Debt-shifting in Europe

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Abstract

This article aims to analyze the link between subsidiary capital structure and taxation in Europe. First we introduce a trade-off model, which looks at a MNC's financial strategy and in particular debt shifting from low-tax to high-tax jurisdictions. By letting the MNC choose both leverage and the profit shifting percentage, we depart from the relevant literature which has mainly focused on the latter. Using the AMADEUS dataset we show that: i) in line with the relevant literature, subsidiary leverage increases with its statutory tax rate; ii) contrary to previous work, if a parent company is located in a high-tax country and its subsidiary is making profit, an increase in the parent company's tax rate has a positive impact on the subsidiary's leverage.

JEL classification: G31, H25, H32.

Keywords: capital structure, default, debt shifting, multinationals, taxation.

1 Introduction

Research on multinational companies (MNCs) has gathered interesting evidence regarding both financing decisions and their ability to shift debt from high- to low-tax jurisdictions. In particular, this evidence shows that the amount of debt shifted depends on tax rate differentials.

Most empirical work on MNCs' choices is based on US and Canadian data.[1] More recently, however, scholars have focused on tax determinants of European company strategy. In particular, Buettner et al. (2006, 2009), Buettner and Wamser (2007), Ramb and Weichenrieder (2005), Mintz and Weichenrieder (2005, 2010) and Overesch and Wamser (2010) have analyzed the impact of taxation on German companies. Huizinga et al. (2008) have applied a static model of a multinational firm's optimal debt shifting policy. Using the AMADEUS firm-level dataset for European companies, they have shown that their theoretical predictions are supported by the empirical evidence. In particular, a foreign subsidiary's capital structure depends on local corporate tax rates as well as on the difference between its parent company's tax rate and other foreign subsidiaries' rates.

It is worth noting that the existing literature has used the differential between the subsidiary's and the parent company's tax rate, as the main determinant of debt shifting within a group. In particular, denoting this differential as $(\tau_A - \tau_B)$, with τ_A and τ_B as the parent company and subsidiary tax rate, respectively, scholars expect that τ_B stimulates the subsidiary's leverage and that the opposite is true when τ_A rises. As will be shown, however, tax effects are more complex. This is due to the fact that taxes affect both a MNC's borrowing decision and the distribution of debt

[1] For instance, Collins and Shackelford (1992) and Froot and Hines (1995) use consolidated financial accounting data from Compustat. They show that a firm's financial activities are affected by taxation. Altshuler and Mintz (1995) studied the impact of the changes to interest allocation rules in the 1986 tax reform, using the data of large companies. Desai et al. (2004) used confidential individual data and find that tax rates strongly affect the use of debt by affiliates. Their central estimate is that a 10% higher tax rate is associated with 2.8% higher affiliate debt as a proportion of assets. Internal debt is particularly sensitive.

A related topic about income shifting activities was dealt with by Altshuler and Grubert (2003), Desai et al. (2004), Graham and Tucker (2005), Hines (1999), Jon and Tang (2001), Mills and Newberry (2004), Newberry and Dhaliwahl (2001), Mintz (2000) and Mintz and Smart (2004). For further details, see also Graham (2005), Graham and Tucker (2006), Devereux (2007) and de Moij (2011).

among its entities. In other terms, taxation affects not only the benefit of each Euro of debt shifted from one country to another (according to the relevant literature), but also the absolute value of borrowing.

In order to analyze a MNC's financial choices, we will use a continuous-time trade-off model, where default is a contingent event, which depends on the EBIT's volatility as well as on other deep parameters (such as the risk-free interest rate and the expected growth of EBIT). We will then study a MNC's choices in terms of both optimal leverage and debt shifting. As will be shown, the parent company's tax rate may have a positive effect on a subsidiary's leverage. The reasoning behind our finding is straightforward. On the one hand, an increase in the parent company's tax rate τ_A reduces the tax benefit of shifting debt from the parent company to its subsidiary. On the other hand, the tax rate increase raises the MNC's overall tax rate, thereby increasing the tax benefit of interest deductibility. This latter effect encourages the MNC to raise debt. In turn, debt is divided between the parent company and the subsidiary. If therefore this latter effect dominates the former, the parent tax rate has a positive impact on a subsidiary's leverage.[2]

In order to test the predictions of our theoretical model, we look at the link between subsidiaries' capital structure and taxation in Europe. Using the AMADEUS dataset, we will use subsidiary leverage as the dependent variable and show that, in line with the existing literature, it increases with its host country tax rate (τ_B). Moreover, if the parent company is located in a high-tax country and its subsidiary is profitable, an increase in the parent company tax rate has a positive impact on its subsidiary's leverage. This result contrasts with previous findings.

The structure of the article is as follows. Section 2 discusses the trade-off model and focuses on the tax determinants of financial choices. Section 3 deals with the AMADEUS dataset and discusses some preliminary evidence on our sample. Section 4 and 5 provide an empirical investigation of the determinants of subsidiaries' financial structure. Section 6 summarizes our findings.

[2] Ramb and Weichenrieder (2005) studied the impact of parent companies' tax rates. However, they showed that parent tax rates have no statistically significant effect on subsidiaries' leverage. More recently, Overesch and Wamser (2010) have studied the effects of parent companies' tax rates on parent companies' capital structure.

2 The model

In this section we introduce a trade-off model describing the financial choices of a MNC consisting of a parent company resident in country A and a subsidiary located in country B. Here, we assume that our MNC (both the parent company and its subsidiary) can borrow from a third-party lender operating in a perfectly competitive sector, which is characterized by a given risk-free interest rate r and by symmetric information.

