This specific structure of the dataset allows to compare tax burdens across countries whilst controlling for econometric biases due to endogeneity, as explained in more details in Section 4.1 and in Appendix A and C.

Descriptive statistics for the entire sample, the sample of companies headquartered in territorial jurisdictions, and the sample of companies resident in worldwide jurisdictions are shown in Table 6. Companies in the last two groups do not differ substantially in terms of mean tax bill (over total assets), mean profitability (when positive), and mean size (measured by log(employees)). Nonetheless, companies in worldwide jurisdictions report consolidated losses more frequently (27 versus 16 per cent of observations in territorial countries) and when they do so, they report larger losses over total assets (a mean value of -.26 versus -.11 in territorial jurisdictions). Companies in territorial jurisdictions are more likely to have at

[10]The online version of ORBIS contains information on second- and further-level subsidiaries but it is not possible to download it in a format processable with standard econometric softwares.

[11]The information refers to the last available year, mainly 2007.

least one tax haven subsidiary (53 per cent versus 37 per cent). Their mean number of low-tax off-shore subsidiaries is also higher (2.5 versus 1.9) but with a lower standard deviation (5.66 versus 6.28). Companies in worldwide jurisdictions are more intangible intensive, with a mean value of intangibles over total assets of 0.22 (versus 0.15) and a maximum value of 0.97 (versus 0.86).

In the sample, multinationals are evenly split between those with and those without first-level tax haven subsidiaries (see Table 7). Each of the two groups represents about 40 per cent of the total GUOs. Most of the individual countries are characterised by a higher proportion of multinational ultimate owners without offshore first-level subsidiaries, with the exception of Austria, Belgium, France, Germany, the Netherlands, and Switzerland.

Multinationals with operations in tax havens are on average not only the most profitable but also the least likely to run losses (see tables 7 and 8). Additionally, their losses are the smallest on average. These factors explain their higher tax bill (divided by total assets): higher profits lead to higher tax charges, *ceteris paribus*. It is therefore crucial to control for profitability and size when comparing tax burdens across firms. Ultimate owners with subsidiaries in low-tax jurisdictions are also the largest in terms of number of employees and of number of total subsidiaries, including non-tax havens subsidiaries.

4 Empirical Model and Empirical Challenges

The purpose of this paper is twofold. First, it evaluates whether and how the worldwide system of taxation of foreign profits implies a higher fiscal burden compared to the territorial system. Second, it assesses how tax haven operations impact on the tax bill of a corporate group. It tests whether groups headquartered in territorial jurisdictions reduce their tax

bill through tax avoidance to a relatively greater extent than do groups headquartered in worldwide jurisdictions.

To motivate the empirical analysis illustrated later in this paper, the consolidated profit of a corporate group with operations both at home (H) and abroad (F) can be described with a stylised model where a MNC headquartered in country H owns a subsidiary in country F. Assume that at the beginning of the period, total profits of π^A are generated, of which a fraction $(1-d)$ arises at home and a fraction d arises abroad in country F. At the end of the period, profits are repatriated from F to H. No new profits are produced in period 2. It is therefore possible to write:

$$\Pi^* = \pi^A - T \tag{1}$$

where for a corporate group headquartered in a territorial country, $T = T_T$:

$$T_T = \tau^H[\pi^A(1-d)(1-\xi^H)] + \tau^F[\pi^A d(1-\xi^F)] \tag{2}$$

For a corporate group headquartered in a worldwide country, $T = T_W$:

$$\begin{aligned} T_W = \tau^H\pi^A(1-d)(1-\xi^H) + \tau^F\pi^A d(1-\xi^F) + \\ +\tau^H\pi^A d(1-\xi^H) - \tau^F\pi^A d(1-\xi^F) = \\ = \tau^H\pi^A(1-\xi^H) \end{aligned} \tag{3}$$

τ^H is the statutory corporate tax rate in the home country and τ^F is the statutory corporate tax rate in country F. Without loss of generality, I assume that $\tau^H > \tau^F$. ξ^H and ξ^F represent the proportion of accounting profit which does not form part of the taxable profit at home and aborad, respectively.[12]

[12]The main results of the model hold if I assume that only a fraction ψ of foreign profits d is repatriated from F to H. For simplification purposes, here I assume $\psi = 1$.

It is possible to define the marginal effective tax rate (METR) as

$$METR_T = \frac{\partial T_T}{\partial \pi^A} = \tau^H(1-d)(1-\xi^H) + \tau^F d(1-\xi^F) \tag{4}$$

and

$$METR_W = \frac{\partial T_W}{\partial \pi^A} = \tau^H(1-\xi^H) \tag{5}$$

The METR measures the increase in the consolidated tax bill when consolidated accounting profits increase by one dollar. It can be showed that $METR_W > METR_T$ if $\tau^H(1-\xi^H) > \tau^F(1-\xi^F)$.

Three components affect the METR: the statutory rate τ^H, the statutory rate τ^F and the tax base, determined by ξ. To isolate the effect of the statutory tax rates on the tax burden of a firm, I introduce the marginal effective tax base (METB), that is the increase in the tax base for a unitary increase in accounting profit. The METB for a corporate group headquartered in a territorial jurisdiction is

$$METB_T = (1-d)(1-\xi^H) + d(1-\xi^F) \tag{6}$$

whilst for a group headquartered in a worldwide country, the METB is

$$METB_W = (1-\xi^H) \tag{7}$$

It can be showed that $METB_W > METB_T$ if $d(\xi^H - \xi^F) < 0$. In other words, if the deductions on the tax base in H (ξ^H) are smaller than the deductions on the tax base in F (ξ^F), the METB of a group headquartered in a worldwide jurisdiction will be larger than the METB of a group headquartered in a territorial jurisdiction.

Let's also assume that corporate groups are engaged in profit shifting activities (s) towards

a tax haven with a statutory corporate tax rate $\tau^{TH} = 0$.

$$\Pi^* = \pi^A - T - \frac{\gamma_1}{2}s_1^2 - \frac{\gamma_2}{2}s_2^2 - \frac{\gamma_3}{2}s_3^2 \tag{8}$$

For a corporate group headquartered in a territorial country:

$$T_T = \tau^H[\pi^A(1-d)(1-\xi^H - s_1) - s_2K - s_3I] + \tau^F[\pi^A d(1-\xi^F)] \tag{9}$$

For a corporate group headquartered in a worldwide country:

$$T_W = \tau^H[\pi^A(1-\xi^H - s_1) - s_2K - s_3I] \tag{10}$$

K represents consolidated total assets. The amount of profit shifted to the tax haven can either be proportional to accounting profit (s_1) and (or) be associated with other characteristics of the firm such as size K (s_2) or the amount of intangible assets I (s_3). Two corporate groups with the same profitability may be able to shift different amounts of profits around the world. In particular, larger firms may have more opportunities to relocate earnings in one of their many subsidiaries. Intangible assets could also have an important role in profit-shifting activities. For US-owned MNCs, Grubert [2003] argues that half of the difference between their profitability in low-tax and high-tax subsidiaries can be explained by transfer of intellectual property. The terms $\frac{\gamma_1}{2}s_1^2$, $\frac{\gamma_2}{2}s_2^2$, and $\frac{\gamma_3}{2}s_3^2$ represent the cost of profit shifting entailed by the resources needed to set up tax avoidance schemes and by the legal expenses arising if such schemes are contested by the tax authorities or by the minority shareholders. Such costs are assumed not to be tax deductible.

For simplification, suppose the only decision variables are the amounts of profit shifted to the tax haven.[13] The firm maximises its overall profit by choosing to shift optimal amounts

[13]Without loss of generality, I assume that d, the fraction of total profit produced abroad in F does not depend on the firm's decisions but it is taken as given. This assumption should not be problematic in the

of profits s_1^*, s_2^*, and s_3^* such that:

$$s_{T,1}^* = \frac{\tau^H \pi^A (1-d)}{\gamma_1} \quad and \quad s_{W,1}^* = \frac{\tau^H \pi^A}{\gamma_1} \tag{11}$$

where $s_{T,1}^*$ is the optimal amount of shifted profit s_1 for a corporate group headquartered in a territorial jurisdiction and $s_{W,1}^*$ is the optimal amount of s_1 for a corporate group headquartered in a worldwide jurisdiction. s_2^* and s_3^* do not vary across jurisdictions and can be derived as follows:

$$s_2^* = \frac{\tau^H K}{\gamma_2} \tag{12}$$

$$s_3^* = \frac{\tau^H I}{\gamma_3} \tag{13}$$

Equations (11), (12), and (13) indicate that the corporate group shifts profits to the tax haven jurisdiction as long as $\tau^H > 0$.

The data described in Section 3 do not contain information on the flows of profits between the subsidiaries and the ultimate owner.[14] Only the number of tax havens subsidiaries is available. Additionally, during the sample period, very few companies in the sample switch from having zero tax haven subsidiaries to having at least one low-tax subsidiary (or *viceversa*).[15] Given the restrictions placed on this analysis by the data, in the empirical specification below the profit-shifting functions s_1, s_2, and s_3 are represented as a general quadratic function of the number of tax havens subsidiaries such that:

$$s_1 = \delta_1 n + \delta_2 n^2 \tag{14}$$

short term.

[14] I am not aware of any publicly available datasets containing unconsolidated account information for tax haven subsidiaries, which generally do not have the obligation or the incentive to disclose accounting data.