As pointed out in the introduction, we will let our MNC choose both its overall leverage and the distribution of debt within the group. To complete our framework, we will also introduce the following:

Assumption 1 *The MNC's EBIT (Earning Before Interest and Taxes), defined as* $\Pi(t)$*, follows a geometric Brownian motion*

$$\frac{d\Pi(t)}{\Pi(t)} = \mu dt + \sigma dz(t), \quad \textit{with } \Pi(0) > 0, \tag{1}$$

where μ *is the expected rate of growth,* σ *is the instantaneous standard deviation of* $\frac{d\Pi(t)}{\Pi(t)}$*, and* $dz(t)$ *is the increment of a Wiener process.*

Assumption 2 *Within the multinational group, the parent company produces a portion* $\chi \in (0,1)$ *of the overall EBIT; the remaining part* $(1-\chi)$ *is produced by its foreign subsidiary.*

Assumption 3 *At time 0, the MNC can decide how much to borrow and consequently pays a constant coupon, defined as* C*, for debt finance.*

Assumption 4 *Debt is optimally divided between the parent company and its subsidiary with weights* a *and* $(1-a)$*, respectively.*

Assumption 5 *Debt is non-renegotiable and default occurs when the MNC's net cash flow falls to zero.*

Assumption 6 *The cost of default is* $\upsilon \in (0,1)$ *times the value of the bankrupt MNC.*

According to assumption 1, a MNC's EBIT evolves stochastically and is jointly produced by the parent company A and the subsidiary B, with weights (see assumption 2) χ and $(1-\chi)$, respectively.[3] According to assumption 3, the MNC chooses its leverage ratio by setting a coupon C.[4] Assumption 4 states that the MNC chooses how to divide debt between the parent company and its subsidiary.

As explained by Smith and Warner (1979), if debt renegotiation is costly or even impossible (according to assumption 5), default may take place.[5] In our model, default occurs when the MNC's net cash flow falls to zero.[6] In this case, the MNC is expropriated by the lender, who faces a sunk cost.[7] In line with Leland (1994), such a cost is assumed to be proportional to the MNC value (assumption 6).

Taxation plays a crucial role in our model. Indeed, with zero tax rates, the MNC would have no incentive to borrow: debt finance might cause costly default with no benefit. When however, taxation is introduced and interest payments are deductible, debt finance leads to tax savings. Hence, both τ_A and τ_B will affect debt finance.

For simplicity, we assume that taxation is fully symmetric (i.e., profit and loss are treated symmetrically) and that it follows the source principle.[8] In this case, the MNC finds it optimal to borrow by trading off the tax benefit of interest deductibility and the expected cost of default. According to assumption 4, debt can be divided between the parent company and its subsidiary.

It is worth noting that, whenever tax rates are different, a MNC has an incentive to shift debt. In particular, we expect that the MNC's entities will sign a financial arrangement according to which the entity operating in a

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[3]By setting χ and $(1-\chi)$ as exogenously given, we assume that the locational choice has already been made. We leave the joint analysis of locational and financial decisions for future research.

[4]Given C we can calculate the fair value of debt. For further details on this point see Leland (1994). Also, notice that here we focus on pure debt finance. For an analysis of hybrid derivatives and their tax treatment see Panteghini (2011).

[5]For an analysis of costly debt renegotiation see, e.g., Goldstein et al. (2001).

[6]This also implies that debt is secured. As explained by Smith and Warner (1979, p. 127) "[s]ecuring debt gives bondholders title to pledged assets until the bonds are paid in full". As pointed out by Leland (1994), minimum net-worth requirements, implied by secured debt, are more common in short-term debt financing.

[7]For further details on default conditions see Smith and Warner (1979), and Leland (1994). For a study of corporate taxation under default risk see also Panteghini (2006, 2007 and 2011).

[8]Notice that the existence of deferral possibilities and limited credit rules can *de facto* lead to the application of the source principle.

high-tax country borrows from the entity placed in the low-tax country. This leads to the payment of an interest which reduces (increases) the reported profit where taxation is high (low). The MNC's overall tax burden is thus reduced.

Shifting debt is costly. This is due to the joint effect of two factors: one is related to advising activities and the other to anti-avoidance rules. On the one hand, shifting debt usually requires the costly advice of tax and financial experts. On the other hand, countries aim to prevent tax-avoiding practices by introducing *ad hoc* rules, such as thin capitalization and earning-stripping devices.[9] It is worth noting that if tax rates were equal, there would be no tax incentive to divide debt and EBIT with different weights. Denoting a and $(1-a)$ as the parent company's and subsidiary's weight, respectively, we would expect that given the same tax rate, the equalities $a=\chi$ and $(1-a)=(1-\chi)$ hold. If however tax rates were different, the MNC could set $a\neq\chi$ so as to minimize its overall tax burden. Denoting $\nu(a)$ as the concealment cost paid by the MNC to shift debt from one entity to another, we introduce the following:

Assumption 7 *Debt shifting entails a quadratic concealment cost function, i.e.,*

$$\nu(a)=\frac{n}{4}\left\{(\chi-a)^2+[(1-\chi)-(1-a)]^2\right\}.$$

According to assumption 7, setting $a\neq\chi$ is costly. As usual, we assume that such a cost function is quadratic. Moreover, it is proportional to the sum between the parent company's debt shifting cost, $(\chi-a)^2$, and the subsidiary's one, $[(1-\chi)-(1-a)]^2$. Parameter n allows us to deal with both institutional determinants and advising activities. In other terms, the introduction of thin capitalization and earning-stripping rules, aimed at preventing any tax avoidance activity, raises n and hence the costs of debt shifting. Moreover, the decrease in the cost of tax sheltering operations, which is linked to the degradation of book and tax profits (see, e.g., Desai, 2003, 2005), leads to a decrease in n.

For simplicity, we will assume that the concealment cost is non-deductible and that it is imputed to the parent company.[10] Given these assumptions,

[9] For a discussion on the application of these devices in EU countries see Garbarino and Panteghini (2007), and Mintz and Weichenrieder (2010).

[10] The quality of results would not change if we assumed partial or full deductibility of such costs (see Panteghini and Schjelderup, 2006).

we can now write the MNC's after-tax profit function:

$$\begin{aligned}\Pi^{N}(\Pi) &= \underbrace{\{(1-\tau_A)[\chi\Pi - aC] - \nu(a)C\}}_{\text{parent company's after-tax profit}} \\ &+ \underbrace{\{(1-\tau_B)[(1-\chi)\Pi - (1-a)C]\}}_{\text{subsidiary's after-tax profit}} \\ &= (1-\widehat{\tau})\Pi - [1-\tau_C(a)]C,\end{aligned} \tag{2}$$

where $\widehat{\tau} \equiv \chi\tau_A + (1-\chi)\tau_B$ is the MNC's effective tax rate levied on a MNC's EBIT and

$$\tau_C(a) \equiv \tau_A a + \tau_B(1-a) - \nu(a) \tag{3}$$

is the net tax benefit of debt finance.

According to assumption 5, default occurs when $\Pi^{N}(\Pi)$ goes to zero. Therefore, setting (2) equal to zero and solving for Π gives the default threshold point:[11]

$$\overline{\Pi} = \frac{1-\tau_C(a)}{1-\widehat{\tau}}C. \tag{4}$$

Using (4) we can now write the MNC's value (see Appendix A) as:

$$V(C,a;\Pi) = \frac{(1-\widehat{\tau})\Pi}{\delta} + \frac{\tau_C(a)C}{r} - \left[\frac{\upsilon(1-\widehat{\tau})\overline{\Pi}}{\delta} + \frac{\tau_C(a)C}{r}\right]\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2}, \tag{5}$$

where $\delta = r - \mu$ is the so-called dividend yield (see Dixit and Pindyck, 1994) and $\beta_2 = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} < 0$.[12] As can be seen, function (5) consists of three terms. The first term measures the net present value of the after-tax EBIT. The second term measures the overall net benefit arising from debt financing. The third term measures the expected cost of default. This cost is proportional to the coupon paid. Moreover, it depends both on the tax benefit lost (i.e., $\tau_C(a)$) after default and on the cost of default. The term $\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2}$ measures the present value of 1 Euro contingent on the event of default.

[11] The quality of results does not change if we set a different threshold value. For further details on default conditions, see, e.g., Brennan and Schwartz (1977), Smith and Warner (1979), and Leland (1994).

[12] For simplicity, we let δ be non-negative (see Dixit and Pindyck, 1994).

2.1 The MNC's choices

As pointed out, the MNC takes two tax-motivated decisions. Accordingly, it chooses both the overall coupon (C^*) and the percentage of debt shifting (a^*). Given (5), a^* and C^* are the solutions of the following problem:[13]

$$\max_{C,a} V\left(C, a; \Pi\right). \tag{6}$$

Solving (6) we obtain (see Appendix B):

$$a^* = \chi + \frac{\tau_A - \tau_B}{n} \tag{7}$$

and

$$C^* = \left\{ \frac{1-\widehat{\tau}}{1-\tau_C\left(a^*\right)} \left[\frac{\tau_C\left(a^*\right)}{\left(1-\beta_2\right)\left[\frac{r(1-\tau_C(a^*))v}{\delta} + \tau_C\left(a^*\right)\right]} \right]^{-\frac{1}{\beta_2}} \right\} \Pi. \tag{8}$$

As shown in (7), a^* depends on the tax rate differential $(\tau_A - \tau_B)$. If $\tau_A = \tau_B$, no debt is shifted and the overall amount of debt is divided with weights χ and $(1-\chi)$. Otherwise, it is optimal for the MNC to choose a different allocation of debt. In particular, if $\tau_A > \tau_B$, the MNC shifts debt from the foreign to the home country and vice versa. Using (7) the tax benefit of shifting 1 Euro of debt is equal to:

$$\tau_C\left(a^*\right) = \tau_A a^* + \tau_B\left(1-a^*\right) - \nu\left(a^*\right) = \widehat{\tau} + \frac{\left(\tau_A - \tau_B\right)^2}{2n}.$$

As can be seen, the optimal tax benefit $\tau_C\left(a^*\right)$ depends on both the MNC's effective tax rate $\widehat{\tau}$ and the tax rate differential $(\tau_A - \tau_B)$. As can be seen, the inequality $\tau_C\left(a^*\right) > \widehat{\tau}$ holds if $\tau_A \neq \tau_B$. This means that the default threshold point (of Eq. (4)) is less than the optimal coupon, C^*.[14]

When the equality $\tau_A = \tau_B$ holds, it is easy to show that $\frac{\partial C^*}{\partial \tau}\Big|_{\tau_A=\tau_B=\tau} > 0$ (see Panteghini 2007). When however tax rates are different, the effect of taxation on C^* is much more complex, since it depends on both the effective

[13] The maximization of the MNC's overall value (including debt) implicitly rules out any agency conflict between shareholders and the lender.

[14] Due to full tax symmetry, if the MNC's EBIT Π ranges between $\overline{\Pi}$ and C^* (and so the group is making a loss), it is optimal not to default to exploit interest deductibility.

tax rate $\widehat{\tau}$ and the net tax benefit $\tau_C(a^*)$. In particular, the choice of a affects $\tau_C(a^*)$ and therefore the choice of the coupon. It is worth noting that so far, this effect has not been treated by the existing literature.[15]

2.2 The subsidiary's leverage

As pointed out in the introduction, we will focus on subsidiaries' leverage ratio. Given the solutions of Problem (6), we can calculate the subsidiary's coupon as $C_S \equiv (1-a^*)\,C^*$. It is easy to show that:

$$\frac{dC_S}{d\tau_B} > 0.$$

Not surprisingly, an increase in τ_B is expected to raise C_S: such a tax rate increase causes a rise in the MNC's average tax rate, thereby stimulating borrowing. Moreover, it induces the MNC to shift more debt towards the host country where the subsidiary operates.