[15] For a more detailed discussion on why dummies have not been used here, see the Appendix D.

$$s_2 = \phi_1 n + \phi_2 n^2 \tag{15}$$

$$s_3 = \lambda_1 n + \lambda_2 n^2 \tag{16}$$

Substituting (14), (15), and (16) in equations (9) and (10), dividing through by K and rearranging, it is possible to write

$$\begin{aligned} T_T = \{\tau^H[\pi^A(1-d)(1-\xi^H-\delta_1 n-\delta_2 n^2)-(\phi_1 n+\phi_2 n^2)K+ \\ -(\lambda_1 n+\lambda_2 n^2)I]+\tau^F \pi^A d(1-\xi^F)\} * \frac{1}{K} \end{aligned} \tag{17}$$

and

$$\begin{aligned} T_W = \tau^H[\pi^A(1-\xi^H-\delta_1 n-\delta_2 n^2)-(\phi_1 n+\phi_2 n^2)K+ \\ -(\lambda_1 n+\lambda_2 n^2)I] * \frac{1}{K} \end{aligned} \tag{18}$$

Equation (17) and (18) can be combined in the same regression using a dummy variable dW which takes value one if the company is headquartered in a worldwide jurisdiction and zero otherwise. The estimated equation will be

$$\begin{aligned} Y_{i,t} = \alpha_0 + \alpha_1(\frac{\pi^A}{K})_{i,t} + \alpha_2(\frac{\pi^A}{K})_{i,t} * dW_{i,t} + \\ \alpha_3(\frac{\pi^A}{K}n)_{i,t} + \alpha_4(\frac{\pi^A}{K}n^2)_{i,t} + \\ \alpha_5(\frac{\pi^A}{K}n)_{i,t} * dW_{i,t} + \alpha_6(\frac{\pi^A}{K}n^2)_{i,t} * dW_{i,t} + \\ +\sigma_1 n_{i,t} + \sigma_2 n_{i,t}^2 \\ +\rho_1(\frac{I}{K}n)_{i,t} + \rho_2(\frac{I}{K}n^2)_{i,t} + f_i + \epsilon_{i,t} \end{aligned} \tag{19}$$

where

$$\begin{aligned}
\alpha_1 &= \tau^H(1-d)(1-\xi^H) + \tau^F d(1-\xi^F); \\
\alpha_2 &= \tau^H d(1-\xi^H) - \tau^F d(1-\xi^F); \\
\alpha_3 &= \delta_1\tau^H(1-d);\ \alpha_4 = \delta_2\tau^H(1-d); \\
\alpha_5 &= \delta_1\tau^H d;\ \alpha_6 = \delta_2\tau^H d; \\
\sigma_1 &= \phi_1\tau^H;\ \sigma_2 = \phi_2\tau^H; \\
\rho_1 &= \lambda_1\tau^H;\ \rho_2 = \lambda_2\tau^H
\end{aligned} \tag{20}$$

$Y_{i,t}$ is the tax charged to the consolidated P&L account divided by total assets;[16] π^A is accounting profitability and it is measured as P&L before taxation;[17] K is capital stock, measured by the book value of total assets; I represents intangibles measured by the book value of intangible fixed assets; n is the extent of tax haven operations and it is measured by the number of subsidiaries located in the low-tax jurisdictions listed in Table 4.

In equation (19), α_1 measures the METR for a group without tax haven operations and headquartered in a territorial jurisdiction (that is, dW=0 and n=0):

$$\alpha_1 = \frac{\partial(T/K)}{\partial(\pi^A/K)} = \frac{\partial T}{\partial \pi^A} = METR \tag{21}$$

For a corporate group headquartered in a worldwide jurisdiction (that is, dW=1), the METR is

$$\frac{\partial(T/K)}{\partial(\pi^A/K)} = \frac{\partial T}{\partial \pi^A} = \alpha_1 + \alpha_2 \tag{22}$$

Equation (19) allows the group tax payments to change when the size of operations in tax

[16]For more details on the variables used, see Appendix A.

[17]P&L before tax is net of royalties and interest payments. Even if there is shifting of profits to low-tax subs, this should not be a problem in this study: in consolidated accounts, flows within the multinational group will be compensated with each other.

havens changes. In this context, it is possible to estimate the extent to which the group METR drops when more offshore operations become available within a corporate group. α_3 and α_4 measure the additional effect on the METR of an increase of one unit in the number of tax havens subsidiaries (and headquartered in territorial countries); α_3 is expected to be negative, as the METR should decline when tax haven operations are available; α_4 captures the non-linear effects of tax haven operations on the METR. For companies with tax haven operations and headquartered in territorial jurisdictions, the METR is given by $(\alpha_1 + \alpha_3 n + \alpha_4 n^2)$. For corporate groups headquartered in worldwide jurisdictions, the total METR is measured by $(\alpha_1 + \alpha_2 + \alpha_3 n + \alpha_4 n^2 + \alpha_5 n + \alpha_6 n^2)$.

The coefficient σ_1 captures the effect of tax haven operations independently of profitability (direct effect); σ_1 is expected to be negative. σ_2 captures any non-linear relationship between tax haven operations and the corresponding conditional expectation of $Y_{i,t}$.

Intangible assets such as patents and copyrights are often used to transfer profits from high- to low-tax jurisdictions: they can be moved relatively easily and arm's length prices are difficult to establish for them. Since a higher concentration of intangibles creates more opportunities for transfer-pricing, ρ_1 is expected to be negative. ρ_2 captures non-linear effects of low-tax operations.

Two elements affect the METR: the statutory rates and the tax base. For a comparison of tax burdens between territorial and worldwide jurisdictions, it is important to understand which element affects the difference in tax burdens across jurisdictions. The METB is able to isolate the effect statutory rates from the effect of the tax base. It is possible to estimate the METB if equation (19) is transformed as follows:

$$
\begin{aligned}
Y_{i,t} = \beta_0 + \beta_1(\frac{\pi^A * \tau^H}{K})_{i,t} + \beta_2(\frac{\pi^A \tau^H}{K})_{i,t} * dW_{i,t} + \\
+\beta_3(\frac{\pi^A \tau^H}{K} n)_{i,t} + \beta_4(\frac{\pi^A \tau^H}{K} n^2)_{i,t} + \\
+\beta_5(\frac{\pi^A \tau^H}{K} n)_{i,t} * dW_{i,t} + \beta_6(\frac{\pi^A \tau^H}{K} n^2)_{i,t} * dW_{i,t} + \\
+\sigma_1 n_{i,t} + \sigma_2 n_{i,t}^2 \\
+\rho_1(\frac{I}{K} n)_{i,t} + \rho_2(\frac{I}{K} n^2)_{i,t} + f_i + \epsilon_{i,t}
\end{aligned}
\tag{23}
$$

where τ^H is the statutory corporate tax rates in the home country.

Approximating $T \approx (\tau^H * tax\ base)$,

$$
\begin{aligned}
\beta_1 = \frac{\partial(T/K)}{\partial(\pi^A * \tau^H/K)} = \frac{\partial T}{\partial \pi^A * \tau^H} = \\
= \frac{\partial(\tau^H * tax\ base)}{\partial \pi^A * \tau^H} = \frac{\partial(tax\ base)}{\partial \pi^A} = METB
\end{aligned}
\tag{24}
$$

β_1 measures the METB for a group without tax haven operations and headquartered in a territorial jurisdiction. This means that an additional dollar of accounting profits increases the tax base by β_1 cents. β_3 and β_4 measure the additional effect for a group increasing its number of tax havens subsidiaries by one unit (and headquartered in territorial countries); β_3 is expected to be negative, as the METB should decline when tax haven operations are available; β_4 captures the non-linear effects of tax haven operations on the METB. For companies with tax haven operations and headquartered in territorial jurisdictions, the marginal increase in the tax base for an additional dollar of accounting profit is given by $(\beta_1 + \beta_3 n + \beta_4 n^2)$.

For corporate groups headquartered in worldwide jurisdictions, the total METB is captured by $(\beta_1 + \beta_2 + \beta_3 n + \beta_4 n^2 + \beta_5 n + \beta_6 n^2)$.

Note that using (4) and (5), it is possible to write

$$\frac{\partial T_T}{\partial(\pi^A * \tau^H)} = \frac{\partial T_T}{\partial \pi^A} * \frac{1}{\tau^H} = (1-d)(1-\xi^H) + \frac{t^F}{t^H} d(1-\xi^F) \tag{25}$$

for a corporate group headquartered in a territorial jurisdiction and

$$\frac{\partial T_W}{\partial(\pi^A * \tau^H)} = \frac{\partial T_W}{\partial \pi^A} * \frac{1}{\tau^H} = (1-\xi^H) = METB_W \tag{26}$$

for a corporate group headquartered in a worldwide jurisdiction.

In the consolidated data used here it is not possible to disentangle $(1-d)(1-\xi^H)$ from $d(1-\xi^F)$ as in equation (25). Also the data do not contain information on all jurisdictions where the MNC is located. Therefore, in the empirical analysis τ^F is approximated with τ^H, the statutory corporate tax rate applied in the jurisdiction where the corporate group is headquartered. For a corporation headquartered in a territorial jurisdiction, a bias could arise. If $\tau^F < \tau^H$ ($\tau^F > \tau^H$) the results of this paper will underestimate (overestimate) the METB of a corporate group headquartered in a territorial jurisdiction, as showed in equation (25). The lower (higher) τ^F with respect to τ^H, the larger the downward (upward) bias. The problem does not arise when estimating the METB for a group headquartered in a worldwide jurisdiction when all the profits in F are repatriated to H ($\psi = 1$), as showed in equation (26). If $\psi < 1$, the estimated METB for a corporate group headquartered in a worldwide jurisdiction will also be underestimated (overestimated) if $\tau^F < \tau^H$ ($\tau^F > \tau^H$).[18]

4.1 Empirical challenges

In the setting analysed here, there are three econometric issues that need to be addressed. The first is the possible endogeneity of tax haven operations. The choice of setting up oper-

[18] In this case, the real METB will be $METB_W = (1-d-\psi*d)(1-\xi^H) + (d-\psi*d)(1-\xi^F)$ whilst the estimated METB will be $\widehat{METB}_W = (1-d-\psi*d)(1-\xi^H) + \frac{\tau^F}{\tau^H}(d-\psi*d)(1-\xi^F)$.

ations in low-tax jurisdictions might be determined by the profit and hence by the tax bill itself. Table 8 shows that groups without tax haven operations are more likely to report losses, and their losses are larger than those of groups present in tax havens. Unprofitable companies have less profits to shift and therefore they will gain less from tax haven operations, as they are already able to reduce their tax bill through the loss carryforward provisions. Alternatively, losses can be produced because no low-tax off-shore operations are available. This implies that the selection of only profitable companies can bias the estimations towards finding a negative effect of tax haven subsidiaries on tax liabilities as profitable firms have a greater incentive to locate part of their operations in offshore low-tax jurisdictions. Two key implications can be drawn from Table 8. First, unprofitable entities and unprofitable years should be included in the sample. Second, the presence in tax havens is likely to be determined endogenously by previous tax positions. This paper tackles the first issue by including unprofitable entities and years in which a group reports an aggregate loss and the second issue by using a dynamic model where the tax bill (over total assets) is regressed on its first lag.