The effect of τ_A, however, is ambiguous. As shown in Appendix C, differentiating C_S w.r.t. τ_A gives:

$$\frac{dC_S}{d\tau_A} = \left\{ \underbrace{\left[-\frac{1}{1-a^*}\frac{da^*}{d\tau_A} \right]}_{<0} + \underbrace{\left[\frac{1}{C^*}\frac{dC^*}{d\tau_A} \right]}_{\gtreqless 0} \right\} C_S. \tag{9}$$

As shown in (9), the effect of an increase in τ_A is twofold. On the one hand, an increase in the parent company's tax rate τ_A reduces the tax benefit of shifting debt towards the subsidiary: this reduces the optimal debt weigh $(1-a^*)$. On the other hand, the increase in τ_A may raise the weighted average of a MNC's tax rate $\tau_C(a^*)$, thereby stimulating the group to increase borrowing: this leads to an increase in the overall coupon C^*. Since the impact of τ_A on the subsidiary's coupon may have the opposite sign, the net effect is ambiguous. As shown in Appendix C, if $\tau_A > \tau_B$ we have $\frac{dC^*}{d\tau_A} > 0$: in this case, the latter effect always dominates the former one. As will be

[15] As shown in (8), C^* is proportional to the current EBIT, Π. It is also easy to prove that $\frac{\partial C^*}{\partial v} < 0$; i.e., an increase in the sunk cost of default reduces the propensity to borrow. As shown by Leland (1994), the value of debt is a U-shaped function of volatility (i.e., it increases up to a certain threshold value of the coupon). For further details see Leland (1994) and Goldstein et al. (2001).

shown in the empirical part, for most European foreign owned companies the inequality $\tau_A > \tau_B$ holds therefore, we expect that an increase in their parent company's tax rate leads to an increase in the subsidiary's propensity to borrow.

2.3 Bringing the model to the data

So far we have focused on flow rather than stock variables. In the empirical part of this article however, we will use financial statement data to estimate the sign and size of the tax rate effects. Hence, the dependent variable will be equal to

$$L_S(\Pi) = \frac{D_S(\Pi)}{E_S(\Pi) + D_S(\Pi)}, \tag{10}$$

where $D_S(\Pi)$ and $E_S(\Pi)$ are the subsidiary's debt and equity value, respectively. As shown in Appendix D they are equal to:

$$D_S(\Pi) = \begin{cases} \frac{(1-\chi)(1-\tau_B)\Pi}{\delta} & \text{a.d.,} \\ \frac{(1-a^*)C^*}{r} + \left[\frac{(1-\upsilon)(1-\chi)(1-\tau_B)\overline{\overline{\Pi}}}{\delta} - \frac{(1-a^*)C^*}{r}\right]\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2} & \text{b.d.,} \end{cases}$$

and

$$E_S(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ (1-\tau_B)\left\{\left[(1-\chi)\frac{\Pi}{\delta} - (1-a^*)\frac{C^*}{r}\right] \right. & \\ \left. -\left[(1-\chi)\frac{\overline{\overline{\Pi}}}{\delta} - (1-a^*)\frac{C^*}{r}\right]\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2}\right\} & \text{b.d.,} \end{cases}$$

where 'a.d.' and 'b.d.' mean 'after default' and 'before default', respectively.

Given this result, we expect that the leverage of the subsidiary $L_S(\Pi)$ is a complex function of both parent company tax rate (τ_A) and its own tax rate (τ_B). In particular, the parent company's tax rate causes two offsetting effects (see **Figure 1**). On the one hand, an increase in the parent company's tax rate τ_A raises the average MNC's tax rate, thereby increasing its leverage. This may lead to an increase in the subsidiary's leverage, even if the optimal weight $(1-a^*)$ decreases. On the other hand, the increase in τ_A increases the tax rate differential $(\tau_A - \tau_B)$ thereby discouraging the subsidiary's propensity to borrow.[16]

[16] Our model shows that tax effects are non-linear and may have an ambiguous sign. We can therefore understand the empirical results of Mintz and Weichenrieder (2010), who found that τ_B^2 is statistically significant. Moreover, we can explain why, as argued by Gordon (2010), tax responses may be limited: this may be due to the offsetting effects depicted in Figure 1.

Figure 1

To analyze tax effects we run a numerical simulation of the subsidiary's optimal coupon $C_S \equiv (1 - a^*) C^*$ and leverage function (10). We will assume realistic tax rate values, (i.e., $0 \leq \tau_A \leq 0.5$, $0 \leq \tau_B \leq 0.5$) and, in line with Dixit and Pindyck (p. 157 and p. 193, 1994; 1999), we will set $r = 0.04$, $\mu = 0$ and $\sigma = 0.2$. Finally, we will assume that: $\Pi = 1$, $\upsilon = 0.2$, $n = 2$ and $\chi = 0.5$ (i.e., the parent company and its subsidiary have equal weight).

Given $\tau_B = 0.20$, we show in **Figure 2** simulated optimal coupon C_S, debt D_S, equity E_S and leverage L_S as functions of the parent company tax rate, τ_A, when $\tau_A > \tau_B$., that is, the most common case in our European data. As can be seen, an increase in τ_A raises the subsidiary's coupon C_S. As a consequence, debt increases while the equity value decreases. For this reason, the subsidiary's leverage is increasing in τ_A.[17] In **Figure 2** we also show that Debt is increasing in the parent tax rate. This implies that given the book value of a subsidiary's assets, the ratio Debt/Assets may also be increasing in τ_A. Since our dataset contains both book and market values (depending on the host country and the characteristics of each company), we can say that our theoretical prediction holds under both kinds of accounting standards.

Figure 2

3 Data and preliminary evidence

The relation between tax schemes and firm capital structure for foreign owned companies can be studied exploiting time variation and cross-national heterogeneity of both national and home country tax rates.

AMADEUS by Bureau van Dijk provides standardized annual balance sheet and profit & loss items from 38 European countries, together with information on their legal form and ownership structure. We have used the December 2007 *"Top 1.5 Million Companies"* release of the dataset, which includes companies that satisfied at least one of the following criteria: i) more than 15 employees; ii) operating revenue of at least 1 million euros; iii) total assets of at least 2 million euros.[18] We focus on limited companies

[17] Sensitivity analysis on parameters χ, n and υ is available upon request.

[18] For UK, Germany, France, Italy, Spain, Ukraine and Russian Federation the limits are 1.5 million Euro for operating revenue, 3 million Euro for total assets and 20 employees.

and limited liability companies, whose ultimate owner is resident abroad in a known country and is not an individual or a family.[19]

We define the ultimate owner as the company which directly or indirectly possesses at least 50% of the shares of a subsidiary. We set a high share of ownership because a parent company with a lower level of (direct or indirect) ownership may not be able to affect debt policy' choices (Mintz and Weichenrieder, 2005). Finally, as information on ownership refers to 2005, we keep only those companies whose accounting data were available at least for 2005. We therefore selected 31,650 subsidiaries controlled by foreign companies with all the necessary unconsolidated accounts data available for at least two years (see **Table 1**). The number of available observations per each firm varies across countries, ranging from 2 for Macedonia to 7.4 years for Finland and Greece. The time interval considered goes from 1999 to 2005 for most companies.

Company data are matched with information about statutory tax rates drawn mainly from KPMG's Corporate Tax Rate Survey. In the time interval considered, corporate income tax rates remained constant in Spain, Lithuania, Latvia, Norway, Sweden and Slovenia. They changed only once in Austria, Belgium, Denmark, Estonia, Great Britain, Hungary, Iceland, Luxembourg and Ukraine and more frequently in other countries. Nevertheless, Romania (-22 percentage points), Slovakia (-21 pp), Germany, Poland, Russian Federation (-19 pp) and Bulgaria (-18 pp) experienced dramatic tax cuts in this period. A similar picture can be drawn for the statutory tax rates of the ultimate owners. Again, substantial time variation of tax rates can be observed in a few countries (e.g., Germany, Ireland and Japan among the most relevant parent countries), while there is no variation at all for others (e.g., Norway, Sweden and most Caribbean states).

In **Table 1** we show the average subsidiary tax rate $\bar{\tau}_B$ and the average parent tax rate $\bar{\tau}_A$ by subsidiary country. The table indicates that, for instance, the 32 Austrian subsidiaries in the sample face an average tax rate of 31.12%, while the average statutory tax rate of their foreign ultimate owners is 35.89%. The last column of the table states that for 26.8% of the Austrian observations, the subsidiary's tax rate is higher than its parent company's

[19] From Amadeus Internet Guide: *"Limited Companies: companies whose capital is divided into shares which can be offered to the general public and whose members are only liable for its debts to the extent of any amount unpaid on their shares; Limited Liability Companies: companies whose capital is divided into shares which cannot be offered to the general public. The liability of its members is limited to the amount of their shares."*

one. On average, the subsidiaries' tax rates are 1.5 percentage points less than parent company ones. This may suggest that parent companies prefer to locate subsidiaries in low-tax countries (see, e.g., Devereux, 2007).

Table 1

In **Figure 3** we plot the average subsidiary and parent company tax rates (together with the 45° line) by either the host (left panel) or the home country (right panel). The left panel depicts columns 3 ($\bar{\tau}_B$, on the horizontal axis) and 4 ($\bar{\tau}_A$, on the vertical axis) of **Table 1**. The comparison with the bisector line makes clear that foreign owned subsidiaries in Belgium, France, Germany, Greece and Italy face an average tax rate that is higher than the average tax rate of their parent companies. In the right panel, each point identifies a home country. So for instance, the position of Austria is determined by the average tax rate faced by Austrian subsidiaries in their host countries ($\bar{\tau}_B = 30.8\%$, on the horizontal axis) and the average tax rates of their parent companies in Austria ($\bar{\tau}_A = 32.1\%$, on the vertical axis). The picture shows that the sample includes a group of subsidiaries owned by parents resident in tax havens (about 2% of the companies with $\bar{\tau}_A \approx 0$) and that global ultimate owners based in US, Germany, France and Japan (among others) typically own affiliates in countries with lower tax rates.

Figure 3

Table 2 shows the percentage of subsidiaries in each host country by the home country of their parent companies. This gives a clearer picture of the weight of each *home (parent) - host (subsidiary)* country tax differential. For example, 46.9% of Austrian foreign-owned subsidiaries are held by German companies. Moreover, we can see that: i) many East European subsidiaries are held by German ultimate owners; ii) about 1/4 of the subsidiaries are owned by a US global ultimate owner; iii) another quarter is owned by either a German, British or French company. Therefore, within Europe and US-European countries tax differentials are by far the most relevant ones for our dataset and they will play a major role in determining the results of our regression analysis.

Table 2

The empirical literature on tax-motivated debt finance uses book data rather than mark-to-market values. We also follow this approach due to the characteristics of the dataset. Book and mark-to-market values are likely to be close only for listed companies, due to the application of international accounting principles (IAS/IFRS). As for non-listed companies (that is, a large majority) however, accounting principles may allow us to reckon historical rather than fair values. In this case, the book value of one item may differ from its fair value. In line with most research (see, e.g., Altshuler and Grubert, 2003, Desai et al., 2003, Jog and Tang, 2001, and Mintz, 2000), leverage is given by the ratio between debt (long- and short-term liabilities) and total assets. The return on assets (ROA) is the ratio between earnings before interest payments and taxes (EBIT) and total assets. For the *Z-score* we consider the weights proposed in the literature (see Altman, 2002):

$$Z - score = 6.56x_1 + 3.26x_2 + 6.72x_3 + 1.05x_4,$$

where x_1 is the ratio between working capital and total assets, x_2 is the variation of the "other shareholders funds" over total assets, x_3 is the ratio between EBIT and total assets, and

$$x_4 = \frac{shareholders\ funds}{non\ current\ liabilities + current\ liabilities}.$$

Table 3

Table 3 shows the median values of the main balance sheet items and ratios conditional on the residence country. As the population of firms is typically composed of many small-medium size companies and a few large ones, we prefer to refer to median values to summarize the characteristics of our sample. Focusing on those countries which contribute the most to the sample as number of subsidiaries (see **Table 1**), it can be noticed that the median size of the companies - in terms of operating revenues - is similar for Belgium, Spain, France, Great Britain, Italy and Sweden (ranging from 11 to 18 millions Euro), is halved in Norway (6 millions Euro) and is much higher in Germany (90 millions Euro). Such cross-country heterogeneity highlights the actual differences in the company size, together with the variety of accounting and disclosure obligations and practices. Italian, German and Belgian subsidiaries are those with the highest median leverage:

these are also the subsidiaries facing the highest statutory tax rates, which are typically higher than their parents' tax rates (see **Table 1** and **Figure 3**). The 31 European countries experienced dramatically different growth rates during the period: the average PPP per capita GDP growth rate for the 133 subsidiaries in Latvia was 7.83%, ten times the growth rate for the Italians (0.76%).