The second econometric issue stems from the likely presence of unobservable group fixed effects and unobservable time-variant shocks which simultaneously affect the tax bill and the decision to locate activities in tax havens. The third issue concerns regressors other than the number of tax haven subsidiaries. Important determinants of the tax bill such as profitability and intangibles intensity could be determined simultaneously with the tax bill. This paper deals with the last two issues by first constructing a time-variant indicator for tax haven operations and then by using the GMM-diff estimator described in Arellano and Bond [1991]. The GMM-diff estimator controls for unobserved fixed effects by using first-differences. It also controls for unobserved time-variant shocks with the use of instrumental variables. As standard in Arellano and Bond [1991], instruments employed are the second and further lags of profitability, intangible intensity, size, and of their interactions with the dummy indicating whether a corporate group is headquartered in a jurisdiction with a worldwide system

of taxation of profits. Other instruments are the first and second lag of the previous two periods' average tax bill divided by total assets. Country-year dummies are also included in the instrument set.[19]

5 Results

This section describes the results. In all specifications presented here, the diagnostic tests are successfully passed. The test for over-identification and the tests for first and second order serial correlation are satisfactory. The null hypothesis of first order serial correlation is rejected and the null hypothesis of second order serial correlation is not rejected. Under the Sargan-Hansen test, the joint null hypothesis that the instruments are uncorrelated with the error term, and that they are correctly excluded from the estimated equation is not rejected.

Table 9 presents results for a basic specification of equation (19) where subsidiaries in tax havens are not considered and the dependent variable is the ratio of consolidated tax charges to the consolidated book value of total assets.[20] The regressions also control for aggregate losses and for the size of the corporate group. Columns 1 and 3 report results for the entire sample, whilst column 2 and 4 investigate only multinational firms.

In columns 1 to 4, the METR for companies headquartered in a territorial jurisdiction and estimated by the coefficient of profitability α_1 is highly statistically significant. It remains so across all specifications in this paper. Its magnitude is estimated to be around 17 per cent. This means that on average for companies in a territorial country, a one dollar increase in the consolidated accounting profit leads to about a 17 cents increase in the consolidated tax liabilities. In column 1 and 2, the coefficient α_2 on the interaction term between profitability

[19]For more details on the estimator and the instruments used in this paper, see Appendix C.

[20]For presentational purposes, in the regressions the dependent variable and its lag value have been multiplied by 100 so that the coefficient attached to profitability can be interpreted as a percentage.

and the dummy for worldwide countries[21] is positive and highly significant. This implies that the METR of companies headquartered in worldwide jurisdictions is estimated to be significantly higher, by around 19 (for the whole sample) and 18 (for multinationals only) percentage points than the METR of companies resident in territorial jurisdictions.

As discussed in Section 4.1, it is important to control for losses, as companies with negative earnings might display a lower tax bill. In column 1 to 4, the coefficient of the dummy indicating an aggregate loss is instead positive and significant. This might seem counter-intuitive. However it is possible that an ultimate owner has a positive tax bill even when it reports losses in the consolidated accounts. In fact some of its subsidiaries might be profitable and therefore might be paying taxes, even if total group losses are larger than the profits of those subsidiaries.[22]

It is known that larger firms tend to have more intangibles. To identify the effects of intangibles separately from size, it is useful to control for both intangibles and size.[23] In the specifications presented in column 1 to 4, the coefficient of intangible intensity is not statistically significant at conventional levels.[24] The effect of size on the tax bill seems more complex to analyse. In column 1 to 4, the significant and negative effect of the coefficient attached to the logarithm of employment indicates that larger firms headquartered in territorial countries display a slightly lower ratio of taxes to total assets. This is unsurprising as larger firms have more opportunity to shift income to low tax subsidiaries than smaller firms do. For corporate groups headquartered in worldwide jurisdictions, the overall effect is instead not significantly different from zero.

[21] The dummy dW takes value one when the GUO is resident in a jurisdiction which applies a worldwide system for the taxation of corporate profits.

[22] The interaction between the dummy for reporting losses and the dummy for worldwide countries is never significant. For this reason, the variable is not included in the regressions.

[23] Size is measured by the logarithm of the number of employees. For more details, see Appendix A.

[24] Despite its coefficient being estimated as not significant at conventional level, the variable intangibles over total assets is kept in the analysis. It will become important and its coefficient will be estimated at a conventional significant level in later specifications.

A key question in this investigation is whether the higher METR found for worldwide jurisdictions is driven by characteristics of individual countries and their legislation. Column 3 and 4 investigate this issue by substituting the dummy for worldwide jurisdictions with three separate dummies for Ireland, the United Kingdom, and the United States. By interacting country dummies with the profitability term, the last two columns explain in more details the determinants of the difference in METRs between worldwide and territorial jurisdictions. The corporate groups headquartered in the United States are characterised by the highest METR which is between 19 (for the whole sample) and 16 (for MNCs only) percentage points higher than the mean METR of groups headquartered in territorial countries. The METR for groups headquartered in the US is therefore estimated to be between 33.5 (column 4) and 35.5 per cent (column 3). Companies headquartered in the United Kingdom have a METR of between 28.5 per cent (column 3) and 29.8 per cent (column 4), around 12 percentage points higher than companies headquartered in territorial countries.[25] Irish companies display an overall METR which is not statistically different from that of groups headquartered in territorial countries. This is expected as Ireland has the lowest corporate tax rate among OECD countries (12.5 per cent) and no Controlled Foreign Corporation (CFC) rules, despite being in principle a worldwide jurisdiction.

The results of Table 9 might lead me to think that corporate groups headquartered in countries which exempt foreign profits are able to reduce overall tax liabilities by locating real activities and by shifting profits into jurisdictions that can guarantee a lower fiscal burden. However the difference between the METR of the two groups cannot be entirely attributed to the different ways in which foreign profits are taxed. The METR of each company is also influenced by the statutory corporate tax rate.

[25]It is interesting to note that in our sample, multinationals display a METR which is not systematically lower than that of domestic entities. This seems to depend on the country of residence. This is consistent with the results in Markle and Shackelford [2011].

As discussed in the previous section, equation (23) is estimated to control for the national statutory corporate tax rates. Table 10 reports the results for the estimation of equation (23) without controlling for tax haven operations. As in the previous table, the regressions also control for losses and size. Column 1 and 2 display findings for a model where the profitability variable is interacted with a dummy dW taking the value one when the GUO is resident in a jurisdiction applying a worldwide system. Column 3 and 4 display estimates for a model where dummies for individual worldwide countries are interacted with the profitability term. Column 1 and 3 illustrate outcomes for the whole sample, whilst column 2 and 4 show findings for multinationals only.

From a general perspective, column 1 to 4 report a statistically significant estimate of the coefficient β_1 attached to the profitability term multiplied by τ^H, the national statutory corporate tax rate in the country of headquarters. The METB β_1 is estimated to be 83 per cent in column 1. This means that an additional dollar of accounting profit increases the tax base by 83 cents. In column 2 where domestic entities are excluded, the estimate is a little lower (80.3 per cent). In column 3 and 4, β_1 is estimated at around 82 and 81 per cent, respectively.

From Table 10 it is clear that when controlling for the corporate statutory tax rate, there is no statistically significant difference between worldwide and territorial countries in how an additional dollar is transformed in additional tax base. In column 1 to 4, the METB measured by the coefficient β_2 is never statistically significant. In other words, once one controls for statutory rates, the difference in tax burdens between worldwide and territorial countries disappears. It seems therefore natural to think that differences in METRs and AETRs found in Table 9 and in other studies (Markle and Shackelford [2011]) are mainly driven by statutory rates.

In the specifications of Table 10 the coefficient attached to the dummy indicating consolidated losses remains positive and highly statistically significant. The other variables are not significant in this model.

This paper also investigates the different systems of taxation of foreign profits by testing their resilience to tax avoidance, to which the territorial system is considered more vulnerable. Table 11 and 12 control for this using the presence of the corporate groups in tax havens.

Presence in offshore low-tax jurisdictions is measured by the number of first-level subsidiaries in tax havens.[26] The specifications of Table 11 and 12 are obtained by interacting the variables of the previous specifications with the variable recording the number of tax haven subsidiaries within the same corporate group. Some interacted variables are then dropped if their estimated coefficient is not statistically significant at conventional levels in any of the specifications. This should reduce multicollinearity problems and shrink the number of instruments.

In Table 11, column 1 and 2 present results for a model where one unique dummy for worldwide countries is interacted with the profitability term and with the number of subsidiaries in tax havens and their squared number. Column 3 and 4 display findings for a model where country-specific dummies for Ireland, the United Kingdom, and the United States are interacted with the profitability term. Regressions reported in column 1 and 3 are run on the entire sample, whilst column 2 and 4 are run on multinationals only.

In the first column, the METR for groups headquartered in territorial jurisdictions is estimated to be around 21 per cent and highly significant across different specifications. There is also a negative and statistically significant effect of low-tax operations on the METR as

[26]The presence in tax havens could have also been recorded using dummies. For more details on why this is not a suitable choice for this study, see Appendix D.

α_3 is negative and statistically significant. The coefficient α_4 is also significant at one per cent indicating a non-linear relationship. Considering a corporate group headquartered in a territorial jurisdiction with 2.5 tax haven subsidiaries,[27] the coefficient estimates imply that its METR will be 1.7 percentage points lower than the METR of companies without tax haven subsidiaries, *ceteris paribus*.

This paper compares the tax burden of corporate groups headquartered in territorial jurisdictions with that of similar entities in worldwide countries. A crucial result is the sign of the coefficient α_5 attached to the interaction between profitability, the worldwide countries dummy, and the number of tax haven operations. A positive sign would indicate that, for companies headquartered in worldwide jurisdictions, tax haven subsidiaries have a smaller negative impact[28] on the METR with respect to corporate groups resident in territorial countries. In column 1 the sign of the coefficient is positive but not statistically significant. In column 2 to 4, the coefficient is positive and statistically significant. To better grasp the meaning of these results, using the coefficients of column 2, it is useful to calculate the effect of one tax haven subsidiary for a group headquartered in a territorial jurisdiction versus a group headquartered in a worldwide jurisdiction. For the former, the METR will be reduced by -0.844 + 0.027 percentage points, for a total of 0.817 percentage points. For the latter, the METR will be reduced by (-0.844 + 0.027 + 0.027 - 0.025) for a total of 0.17 percentage points. Coefficient estimates are very similar across all specification of column 2, 3 and 4. It is therefore possible to conclude that Table 11 presents evidence that low tax offshore operations reduce the METR more in territorial than in worldwide jurisdictions. Territorial systems seem to be more vulnerable to tax avoidance through tax havens.