ROA shows high variability in the sample: it ranges from a median of 4% for the Luxembourg companies to 18% for Russian ones. Moreover, although the overall median ROA is positive (5.23%), in the previous year about 25% of subsidiaries reported losses. This remark is relevant, because our theoretical model is based on the assumption of full tax symmetry. Real-world tax systems however, implement asymmetric devices (such as limited carry-backward or carryforward provisions). Hence, our empirical analysis must account for tax asymmetry and the possibility that loss-making firms have a different reaction to tax rate changes. In the following regression analysis, we will therefore pay attention to this possible heterogenous tax effect.

4 Regression analysis

According to our model, the subsidiary leverage $L_S(\Pi)$ is a non-linear function of the subsidiary and parent company tax rates. Hence equation (10) can be approximated with the following second-order Taylor expansion:

$$\begin{aligned} L_S(\Pi) \simeq\ & const + \left.\frac{\partial L_S(\Pi)}{\partial \tau_A}\right|_{\tau_A=\overline{\tau}_A} \Delta\tau_A + \left.\frac{\partial L_S(\Pi)}{\partial \tau_B}\right|_{\tau_B=\overline{\tau}_B} \Delta\tau_B \qquad (11) \\ & + \frac{1}{2}\left[\left.\frac{\partial^2 L_S(\Pi)}{\partial \tau_A^2}\right|_{\tau_A=\overline{\tau}_A} \Delta\tau_A^2 + \left.\frac{\partial^2 L_S(\Pi)}{\partial \tau_B^2}\right|_{\tau_B=\overline{\tau}_B} \Delta\tau_B^2 \right. \\ & \left. + 2\left.\frac{\partial^2 L_S(\Pi)}{\partial \tau_A \partial \tau_B}\right|_{\substack{\tau_A=\overline{\tau}_A \\ \tau_B=\overline{\tau}_B}} \Delta\tau_A \Delta\tau_B \right], \end{aligned}$$

where $\Delta\tau_i \equiv \tau_i - \overline{\tau}_i$ with $i = A, B$. Accordingly, our regression equation should consider non linearities in τ_A and τ_B either including a quadratic function or more flexible forms. We therefore consider the following specification for our regression analysis on panel data:

$$L_{it} = g(\tau_{Ait}, \tau_{Bit}) + \boldsymbol{F}'_{it-1}\boldsymbol{\beta} + \boldsymbol{B}'_{it}\boldsymbol{\delta} + \alpha_i + \varepsilon_{it}, \qquad (12)$$

where i identifies the subsidiary firm and t denotes the year of reference, $g(\tau_{Ait}, \tau_{Bit})$ is a (possibly non-linear) function of subsidiary and parent company tax rates, $\boldsymbol{F}_{it-1}$ is a set of covariates coming from past financial accounts of the companies, the variables in $\boldsymbol{B}_{it}$ are used to control for business cycle effects, α_i represents the unobservable company-specific time-invariant heterogeneity and ε_{it} is an idiosyncratic error term. Similarly to Fan et al. (2010), we condition on the ROA, the logarithm of the operating revenues, the *Z-score* index, the ratio between fixed assets over total assets and a dummy variable which equals one if at time $t-1$ the subsidiary generated negative EBIT.[20]

Past financial accounts are preferred to current ones for two reasons. Firstly, this strategy reduces potential endogeneity generated by accounting practices. Secondly, we assume that leverage at time t (L_{it}) is planned at least one year ahead on the basis of information available at time $t-1$. We include a measure of firm profitability such as ROA (i.e., the ratio EBIT/total assets) because more profitable companies have lower incentives to implement debt policies as they could finance their investments through their own resources. Firms reporting losses have no fiscal incentives to increase their debt and they might face credit constraints. At the same time, they are likely to demand more loans. We evaluate which of the two effects is more relevant by including in $\boldsymbol{F}_{it-1}$ a dummy variable indicating whether companies reported a loss in the previous fiscal year. Since bankruptcy cost may be lower for larger firms (Warner, 1977; Ang et al., 1982; Pettit and Singer, 1985) we include a measure of firm size (the logarithm of the operating revenue, 2005 Euro values).

We also consider the fixed-to-total assets ratio in order to assess to what extent firms' assets structure affects the level of leverage. Indeed, fixed assets are guarantees for creditors and can positively influence a firm's leverage (Myers, 1977; Scott, 1977; Harris and Raviv, 1990). Furthermore, the *Z-score* index is included in the regression in order to account for a company's credit worthiness (Desai et al. 2004; Fan et al. 2003). Finally, $\boldsymbol{B}_{it}$ includes the GDP growth rate for the subsidiary country and a set of year dummies.[21]

[20] Our theoretical model assumes for simplicity that EBIT (i.e., Π) evolves according to a Geometric Brownian Motion. This means that it cannot have negative values. In the empirical part however, we must control for the sign of Π.

[21] We also used other macro variables. In particular we considered variables aimed at describing national credit markets characteristics in the vein of Rajan and Zingales (1995). Due to little time variability, however, their predictive power is negligible when the model

We provide company fixed-effect estimates of different versions of equation (12): using a within-group estimator, we indirectly control for any source of time invariant heterogeneity (e.g., parent company, industry and country effects) and obtain estimates which are robust to the possible correlation between unobserved heterogeneity and observed covariates. Moreover, we provide cluster-robust standard errors where the clusters are identified by the home countries. Finally, we consider also random effects estimates, but the cluster-robust Hausman test overwhelmingly rejects the overidentification conditions.

For expositional purposes we first present our estimates from the following basic linear version of equation (12):[22]

$$L_{it} = \gamma_0 + \gamma_1 \tau_{Ait} + \gamma_2 \tau_{Bit} + \boldsymbol{F}'_{it-1}\boldsymbol{\beta} + \boldsymbol{B}'_{it}\boldsymbol{\delta} + \alpha_i + \varepsilon_{it}. \tag{13}$$

Table 4 provides the estimates of $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$. According to the estimated equation (13), previous year firm profitability, ROA_{it-1}, negatively affects firm leverage; firms with a negative operating profit in the previous year have a higher leverage and a higher level of fixed assets raises the leverage.[23] Our estimates suggest that one percentage point more of GDP growth rate decreases leverage by 0.4 percentage points.