As in previous specifications, the coefficient of the dummy recording whether the corporate

[27]The sample mean value of the variable number of subsidiaries in tax havens is 2.5. For more details see Table 6.

[28]Clearly, the magnitude of the coefficient has to be smaller than the magnitude of the coefficient attached to the interaction between the profitability variable and the number of subsidiaries in tax havens.

group reports a consolidated loss is positive and statistically significant in column 1 to 4. This positive effect is however reduced by the use of tax haven operations as indicated by the negative and statistically significant value of the coefficient on the interaction term between the indicator for losses and the number of subsidiaries in tax havens. This provides evidence that the combined presence of aggregate losses and operations in low-tax jurisdictions reduces the tax burden of the corporate group. For the losses variable, there is no difference between worldwide and territorial jurisdictions.[29]

Low-tax offshore operations also reduce tax liabilities through the use of intangibles as shown by the negative and highly significant coefficient of the interaction between tax haven subsidiaries and intangible assets in all columns of Table 11. The relationship with the dependent variable is non-linear as the coefficient of the variable interacted with the squared value of the number of tax haven subsidiaries is statistically significant at one per cent. In the previous tables, the coefficient attached to intangibles intensity was never estimated at a level conventionally considered significant. This means that, without low tax operations, intangibles *per se* do not seem to reduce tax liabilities (over total assets). In the sample used here, it is the combination between intangibles and low-tax operations which produces tax savings for the group.

As in previous tables, the significant and negative effect of the coefficient attached to the size variable indicates that larger firms headquartered in territorial countries display a lower ratio of taxes to total assets. For corporate groups headquartered in worldwide jurisdictions, the overall effect of size on the tax bill is not statistically significant from zero. The result are robust across all specifications of Table 11.

With the exception of column 2, all specifications also identify a negative and statistically

[29]The interaction between the worldwide countries dummy, the loss dummy, and the number of tax haven subsidiaries is never significant. The variable is therefore dropped.

significant *direct effect* of tax haven operations on the tax bill (σ_1). As expected, offshore operations reduce the ratio of tax charges to total assets. The relationship is non-linear as the coefficient attached to the variable measuring the squared number of low tax subsidiaries is positive and statistically significant in column 1 to 4. As explained in Appendix E, at the mean, the effect is very large: one additional tax haven subsidiary reduces the tax bill over total assets by 0.8 percentage points. This represents a reduction of 49 per cent in the short run and by 53 per cent in the long run. Since the number of tax haven subsidiaries is an imperfect measure of avoidance activities, the magnitude of the overall effect should be interpreted with caution.

As discussed in the previous section, equation (23) is estimated to control for the national statutory rates. Table 12 reports the results. From a general perspective, column 1 to 4 report a statistically significant estimate of the coefficient β_1 attached to the profitability term multiplied by τ^H, the national statutory corporate tax rate. β_1 is the METB and it is estimated to be 84 per cent in column 1. This means that an additional dollar of accounting profit increases the tax base by 84 cents. In column 2 where domestic entities are excluded, the estimate is very similar (83.3 per cent). In column 3 and 4, the dummy for worldwide countries is replaced by three dummies separately indicating Ireland, the United States, and the United Kingdom. In these columns, the METB is estimated at around 84 per cent as well.

As previously showed in Table 10, if the company does not have tax haven subsidiaries, there is no statistically significant difference in the METB between worldwide and territorial countries. In column 1 to 4 of Table 12, the coefficient of the interaction between the dummy for worldwide countries (dW) and the variable $(\pi^A * \tau^H)/K$ is never significant. When controlling for the corporate statutory tax rates, there is no difference in how an additional dollar is transformed in additional tax base.

Table 12 shows an interesting result, though. In column 1 to 4, the coefficient attached to

the interaction between the dummy for worldwide countries, the number of tax havens (n), and the variable $(\pi^A * \tau^H)/K$ is always positive and statistically significant (at least at 5 per cent). This confirms the results in the previous table and it means that in worldwide countries the negative effect of tax haven operations on the METB (β_1) is smaller than in territorial countries. For example, column 1 reports that a company with one tax haven subsidiary and headquartered in a territorial jurisdiction will be able to lower its METB by 2.3 (-2.384 + 0.080) percentage points. The same type of company headquartered in a worldwide jurisdiction will reduce its METB by only 0.24 (-2.384 + 0.080 + 2.144 - 0.076) percentage points. The results suggest that tax haven operations exert a downward pressure on the METB of the corporate groups in both the worldwide and the territorial system. This pressure is more effective at reducing tax liabilities if the company is headquartered in a jurisdiction which exempts foreign profits (versus a worldwide jurisdiction).

The sign and significance of the other coefficients remains the same as in the previous table. The exceptions are the coefficients attached to the size variable. In column 1 and 3 of Table 12, the coefficient attached to size is negative but not significant. In column 2 and 4 where only multinational companies are considered, the coefficient is instead significant, indicating that larger MNCs in territorial countries are able to lower their tax bill (over total assets) more than smaller MNCs are able to. In this model, there is no differential effect for corporate groups headquartered in worldwide jurisdictions.

6 Conclusions

This paper investigates whether the tax burden of companies located in worldwide jurisdictions is systematically different from that of companies headquartered in territorial jurisdictions. The work employs consolidated accounting data for firms headquartered in 15

OECD countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States. Using financial information from ORBIS (2003–2007) and ownership changes constructed by merging ZEPHYR with ORBIS, this paper finds that the METR of companies resident in territorial jurisdictions is lower than the METR of corporate groups headquartered in jurisdictions applying the worldwide principle. More specifically, companies headquartered in the United States are characterised by the highest METR and UK companies by the second highest METR.

When controlling for the headquarter corporate statutory tax rate, the difference in tax burdens between worldwide and territorial jurisdictions disappears: there is no statistically significant difference in how an additional dollar of accounting profit translates into additional tax base. The METBs of groups headquartered in territorial countries are not statistically different from METBs of groups headquartered in worldwide countries. A high statutory tax rate is the key determinant of the difference in METRs.

This paper also investigates whether a territorial system for the taxation of corporate profits is more vulnerable to tax avoidance activities. Using the availability of tax haven operations for proxying tax avoidance activities, this work shows evidence consistent with tax haven operations reducing tax liabilities in both, but more in territorial systems. Using low-tax offshore operations, multinational companies headquartered in territorial countries reduce their METR and their METB more than do corporate groups headquartered in a worldwide country. This differential influence of tax haven subsidiaries in territorial jurisdictions is robust to controlling for statutory tax rates.

Appendix

Appendix A - Construction of the dataset

The dataset employed in this paper is constructed by merging ORBIS with ZEPHYR, both produced by Bureau Van Dijk. The former contains financial information and firms' ownership structure as of 2007. The latter dataset contains mergers and acquisitions (M&A) deals that occurred between 1999 and 2007, including acquisitions and (or) sell-off of affiliates in tax havens. The unit of observation is a corporate group filing consolidated accounts under a GUO firm. A GUO is a company that ultimately owns at least one subsidiary (with at least a share of more than 50 per cent of capital). For the definition used by Bureau van Dijk, at least one of the shareholders of the GUO must be known and this shareholder cannot own more than 50 per cent.

By merging ORBIS and ZEPHYR, it is possible to create a time-varying ownership structure using ORBIS ownership information as a starting point. In other words, if a company in ORBIS appears in ZEPHYR as an acquirer and (or) as a vendor of a subsidiary located in a tax haven, a time-varying variable recording the number of subsidiaries in offshore centres can be built. For an example of how such a variable as been constructed see Table 13. For a summary of the final dataset downloading and construction, see tables 14 and 15. The dataset excludes GUOs which are insurance companies, financial companies, banks, hedge funds, private equity firms, venture capital firms, mutual and pension funds, and public authorities. The different sectors represented in the sample are showed in Table 16. The observations of the final sample are less than 27,120 (see last rows of Table 14) because companies with only one year of data are dropped in a dynamic model with one lagged dependent variable. Also, the use of the instrumental variables and their lags reduces the sample.

To my knowledge this is the first publicly available, cross-country datasets constructed with time-varying information on tax haven operations. The dataset used has also some limitations, though. First, the variable recording the number of tax haven subsidiaries is built starting from the static information recorded in ORBIS. This includes only first-level subsidiaries. The empirical analysis is carried out using a GMM-diff and therefore the effect of tax haven subsidiaries is identified only using the corporate groups which have increased or decreased the number of their first level low-tax subsidiaries during the sample period. It is important, however, to recognise that if a company has only second and further level tax haven subsidiaries, it will not be used to produce the estimates. It is difficult to understand in which direction the bias would be. Companies with first level tax haven subsidiaries could be very special with respect to the average company with low-tax offshore operations. They could also be thought of being more aggressive tax planners. In this case, the results would overestimate the effect of tax haven subsidiaries for the whole population of companies in the economy. On the contrary, it could be possible that corporate groups without first-level tax haven subsidiaries but with less apparent and more complicated structures have greater opportunities to shift profits to low-tax offshore jurisdictions. In this case, the results would underestimate the real effect. Second, the time-varying changes in the number of tax haven subsidiaries are built using ZEPHYR. The latter only records M&A deals. It does not record whether a new subsidiary has been created. More generally, there might be an underestimation of their presence in tax havens.

The variables used in the regressions are $Y_{i,t}$, the tax (**430**)[30] charged to the consolidated P&L account divided by total assets (**412**); π^A symbolising accounting profitability measured as P&L before taxation (**429**);[31] K representing the capital stock which is measured by the book value of total assets (**412**); I representing intangibles measured by the book value of

[30]The variables codes in ORBIS are given in parenthesis and in bold.

[31]P&L before tax is net of royalties and interest payments. Even if there is shifting of profits to low-tax subs, this should not be a problem in this study: in consolidated accounts, flows within the multinational group will be compensated with each other.

intangible fixed assets (**405**); size measured by the logarithm of the number of employees (**425**); n the number of subsidiaries in tax havens.

Appendix B - The Use of Unconsolidated Accounts

In this paper, consolidated accounts are used. Unconsolidated accounts could lead to an overestimation of the effective tax rate (ETR) and therefore also of the METR. Suppose company A owns a subsidiary B located in a tax haven. Suppose that A borrows US$ 100 from B and pays 10 per cent interest. The parent company can deduct interest payments from its tax base. If in the home country the statutory corporate tax rate is 30 per cent and A reports a pre-tax profit of US$ 100, then its ETR is 30 per cent.[32] Suppose additionally that B reports profits only from interest payments received, and that its relevant statutory corporate tax rate is zero. If consolidated data are used, the profit of the tax haven subsidiary will be added to the profit of the parent and the ETR will drop to 27 per cent.[33] Additionally, unconsolidated data only give a partial picture of how offshore low-tax jurisdictions affect tax liabilities. In fact, a reduction in the tax bill of one affiliate could be compensated for by an increased tax bill somewhere else in the group. By failing to provide information on the tax liabilities of the whole group, unconsolidated accounts are not suitable for comparing the tax burdens of corporate groups resident in territorial countries with the tax burdens of companies headquartered in worldwide countries. In an ideal word, unconsolidated financial data for each subsidiary of a corporate group would be available. This would allow to identify financial flows within the multinational company. Unfortunately, no such data are available at present. For a discussion of the publicly and non-publicly available data, see Maffini [2007]. ORBIS does not contain the unconsolidated accounts of all subsidiaries of the group. When both consolidated and unconsolidated data are available for the same group, only a

[32] $[\frac{0.3*(100-10)}{(100-10)}] = 0.30$.
[33] $[\frac{0.3*(100-10)}{(100-10)+10}] = 0.27$.

few subsidiaries report detailed accounting information. Additionally, for some firms only consolidated accounts are available. Finally, for their very own nature, even if a tax haven subsidiary is recorded in ORBIS, its detailed unconsolidated accounts are never reported.

Appendix C - Discussion of the Estimator Used

All specifications presented in Section 5 include a lagged dependent variable which controls for slow adjustments in the tax bill. Tax liabilities might depend on previous tax payments for many reasons. For example, a company may arise the suspicion of tax authorities if it shifts an amount of earnings that is too high with respect to previous years. In the first column of Table 17, the OLS estimator does not control for group-specific effects, nor does it deals with the likely correlation of the regressors with the error term. The within-group estimator in column 2 controls for group fixed effects, but it does not deal with the bias arising from the correlation between the regressors and the error term. Blundell et al. [2000] showed that the pooled OLS estimator of the coefficient of the lagged dependent variable is upward-biased, whilst the within-group estimator is downward-biased. Hence, columns 1 and 2 are useful for setting an upper and a lower bound to the estimates of the lagged dependent variable shown in column 2 and obtained using a GMM-diff estimator. In columns 3 the estimated coefficient of the lagged dependent variable lies between the pooled OLS value of column 1 (0.283) and its within-group equivalent displayed in column 2 (-0.023) as predicted in Blundell et al. [2000]. More specifically, the estimated coefficient of the lagged dependent variable is 0.079.

As explained above, the GMM-diff used in most specifications controls for unobservable group fixed effects, and at the same time it deals with the likely correlation of unobservable shocks with the first-difference of the lagged dependent variable and of other regressors. As standard in Arellano and Bond [1991], instruments employed are the second and further lags of profitability, intangible intensity, size, and of their interactions with the dummy indicating

whether a corporate group is headquartered in a jurisdiction with a worldwide system of taxation of profits. Country-year dummies are also included in the instrument set. Instruments are collapsed as described in Roodman [2009] to contain their proliferation.

The set of instruments used in the GMM-diff of Table 10 and 12 includes also the first and second lag of the previous two periods' average tax bill divided by total assets.[34] The average tax bill in the two previous periods is likely to be a good predictor of whether the company decides to expand its tax haven operations or not. A group with a low-tax bill will be less willing to incur the costs of expanding its operations in low-tax jurisdictions, *ceteris paribus*. Other instruments employed are the second and further lags of profitability, intangible intensity, size, and of their interactions with the dummy indicating whether a corporate group is headquartered in a jurisdiction with a worldwide system of taxation of profits. Country dummies are also included in the instrument set. The appropriate lags of these variables[35] can be good instruments for the number of subsidiaries in tax havens as well. For example, groups with higher profitability in the past have higher incentives to expand their tax haven operations.

Specifications of table 9, 11, and 17 also include country-year dummies controlling for factors in the country of the GUO likely to affect tax liabilities. Examples of such factors are the extent of deductions from the tax base, the effectiveness of the anti-avoidance legislation, the effectiveness of tax authorities in detecting tax avoidance and tax evasion, and the economic cycle. Exceptions are Table 10 and 12 where only year dummies are included as one of the regressors is the statutory corporate tax rate of the country of the headquarters. Such

[34]The average value of the tax bill divided by total assets for the previous two periods is calculated as follows: $\frac{(\frac{tax\ bill_{t-1}}{tot.assets_{t-1}})+(\frac{tax\ bill_{t-2}}{tot.assets_{t-2}})}{2}$. The instruments used are therefore $\frac{(\frac{tax\ bill_{t-2}}{tot.assets_{t-2}})+(\frac{tax\ bill_{t-3}}{tot.assets_{t-3}})}{2}$ and $\frac{(\frac{tax\ bill_{t-3}}{tot.assets_{t-3}})+(\frac{tax\ bill_{t-4}}{tot.assets_{t-4}})}{2}$.

[35]The appropriateness of the lagged values as instruments is tested using the Hansen test for the orthogonality of the instruments to the errors and the Arellano and Bond test to check whether there is serial correlation in the error structure in the original equation.

variable features the same pattern of variation as country-year dummies.

Appendix D - Dummies for Tax Havens Operations

The presence in tax havens could have been analysed by employing dummy indicators for tax haven activity: the dummy would have taken value one in presence of at least one low-tax off-shore subsidiary within the corporate group. To capture additional effects of a large number of tax haven subsidiaries the study could have employed dummies registering whether the group had two or more, three or more, four or more, and 30 or more[36] tax haven subsidiaries. Unfortunately, the aforementioned dummies would vary very little in the sample used here. Table 18 shows that in the sample period employed, only a few companies switch from owning zero to owning some tax haven subsidiaries. The variation is even smaller for the dummies recording whether the corporate group has more than 2, 3, 4, or 30 low-tax offshore subsidiaries. With so little within-group variation the dummies are unlikely to pick up the effects being studied here. As expected, the regressions run using these dummies displayed insignificant coefficients. For brevity, results are not reported here and are available with the author.

Appendix E - The Overall Effect of Tax Havens Operations on the Tax Bill

In a polynomial model with interaction terms, coefficients are not directly interpretable as the effect of their associated covariates depends on the value of the covariate itself and on the value of the other regressors. To quantify the overall effect of an additional tax haven subsidiary, it is useful to write:

[36]The top percentile for the variable 'number of subsidiaries in tax havens' is 30.

$$\frac{\partial Y}{\partial n} = \alpha_3 \frac{\pi^A}{K} + 2\alpha_4 \frac{\pi^A}{K} n + \alpha_5 \frac{\pi^A}{K} dW + 2\alpha_6 \frac{\pi^A}{K} dWn + \\ + \sigma_1 + 2\sigma_2 n + \\ + \rho_1 \frac{I}{K} + 2\rho_2 \frac{I}{K} n + \\ + \rho_3 d_{loss} + 2\rho_4 d_{loss} n + \\ + \rho_5 log(employees) dW + 2\rho_6 log(employees) dWn \tag{27}$$

It is possible to calculate the value of equation (27) for each observation of the sample by multiplying the value of the estimated coefficients by the relevant variables. In this way, it is possible to obtain a sample mean value for the derivative in equation (27). The sample mean value for the derivative is -0.944, which applied to the sample mean value of the dependent variable (1.929)[37] indicates that an additional tax haven subsidiary reduces the tax liabilities over total assets by about 49 per cent. The long-run effect is very similar, at about 53 per cent.[38]

Since the amount of tax haven subsidiaries is just a proxy for avoidance activities, the size of their overall effect on the tax bill (over total assets) should be interpreted with caution.

[37] For presentational purposes, the dependent variable in the regressions has been multiplied by 100.

[38] The calculations of the long-run effect are as follows: $\frac{-0.944}{(1-0.074)} = -1.019$ and $\frac{-1.019}{1.929} = -0.528$.

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Table 1: Country Distribution by Type of Group

	MNCs with TH subs	MNCs without TH subs	Domestic groups	Total (%)
Austria	15 [63]	9 [37]	0	24 (0.71)
Belgium	15 [68]	6 [27]	1 [5]	22 (0.65)
Denmark	15 [44]	18 [53]	1 [3]	34 (1.00)
Finland	21 [34]	36 [59]	4 [7]	61 (1.80)
France	112 [56]	68 [34]	20 [10]	200 (5.89)
Germany	105 [50]	83 [40]	22 [10]	210 (6.18)
Greece	8 [32]	16 [64]	1 [4]	25 (0.74)
Ireland*	9 [29]	20 [65]	2 [6]	31 (0.91)
Netherlands	34 [69]	12 [24]	3 [6]	49 (1.44)
Norway	10 [26]	28 [72]	1 [3]	39 (1.15)
Spain	20 [44]	24 [53]	1 [2]	45 (1.33)
Sweden	36 [42]	45 [53]	4 [5]	85 (2.51)
Switzerland	42 [70]	16 [27]	2 [3]	60 (1.77)
United Kingdom*	242 [38]	255 [40]	142 [22]	639 (18.86)
United States*	635 [34]	710 [38]	520 [28]	1,865 (55.03)
Total	1,319 (38.92)	1,346 (39.72)	724 (21.36)	3,389 (100)

(i) Figures indicate the number of ultimate owners.
(ii) In parenthesis, percentage of ultimate owners over the total sample.
(iii) In brackets, percentage over the total number of ultimate owners within a single country. (iv) * Worldwide jurisdictions.

Table 2: Distribution of Observations Across Years

Year	Frequency	Percent
2003	2,115	16
2004	2,387	17
2005	2,610	20
2006	2,813	22
2007	2,951	23
Total	12,876	100.00

Table 3: Corporate Statutory Tax Rates (per cent)

	2003	2004	2005	2006	2007
Austria	34	34	25	25	25
Belgium	33.99	33.99	33.99	33.99	33.99
Denmark	30	30	28	28	25
Finland	29	29	26	26	26
France	35.43	35.43	34.93	34.43	34.43
Germany	40.66	39.35	39.35	39.35	39.35
Greece	35	35	32	29	25
Ireland*	12.5	12.5	12.5	12.5	12.5
The Netherlands	34.5	34.5	31.5	29.6	25.5
Norway	28	28	28	28	28
Spain	40.3	40.3	40.3	40.3	38.01
Sweden	28	28	28	28	28
Switzerland	21.3	21.3	21.3	21.3	21.3
United Kingdom*	30	30	30	30	30
United States*	40.75	40.75	39.52	39.52	38.3

(i) Statutory corporate tax rates include federal and local rates. (ii) * Worldwide jurisdictions.
(iii) Source: PwC Worldwide Tax Summaries.