Moreover, the dummy variable $1\,(EBIT_{t-1} < 0)$ is estimated to have a positive impact on leverage: this may be due to the fact that a shortage of internal resources induces firms to increase borrowing.

The estimated effects of subsidiary's and the parent company's tax rates (τ_B and τ_A respectively) are illustrated in **Table 5**: a one percentage point increase in τ_B is estimated to increase the subsidiary leverage by 0.18 pp, while the effect of a one pp rise in τ_A causes an increase of 0.05 pp in the subsidiary leverage.

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is estimated using a company fixed effect estimator.

[22] This linear specification in τ_A and τ_B is equivalent to consider a linear specification in τ_B and $(\tau_B - \tau_A)$. In the latter, the parameter of $(\tau_B - \tau_A)$ would be equal to $-\gamma_1$ and the parameter of τ_B to $\gamma_1 + \gamma_2$.

[23] The negative effect of ROA_{it-1} is in line with the Pecking-Order Theory (see, e.g., Myers, 1993). According to the standard Trade-Off Theory however, the higher the profits the lower the default risk and therefore, the higher the leverage ratio would be. As shown by Strebulaev (2007) however, a negative relation between debt and profitability is also compatible with a dynamic trade-off model, where firms adjust their capital structure over time.

Tables 4 & 5

Although appealing due to its plainness, this benchmark specification can hide important sources of heterogeneity in the responses of companies to a variation in tax rates. In particular a variation in τ_A and/or τ_B is likely to differently affect the subsidiaries depending on the sign of the tax rate differential $(\tau_B - \tau_A)$. Furthermore, companies reporting losses ($EBIT_{t-1} < 0$, about 25% of the observations, see **Table 3**) may react to a change in taxation differently from the companies reporting positive $EBIT_{t-1}$. Combining the two criteria we can define four possible cases, whose incidence in each country is described in **Table 6**. Sixtyone % of the Austrian observations refer to subsidiaries which made profit in the previous year ($EBIT_{t-1} \geq 0$) and whose tax rate is lower than their parent companies' tax rate ($\tau_B < \tau_A$). Overall, 44% of the observations fall to this case, a further 31% refers to subsidiaries with positive past profits and tax rates higher than their home country tax rate ($\tau_B > \tau_A$). The remaining 25% of the observations concern subsidiaries reporting past losses ($EBIT_{t-1} < 0$).

Table 6

We consistently enrich the linear specification (13) by introducing the corresponding interaction terms:

$$\begin{aligned} L_{it} = \; & \gamma_0 + \gamma_1 \tau_{Ait} + \gamma_2 \tau_{Bit} + \\ & \gamma_3 \tau_{Ait} \mathbf{1}(\tau_{Bit} \geq \tau_{Ait}) + \gamma_4 \tau_{Bit} \mathbf{1}(\tau_{Bit} \geq \tau_{Ait}) + \\ & \gamma_5 \tau_{Ait} \mathbf{1}(\tau_{Bit} < \tau_{Ait}) \mathbf{1}(EBIT_{it-1} < 0) + \\ & \gamma_6 \tau_{Ait} \mathbf{1}(\tau_{Bit} \geq \tau_{Ait}) \mathbf{1}(EBIT_{it-1} < 0) + \\ & \gamma_7 \tau_{Bit} \mathbf{1}(\tau_{Bit} < \tau_{Ait}) \mathbf{1}(EBIT_{it-1} < 0) + \\ & \gamma_8 \tau_{Bit} \mathbf{1}(\tau_{Bit} \geq \tau_{Ait}) \mathbf{1}(EBIT_{it-1} < 0) + \\ & \gamma_9 \mathbf{1}(\tau_{Bit} \geq \tau_{Ait}) + \gamma_{10} \mathbf{1}(EBIT_{it-1} < 0) + \\ & + \boldsymbol{F}'_{it-1} \boldsymbol{\beta} + \boldsymbol{B}'_{it} \boldsymbol{\delta} + \alpha_i + \varepsilon_{it}. \end{aligned} \tag{14}$$

Column 2 of **Table 4** shows that the interaction terms do not alter the estimates of $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$. *Ceteris paribus*, a subsidiary whose tax rate is higher than its parent company tax rate ($\tau_B > \tau_A$) has a leverage 8 pp. higher than a similar company taxed less than its ultimate owner. This result is in line with the predictions of our model. As pointed out in Section 2.1, when $\tau_B > \tau_A$ the MNC has an incentive to shift debt from the home to the host country. Furthermore, most of the subsidiaries with $\tau_B > \tau_A$ are located in Belgium, Germany and Italy, which are the countries with the highest leverage (see **Tables 1** and **3**). The effects of tax innovations are remarkably different across the four cases (Column 2 **Table 5**). A one percentage point increase of τ_B rises the subsidiary leverage by 0.29 pp if its tax rate is less than its parent company tax rate and the EBIT is positive. In contrast, this effect is statistically not significant if the subsidiary tax rate is higher than its ultimate owner's one and the EBIT is negative.

Let us next analyze the impact of τ_A. According to our model, if the EBIT is positive, the impact of τ_A on L_S is ambiguous due to the offsetting effects drawn in **Figure 1**. In particular, our model predicts that if the subsidiary tax rate is low (i.e., $\tau_B < \tau_A$) and the company reported a positive EBIT, the effect of an increase in τ_A on the subsidiary leverage is positive. Our estimates are consistent with such a prediction: a one percentage point increase of the parent tax rate (τ_A) raises the subsidiary's leverage by 0.07 pp., if $EBIT_{t-1} > 0$ This is the most common case, as it accounts for about 45% of observations. A large portion of observations (30%) has a positive value of $EBIT_{t-1}$, but it is characterized by the inequality $\tau_B > \tau_A$ (i.e., the subsidiary tax rate is higher than its ultimate owner's one). In this case, the estimated effect is not statistically different from zero.

As pointed out, whenever the subsidiary reported losses, our theoretical model does not provide predictions: the effect of a change in τ_A is estimated to be insignificant.