Table 4: Classification of Tax Havens in the Sample

Small tax havens	Large tax havens
Andorra (AD)	Hong Kong (HK)
Anguilla (AI)	Ireland (IE)
Antigua and Barbuda (AG)	Lebanon (LB)
Aruba (AW)	Liberia (LR)
Bahamas (BS)	Panama (PA)
Bahrain (BH)	Singapore (SG)
Barbados (BB)	Switzerland (CH)
Belize (BZ)	
Bermuda (BM)	
Cayman Islands (KY)	
Cyprus (CY)	
Dominica (DM)	
Gibraltar (GI)	
Grenada (GD)	
Iceland (IS)	
Jordan (JO)	
Liechtenstein (LI)	
Luxembourg (LU)	
Macau (MO)	
Mauritius (MU)	
Malta (MT)	
Marshall Islands (MH)	
Monaco (MC)	
Netherlands Antilles (AN)	
Saint Kitts and Nevis (KN)	
Saint Lucia (LC)	
Saint Vincent and the Grenadines (VC)	
Samoa (WS)	
Seychelles (SC)	
Vanuatu (VU)	
Virgin Islands (British) (VG)	

[(i)] Table 4 does not provide an exhaustive list of low-tax jurisdictions. Some tax havens such as the Maldives, the Isle of Man, and the Channel Islands are not included. Table 4 includes only the offshore fiscal centres in which the ultimate owners in the working sample own a subsidiary.

Table 5: Subsidiaries in Each Tax Haven, by Country of GUO

	Country of Global Ultimate Owner (GUO)															
	AT	BE	CH	DE	DK	ES	FI	FR	GR	IE	NL	NO	SE	UK	US	Total
Tax havens																
AD						2		1								3
AG				1										1	1	3
AI														2		2
AN		2	5	1				2			6		1	2	25	44
AW				1							2			1	2	6
BB			1	1				1			2			5	68	78
BH			1	2		1		2						6	5	17
BM			7	1				3		1	2	1	2	15	128	160
BS			1	1				2			3		1	3	22	33
BZ															1	1
CH	11	3	58	79	11	3	11	57	1	1	17	1	20	56	211	540
CY	3	1	4	1				4	8	2	3	1		7	26	60
DM			1					2								3
GD															1	1
GI	1		1										1	4	16	23
HK	1	3	21	21	4	1	5	31	1	1	2	1	9	69	198	368
IE	1	4	10	13	1	7	5	21	1	28	15	1	11	113	181	412
IS				1	2			2					1		5	11
JO	1		3	2				2						3	5	16
KN															1	1
KY			1	5			1	1	1		5		1	17	117	149
LB			3	1		1		8							6	20
LC				2										2	2	6
LI	1		4	2				1			1			3	4	16
LR				1										1	9	11
LU	1	9	11	19	1	6	3	38	2	1	8		7	47	108	261
MC						1		5						2	2	10
MH														1	4	5
MO				1	1									2	6	10
MT	3		2	8				2	1		1			7	5	29
MU	1		3	4	1			10						3	54	76
PA			7	4		4		5			3		1	6	31	61
SC					1			1							1	3
SG	2	3	27	31	6	1	4	46	1	2	12	6	10	69	276	496
VC					1									1		2
VG	1		2	1		1	2	1	1	2	2	1	1	19	48	82
VU															4	4
WS														1	1	2
Total	27	25	173	204	29	28	31	248	17	38	84	12	66	468	1,577	3,026

(i) Source: 2007 ORBIS static ownership structure. (ii) Number of subsidiaries.

Table 6: Descriptive Statistics of the Main Variables

All companies	Mean	Std. Dev.	Min	Max
Tax bill/total assets	.019	.026	-.190	.222
Number of subsidiaries in tax havens	2	6.134	0	192
Dummy - at least one tax haven subsidiary	.409	.492	0	1
Dummy - more than two tax haven subsidiaries	.261	.439	0	1
Dummy - more than three tax haven subsidiaries	.184	.388	0	1
Dummy - more than four tax haven subsidiaries	.139	.346	0	1
Dummy - more than 30 tax haven subsidiaries	.011	.103	0	1
P&L before tax/total assets (if gain)	.070	.070	0	.521
P&L before tax/total assets (if loss)	-.056	.227	-6.964	0
Dummy - aggregate loss	0.243	.429	0	1
Intangibles/total assets	.203	.190	0	.975
Log(employees)	7.390	2.175	0	14.557
Companies headquartered in territorial countries				
Tax bill/total assets	.018	.022	-.190	.222
Number of subsidiaries in tax havens	2.5	5.66	0	104
Dummy - at least one tax haven subsidiary	.53	.50	0	1
P&L before tax/total assets (if gain)	.070	.064	0	.521
P&L before tax/total assets (if loss)	-.11	.15	-2.13	0
Dummy - aggregate loss	0.16	.37	0	1
Intangibles/total assets	.15	.16	0	.86
Log(employees)	7.5	2.12	1.1	13.1
Companies headquartered in worldwide countries				
Tax bill/total assets	.02	.027	-.115	.159
Number of subsidiaries in tax havens	1.93	6.28	0	192
Dummy - at least one tax haven subsidiary	.37	.48	0	1
P&L before tax/total assets (if gain)	.070	.07	0	.48
P&L before tax/total assets (if loss)	-.26	.45	-6.97	0
Dummy - aggregate loss	0.27	.44	0	1
Intangibles/total assets	.22	.20	0	.97
Log(employees)	7.34	2.19	0	14.6

(i) Intangibles include goodwill (ii) The median number of tax haven subsidiaries is 1 for territorial jurisdictions and 0 for worldwide jurisdictions. (iii) The total number of ultimate owners is 3,389 and total number of observations is 12,876.

Table 7: Descriptive Statistics by Type of Group

	Obs.	Mean	Std. Dev.	Min	Max
MNCs with Subsidiaries in Tax Havens					
Tax bill/total assets	5,407	.022	.025	-.190	.222
Number of total subsidiaries		76	137.29	1	2,288
Number of subs in tax havens		5	8.684	0	192
Dummy - any subs in tax havens		.974	.161	0	1
Dummy - less than 2 subs in tax havens		.534	.490	0	1
Dummy - more than 2 subs in tax havens		.439	.496	0	1
P&L before tax/total assets (if gain)		.077	.070	0	.421
P&L before tax/total assets (if loss)		-.021	.102	-2.434	0
Dummy - aggregate loss		.165	.371	0	1
Intangibles/total assets		.207	.174	0	.934
Log(number of employees)		8.406	1.987	0	14.557
MNCs without Subsidiaries in Tax Havens					
Tax bill/total assets	5,045	.019	.027	-.113	.159
Number total subsidiaries		23	59.13	1	1,398
P&L before tax/total assets (if gain)		.069	.071	0	.521
P&L before tax/total assets (if loss)		-.059	.21	-4.252	0
Dummy - aggregate loss		.256	.437	0	1
Intangibles/total assets		.192	.189	0	.924
Log(number of employees)		6.929	1.905	0	12.806
Domestic Groups					
Tax bill/tot. assets	2,424	.013	.027	-.115	.143
Number total subsidiaries		8	17.71	1	249
P&L before tax/total assets (if gain)		.053	.066	0	.483
P&L before tax/total assets (if loss)		-.128	.338	-6.964	0
Dummy - making a loss		.390	.488	0	1
Debt ratio		.536	.353	.012	4.935
Intangibles/total assets		.213	.224	0	.975
Log(number of employees)		6.023	2.040	0	11.695

(i) GUOs are grouped according to their structure in 2007. (ii) The variable 'Number of subsidiaries in tax havens' and the dummy variables indicating the presence of those subsidiaries are equal to zero for all MNCs without tax haven subsidiaries and for domestic groups.

Table 8: ETRs, Losses, and Tax Charges Across Types of Companies

	MNCs with TH subs	MNCs without TH subs	Domestic groups	MNCs with TH subs	MNCs without TH subs	Domestic groups
	ETR - only positive values (per cent)			ETR - all observations (per cent)		
2003	32	34	34	23	21	18
2004	30	31	33	24	20	17
2005	30	30	32	24	21	17
2006	29	30	33	24	21	17
2007	28	30	31	23	20	17
Mean	30	31	33	23	21	17
	Per cent of groups reporting losses			Per cent of groups reporting negative tax charges		
2003	23	31	40	17	24	40
2004	17	27	37	13	23	38
2005	15	24	38	12	21	36
2006	14	23	39	11	20	37
2007	15	23	39	11	21	34
Mean	17	25	40	12	22	37
	Mean gain size (over total assets)			Mean loss size (over total assets)		
2003	.062	.058	.048	.032	.069	.165
2004	.074	.067	.051	.021	.061	.105
2005	.079	.071	.052	.020	.055	.126
2006	.083	.074	.057	.017	.062	.129
2007	.084	.074	.053	.019	.053	.124
Mean	.077	.069	.053	.021	.059	.128

(i) Mean ETR calculated using only observations with both positive pre-tax profit and positive tax charges
(ii) Mean ETR calculated setting to zero observations with either losses or negative tax charge.
(iii) All values are consolidated.

Table 9: Marginal Effective Tax Rate - METR

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)
Lag(tax bill/total assets)	0.079***	0.090***	0.082***	0.089***
	(0.019)	(0.020)	(0.019)	(0.020)
P&L/tot.assets (if gain)	16.607***	17.338***	16.511***	17.474***
	(4.618)	(4.457)	(4.615)	(4.448)
X dW	19.191***	16.736***		
	(5.122)	(5.049)		
X dUS			18.815***	16.223***
			(5.167)	(5.096)
X dUK			12.039**	12.310**
			(5.728)	(5.968)
X dIE			-1.749	-0.852
			(11.433)	(11.466)
Dummy - aggregate loss	1.549***	1.091**	1.582***	1.116**
	(0.558)	(0.500)	(0.558)	(0.500)
Intangibles/tot.assets	-2.287	-1.463	-2.300	-1.467
	(2.664)	(2.419)	(2.665)	(2.416)
X dW	3.177	2.612	2.914	2.452
	(2.875)	(2.622)	(2.857)	(2.611)
Log(employees)	-1.118***	-1.013***	-1.149***	-1.023***
	(0.386)	(0.366)	(0.387)	(0.366)
X dW	1.551***	1.518***	1.367***	1.430***
	(0.510)	(0.484)	(0.499)	(0.481)
Country-year dummies	✓	✓	✓	✓
AR(1)	-13.41	-12.20	-13.41	-12.19
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-0.997	-1.169	-1.195	-1.309
p-value	[0.319]	[0.242]	[0.232]	[0.191]
Hansen over-identification test	58.37	65.11	73.78	76.04
Degrees of freedom	(54)	(54)	(66)	(66)
p-value	[0.318]	[0.143]	[0.239]	[0.187]
Observations	12,876	10,452	12,876	10,452
Number of groups	3,389	2,665	3,389	2,665

(i) Regressions are run on all companies in columns (1) and (3) and only on multinationals in columns (2) and (4). (ii) Regressions run using a GMM-diff estimator (Arellano and Bond [1991]). (iii) Standard errors in parentheses. (iv) Instruments used are 2nd and further lags of firm-level variables and country-year dummies. Instruments are collapsed as described in Roodman [2009]. (v) ***, **, * significant at 1%, 5% and 10% respectively.

Table 10: Marginal Effective Tax Base - METB

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)
Lag(tax bill/total assets)	0.073***	0.080***	0.075***	0.082***
	(0.018)	(0.019)	(0.018)	(0.019)
P&L/tot.assets (if gain) * τ^H	83.465***	80.390***	81.780***	80.662***
	(10.440)	(10.368)	(10.450)	(10.387)
X dW	-1.569	-2.813		
	(11.402)	(11.592)		
X dUS			-8.856	-9.801
			(11.684)	(11.879)
X dUK			20.751	14.291
			(18.743)	(20.875)
X dIE			1.064	-13.395
			(51.973)	(52.274)
Dummy - aggregate loss	1.451***	1.152**	1.628***	1.336**
	(0.544)	(0.534)	(0.544)	(0.532)
Intangibles/tot.assets	2.414	2.460	1.528	1.886
	(2.076)	(1.911)	(2.051)	(1.895)
X dW	-2.067	-1.845	-1.727	-1.735
	(2.098)	(1.931)	(2.085)	(1.916)
Log(employees)	0.020	-0.031	0.003	-0.004
	(0.363)	(0.331)	(0.361)	(0.329)
X dW	0.012	0.162	-0.393	-0.130
	(0.457)	(0.426)	(0.452)	(0.425)
Country dummies	✓	✓	✓	✓
AR(1)	-13.53	-12.33	-13.63	-12.48
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.516	-1.538	-1.126	-1.297
p-value	[0.130]	[0.124]	[0.260]	[0.195]
Hansen over-identification test	69.96	72.04	86.76	90.00
Degrees of freedom	(54)	(54)	(66)	(66)
p-value	[0.071]	[0.051]	[0.044]	[0.026]
Observations	12,876	10,452	12,876	10,452
Number of groups	3,389	2,665	3,389	2,665

(i) Regressions are run on all companies in columns (1) and (3) and only on multinationals in columns (2) and (4). (ii) Regressions run using a GMM-diff estimator (Arellano and Bond [1991]). (iii) Standard errors in parentheses.
(iv) Instruments used are 2nd and further lags of firm-level variables, the 1st and 2nd lag of the previous two periods' average tax bill divided by total assets, and country-year dummies. Instruments are collapsed as described in Roodman [2009]. (v) ***, **, * significant at 1%, 5% and 10% respectively.

Table 11: METR and Tax Haven Operations

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)
Lag(tax bill/total assets)	0.074***	0.083***	0.071***	0.082***
	(0.010)	(0.011)	(0.010)	(0.010)
P&L/tot.assets (if gain)	21.419***	21.728***	21.470***	21.890***
	(3.536)	(3.427)	(3.531)	(3.420)
X dW	14.778***	13.070***		
	(4.147)	(4.095)		
X dUS			15.173***	13.348***
			(4.131)	(4.078)
X dUK			7.724*	7.482*
			(4.194)	(4.207)
X dIE			-4.607	-2.745
			(11.080)	(11.339)
X no. subs tax havens (n)	-0.711**	-0.844***	-0.785***	-0.881***
	(0.297)	(0.303)	(0.294)	(0.299)
X no. subs tax havens squared (n^2)	0.025***	0.027***	0.028***	0.028***
	(0.005)	(0.005)	(0.005)	(0.005)
X dW X n	0.433	0.672**	0.586*	0.746**
	(0.313)	(0.321)	(0.307)	(0.314)
X dW X n^2	-0.022***	-0.025***	-0.025***	-0.027***
	(0.005)	(0.005)	(0.005)	(0.005)
n	-0.817**	-0.381	-1.012***	-0.679*
	(0.409)	(0.398)	(0.375)	(0.368)
n^2	0.015***	0.008*	0.015***	0.010**
	(0.005)	(0.005)	(0.004)	(0.004)
Dummy - aggregate loss	2.378***	1.832***	2.360***	1.805***
	(0.562)	(0.529)	(0.564)	(0.528)
X n	-0.601***	-0.429**	-0.601***	-0.409**
	(0.175)	(0.167)	(0.177)	(0.168)
X n^2	0.022***	0.014*	0.022***	0.013*
	(0.008)	(0.007)	(0.008)	(0.007)
Intangibles/tot.assets	0.796	0.678	0.749	0.686
	(0.833)	(0.843)	(0.810)	(0.823)
X n	-0.358***	-0.346***	-0.380***	-0.378***
	(0.078)	(0.079)	(0.080)	(0.079)
X n^2	0.006***	0.006***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Log(employees)	-1.259***	-1.233***	-1.302***	-1.271***
	(0.310)	(0.314)	(0.312)	(0.312)
X dW	1.373***	1.567***	1.370***	1.570***
	(0.403)	(0.405)	(0.393)	(0.396)
X dW X n	0.114***	0.115***	0.125***	0.127***
	(0.038)	(0.039)	(0.038)	(0.039)
X dW X n^2	-0.003***	-0.003***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Country-year dummies	✓	✓	✓	✓
AR(1)	-13.90	-12.59	-13.82	-12.52
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-0.888	-1.066	-1.183	-1.251
p-value	[0.375]	[0.286]	[0.237]	[0.211]
Hansen over-identification test	140.0	147.2	151.2	156.1
Degrees of freedom	(146)	(146)	(158)	(158)
p-value	[0.624]	[0.457]	[0.636]	[0.527]
Observations	12,876	10,452	12,876	10,452
Number of groups	3,389	2,665	3,389	2,665

(i) Regressions are run on all companies in columns (1) and (3) and only on multinationals in columns (2) and (4). (ii) Regressions run using a GMM-diff estimator (Arellano and Bond [1991]). (iii) Standard errors in parentheses. (iv) Instruments used are 2nd and further lags of firm-level variables and country-year dummies. Instruments are collapsed as described in Roodman [2009]. (v) ***, **, * significant at 1%, 5% and 10% respectively.

Table 12: METB and Tax Haven Operations

Dependent variable: Tax bill/total assets	(1)	(2)	(3)	(4)
Lag(tax bill/total assets)	0.073***	0.083***	0.076***	0.082***
	(0.010)	(0.009)	(0.010)	(0.010)
P&L/tot.assets (if gain)*τ^H	84.023***	83.255***	83.539***	83.897***
	(9.084)	(8.995)	(9.115)	(8.985)
X dW	-2.720	-6.405		
	(10.437)	(10.517)		
X dUS			-7.511	-11.315
			(10.497)	(10.442)
X dUK			7.071	-3.137
			(10.741)	(10.947)
X dIE			10.960	-4.004
			(50.084)	(53.262)
X no. subs tax havens (n)	-2.384***	-3.154***	-2.341***	-3.149***
	(0.834)	(0.891)	(0.829)	(0.886)
X no. subs tax havens squared (n^2)	0.080***	0.090***	0.079***	0.090***
	(0.012)	(0.014)	(0.012)	(0.014)
X dW X n	2.144**	3.097***	1.990**	3.025***
	(0.889)	(0.944)	(0.881)	(0.939)
X dW X n^2	-0.076***	-0.088***	-0.072***	-0.086***
	(0.013)	(0.014)	(0.013)	(0.014)
n	-0.777**	-0.599*	-1.054***	-0.863**
	(0.386)	(0.359)	(0.380)	(0.352)
n^2	0.014***	0.009**	0.020***	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)
Making loss dummy	2.088***	1.705***	2.216***	1.829***
	(0.565)	(0.552)	(0.568)	(0.554)
X n	-0.561***	-0.396**	-0.560***	-0.388**
	(0.170)	(0.167)	(0.166)	(0.166)
X n^2	0.020***	0.012*	0.020***	0.012
	(0.007)	(0.007)	(0.007)	(0.007)
Intangibles/tot.assets	1.040	1.217	0.606	0.865
	(0.815)	(0.816)	(0.788)	(0.792)
X n	-0.326***	-0.376***	-0.329***	-0.393***
	(0.068)	(0.066)	(0.068)	(0.067)
X n^2	0.005***	0.005***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Log(employees)	-0.348	-0.520**	-0.358	-0.516**
	(0.257)	(0.250)	(0.256)	(0.252)
X dW	0.057	0.367	-0.215	0.174
	(0.317)	(0.317)	(0.312)	(0.315)
X n	0.097***	0.107***	0.107***	0.119***
	(0.037)	(0.037)	(0.036)	(0.037)
X n^2	-0.002***	-0.002***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Country dummies	✓	✓	✓	✓
AR(1)	-13.88	-12.66	-14.07	-12.80
p-value	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	-1.352	-1.303	-1.098	-1.194
p-value	[0.176]	[0.192]	[0.272]	[0.232]
Hansen over-identification test	153.2	156.2	174.7	177.1
Degrees of freedom	(146)	(146)	(158)	(158)
p-value	[0.326]	[0.267]	[0.172]	[0.142]
Observations	12,876	10,452	12,876	10,452
Number of groups	3,389	2,665	3,389	2,665

(i) Regressions are run on all companies in columns (1) and (3) and only on multinationals in columns (2) and (4). (ii) Regressions run using a GMM-diff estimator (Arellano and Bond [1991]). (iii) Standard errors in parentheses.
(iv) Instruments used are 2nd and further lags of firm-level variables, the 1st and 2nd lag of the previous two periods' average tax bill divided by total assets, and country-year dummies. Instruments are collapsed as described in Roodman [2009]. (v) ***, **, * significant at 1%, 5% and 10% respectively.

Table 13: Construction of 'Number of Tax Havens Subsidiaries' –Example

Year	Static ownership structure from ORBIS											ZEPHYR (vendors)				ZEPHYR (acquirers)	No. subsidiaries in tax havens
	BB	BM	CH	HK	IE	KY	LC	LU	MO	PA	VC	BH	HK	SG	CH	MC	
1999	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	18
2000	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	17
2001	1	2	1	2	2	1	1	1	1	1	1	0	0	1	1	0	15
2002	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2003	1	2	1	2	2	1	1	1	1	1	1	0	1	0	0	0	14
2004	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	1	15
2005	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2006	1	2	1	2	2	1	1	1	1	1	1	0	0	0	0	0	15
2007	1	2	1	2	2	1	1	1	1	1	1	1	0	0	0	0	14

[(i)] Barbados (BB), Bermuda (BM), Switzerland (CH), Hong Kong (HK), Ireland (IE), Cayman Islands (KY), Saint Lucia (LC), Luxembourg (LU), Macau (MO), Panama (PA), Saint Vincent (VC), Singapore (SG), Monaco (MC). [(ii)] Figures represent the number of subsidiaries located in each tax haven. In the section 'ZEPHYR (vendors)' the figures represent the number of subsidiaries sold by the ultimate owner in that specific year. In the section 'ZEPHYR (acquirers)' the figures represent the number of subsidiaries acquired by the ultimate owner in that specific year. [(iii)] The value of the variable recording the number of subsidiaries located in tax havens for 2007 is created by adding up the static information from ORBIS (column 2 to 12). The value of such a variable for the previous year (2006) is created by adding up the information from ZEPHYR vendors (column 13 to 16, row 2007) and by subtracting the information from ZEPHYR acquirers (column 17, row 2007). The process continues backwards until the last year (here 1999).

Table 14: Construction of the Dataset used in the Empirical Analysis

	No. of companies	No. observations
ORBIS (online version 16/10/2008)		
Selecting on large and very large companies	1,093,428	
Exclude companies with no financial information	739,989	
Region: Western Europe (26), Canada, and the United States	427,331	
Industrial companies only	401,944	
Number of employees available non missing	293,906	
Only Global Ultimate Owners	26,193	
Active companies only	25,201	
Firms with consolidated accounts only	17,876	
Total assets available for last year	17,863	
Companies with majority owned subsidiaries[(i)]	17,816	
Actual download from online version[(ii)]	15,207	136,863
Drop if accounting period different from 12 months	15,207	134,360
Drop if total assets negative or zero	15,207	134,257
Drop non-suitable sectors	14,592	128,833
Drop countries with less than 300 observations	14,555	128,503
Drop if incorporation year is missing	13,918	122,842
Drop outliers[(iii)]	13,710	117,495
Drop if total assets, P&L before tax, or tax bill missing	13,089	76,445
Drop if information on ownership structure missing	12,959	75,930
MERGE WITH ZEPHYR ACQUIRERS	12,959	75,930
- of which present in ZEPHYR (acquirers)	*295*	*348*
MERGE WITH ZEPHYR VENDORS	12,959	75,930
- of which present in ZEPHYR (vendors)	*190*	*271*
- of which present in ZEPHYR (acquirers and (or) vendors)	*437*	*606*
Drop if number of subs in tax havens is negative	12,908	75,532
- of which present in ZEPHYR (acquirers and (or) vendors) also	*386*	*541*
Drop if number of employees missing	5,161	35,288
Drop if (intangibles/total assets) missing	4,618	28,882
Drop if (debt/total assets) missing	4,618	28,882
- of which present in ZEPHYR (acquirers and (or) vendors) also	*335*	*471*
Drop if observations not contiguous in the time for same company	4,618	27,120
- of which present in ZEPHYR (acquirers and (or) vendors) also	*323*	*452*

[(i)] Subsidiaries are of the following type: industrial, insurance, banks, or financial institutions.
[(ii)] The number of companies obtainable through the actual download is slightly smaller than the number of companies potentially available from the online version of ORBIS. This happens because some observations are dropped during the download as they miss all the variables, including the company name and identification number. [(iii)] Outliers are defined as the observations with a value of $\frac{P\&L\ before\ taxation}{total\ assets}$, $\frac{Tax\ bill}{P\&L\ before\ taxation}$, $\frac{Fixed\ assets}{no.\ employees}$, or age within the top or bottom 1 per cent. The observations dropped are 4.35 per cent of the sample.

Table 15: Download of ZEPHYR

ZEPHYR ACQUIRERS (online version 06/01/2009)	No. firms (acquirers)	No. obs	No. deals
Acquirer located in OECD country			379,323
Target located in tax haven			11,348
Deal type: merger or acquisition			6,634
Deal completed from 1999 onwards			4,295
Actual download[i]	3,963	4,762	4,256
Drop if acquirer's ID missing	2,405	3,204	3,142
Drop if country of target missing	2,362	3,143	3,138
Keep if final stake is majority	1,792	2,248	2,244
Drop if year of deal 2008 or missing	1,579	1,957	1,957
Drop if acquirer's country not relevant	1,523	1,886	1,957
Drop if country of target not tax haven	1,491	1,841	1,886
Create a panel with only one observation for each year and each company	1,491	1,701	
ZEPHYR VENDORS (online version 06/01/2009)	No. firms (vendors)	No. obs	No. deals
Vendor located in OECD country			140,425
Target located in tax haven			5,166
Deal completed from 1999 onwards			3,252
Actual download[i]	3,224	4,097	3,223
Drop if aquirer's ID missing	1,528	2,401	2,086
Drop if country of target missing	1,392	2,189	2,084
Drop if year of deal 2008 or missing	1,257	1,822	1,822
Drop if country of target not tax haven	1,220	1,773	1,773
Create a panel with only one observation for each year and each company	1,220	1,528	

[(i)] The number of deals obtainable through the actual download is slightly smaller than the number of deals potentially available from the online version of ZEPHYR. This happens because some observations are dropped during the download as they miss all the variables, including the company name and identification number.

Table 16: Corporate Groups by Sector

Sector	No. of corporate groups	Per cent
Mining and quarrying	110	3.25
Manufacturing of food products and beverages	92	2.71
Manufacturing of tobacco products	5	0.15
Manufacturing of textiles	22	0.65
Manufacturing of wearing apparel	28	0.83
Manufacturing of leather products	11	0.32
Manufacturing of wood	10	0.30
Manufacturing of paper	36	1.06
Publishing and printing	54	1.59
Manufacturing of coke, petroleum, and nuclear fuel	14	0.41
Manufacturing of chemicals	220	6.49
Manufacturing of rubber and plastic products	46	1.36
Manufacturing of other non-metallic products	31	0.91
Manufacturing of basic metals	51	1.50
Manufacturing of fabricated metal prods	46	1.36
v machinery and equipment	172	5.08
Manufacturing of office machinery and computers	65	1.92
Manufacturing of electrical machinery	61	1.80
Manufacturing of radio, TVs, and communication equipment	280	8.26
Manufacturing of medical, precision, and optical instruments	192	5.67
Manufacturing of transport equipment	99	2.92
Manufacturing of various	68	2.01
Electricity, gas and water supply	83	2.45
Construction	76	2.24
Wholesale and retail trade	307	9.06
Hotels and restaurants	73	2.15
Transport	97	2.86
Post and telecommunication	130	3.84
Financial intermediation	102	3.01
Real estate activities	43	1.27
Renting of machinery and equipment	22	0.65
Computer and related activities	348	10.27
Research and development	35	1.03
Other business activities	244	7.20
Recreational, cultural, and sport activities	116	3.42
Total	3,389	100.00

[(i)] Sectors correspond to the two-digit NACE codes (Rev. 1.1).

Table 17: Comparing Different Estimators

Dependent variable: Tax bill/total assets	(1)	(2)	(3)
Lag(tax bill/total assets)	0.283***	-0.023	0.079***
	(0.015)	(0.014)	(0.019)
P&L/total assets (if gain)	20.856***	20.179***	16.607***
	(0.877)	(1.510)	(4.618)
X dW	2.785***	3.883**	19.191***
	(0.955)	(1.901)	(5.122)
Dummy - aggregate loss	0.196*	0.216	1.549***
	(0.105)	(0.145)	(0.558)
Intangibles/tot.assets	0.002	-0.921	-2.287
	(0.204)	(0.634)	(2.664)
X dW	0.133	1.312*	3.177
	(0.219)	(0.681)	(2.875)
Log(employees)	0.057***	-0.029	-1.118***
	(0.013)	(0.109)	(0.386)
X dW	-0.008	0.141	1.551***
	(0.016)	(0.129)	(0.510)
Country-year dummies	✓	✓	✓
AR(1)	.	.	-13.41
p-value	.	.	[0.000]
AR(2)	.	.	-0.997
p-value	.	.	[0.319]
Hansen over-identification test	.	.	58.37
Degrees of freedom	.	.	(54)
p-value	.	.	[0.318]
Observations	12,876	12,876	12,876
Number of groups	3,389	3,389	3,389

(i) Regressions run using a pooled OLS (column 1), a within-group estimator (column 2) and a GMM-diff estimator (Arellano and Bond [1991]) in column 3.
(ii) Standard errors in parentheses and clustered at group level.
(iii) Instruments used are 2nd and further lags of firm-level variables and country-year dummies. Instruments are collapsed as described in Roodman [2009].
(iv) ***, **, * significant at 1%, 5% and 10% respectively.

Table 18: Within-group Changes in Tax Haven Dummies

	No. of groups	Per cent of total corporate groups
Dummy - at least one tax haven subsidiary	47	1.3
Dummy - two or more tax haven subsidiaries	37	1.1
Dummy - three or more tax haven subsidiaries	29	0.9
Dummy - four or more tax haven subsidiaries	19	0.6
Dummy - more than 30 tax haven subsidiaries	10	0.3
Total	3,389	

(i) Number of corporate groups recording at least one change in the dummy.

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