So far, we have considered linear functions of the tax rates. Let us now generalize the regression function by specifying $g(\tau_{Ait}, \tau_{Bit})$ in equation (12) to be a second order polynomial in the tax rates and interacting this function with the four cases discussed above. The estimates in column 3 of **Table 4** confirm our previous results for $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$. Column 3 of **Table 5** shows that the marginal effects of τ_A and τ_B on the subsidiary's leverage when $\tau_B < \tau_A$ and $EBIT_{t-1} > 0$ have a sample average in line with the estimates of the linear model in column (2). Nevertheless, the standard error of the average effect of τ_A is such that we cannot reject the hypothesis that the mean of the change in the subsidiary's leverage due to a variation in its parent company tax rate is zero. Although more consistent with our theoretical model, the use of a non-linear function $g(\tau_{Ait}, \tau_{Bit})$ does not seem to provide remarkably different results from the simpler linear specification.

Overall, we interpret our regression results as evidence consistent with the predictions of our theoretical model: whenever the subsidiary is making positive profit, the estimated effects of home (τ_A) and host country (τ_B) statutory tax rates on the leverage are either positive or negligible.

5 Robustness checks

In this Section, we run some additional regression analysis in order to assess to what extent our conclusions are robust to changes in the estimation strategy. The set of conditioning variables $\boldsymbol{F}_{it-1}$ includes lagged financial information of the subsidiaries. As first robustness check we have estimated the models considering non-lagged variables. For the sake of brevity we do not include the results in the paper (they are available upon request), but we can safely say that our main conclusions are not affected by the choice of using lagged information.

5.1 Year-country dummies

In the previous Section, we have run subsidiary fixed effect estimates (using a within group estimator). Moreover, we have used both the GDP growth rate and common year dummies as regressors. We have therefore (indirectly) controlled for host and home country effects as well as for business cycle effects. Nevertheless, it may be the case that our estimates of tax rates effects are biased due to omitted country-year effects. For this reason we introduce two possible extensions: in the first one, we use a full set of $Year \times Subsidiary\ Country$ dummies, while in the second one we apply a full set of $Year \times Parent\ Country$ dummies. In the former case, the subsidiary tax rate effect is canceled out, but the ultimate owner tax rate effect remains and its estimate is not biased by any omitted variable at the subsidiary country level. The latter extension works specularly for the subsidiary tax rate effect. Column (1) and (2) of **Table 8** show that the estimated effects for the subsidiary and parent tax rates are consistent with those of equation (14) (Column 2, **Table 5**).

Tables 7 & 8

5.2 Linked companies

By using fixed effects estimates we implicitly condition on any time invariant characteristic of the parent company. Other - time variant - information about the parent companies may affect the leverage of their subsidiaries and their omission from the regression equation may bias our estimates. As a further robustness check, we therefore focus on a sub-sample of subsidiaries for which the unconsolidated accounts data of their ultimate owner are available. It is worth noticing that when we complement the subsidiaries' data with the balance sheets of their ultimate owners, we drop those subsidiaries whose parent company is located in the US, Japan and other non-European countries. Furthermore, we cannot recover the accounting data of ultimate owners such as financial institutions, banks and governmental agencies.

As a consequence, the number of observations reduces to 41% of the entire sample. Moreover, this percentage varies across countries (see **Table 9**) and thus, the nationality mix of this sub-sample is considerably different from the original one (e.g., now British subsidiaries account for 15% of the companies, while they were 28% in the original sample). It is interesting to observe that the subsidiaries' median leverage is usually higher than their ultimate owner's one (70% vs. 63%). Moreover, there is no clear relation between subsidiaries and parent companies leverage at the country level, that is, there is no *prima facie* evidence that subsidiaries with high median leverage are typically owned by foreign companies with high leverage. In order to further investigate this issue, we add the leverage of the ultimate owner at $t-1$ as a control variable to the original equation (14). Its estimated parameter is not significantly different from zero (column 3 of **Table 7**). We obtained similar results experimenting with alternative global ultimate owners' information, e.g. profitability. The effects of the subsidiary's tax rates τ_B are in line with the benchmark case (see, column 3 of **Table 8**), the impact of τ_A when $\tau_B < \tau_A$ and subsidiaries report positive $EBIT_{t-1}$ is still positive though is not statistically significant. On the opposite, when $\tau_B < \tau_A$ and $EBIT_{t-1} \leq 0$ the impact of τ_A on the subsidiary's leverage is estimated to be significantly negative. In this latter case, we can say that the absence of a positive EBIT together with a low subsidiary tax rate makes borrowing unattractive in terms of tax savings.

5.3 Cross-border tax rates

In this article, we have used statutory corporate income tax rates. As a further robustness check we replace statutory tax rates with cross-border effective tax rates (τ). These are a (non-linear) combination of statutory tax rates (τ_A and τ_B) and withholding taxes (see Huizinga et al., 2008). In many cases (even before the introduction of the parent-subsidiary directive between EU Member States), withholding tax rates have been low and the tax treatment of cross-border transactions has been almost unchanged over the sample period. We therefore expect the effect of a variation in τ on the subsidiary leverage to be evaluated in the between of the effects of τ_A and τ_B. Moreover, in line with Huizinga et al. (2008), we also consider the possible effect of the relative tax (dis)advantage of equity and internal debt (denoted as φ).[24]

The sample is reduced to 38% of the original one, both because of the different time span and because of the focus on the European parent companies (see **Table 9**). Not surprisingly, the value of the average effective marginal tax rates are very close to the corresponding values of the statutory tax rates. The effective marginal tax rate (τ) on the subsidiary's tax rate is estimated to have a significant positive effect (column 3 **Table 8**), whose magnitude, about 0.13, fulfills our expectations. As Huizinga et al. (2008, see Table 11, column 1), the relative tax advantage of debt over equity (φ) is not statistically significant.

6 Conclusions

In this article we have used a trade-off model to analyze a MNC's financial choices in terms of leverage and debt shifting. As we have assumed, default is a contingent event, which depends on the EBIT's volatility as well as on other deep parameters (such as the risk-free interest rate and the expected growth of EBIT).

Given this framework, we have shown that the parent company's tax rate can have a positive effect on a subsidiary's leverage. The reasoning behind our finding is straightforward. On the one hand, an increase in the parent

[24] The relative taxation of equity and internal debt φ is defined as the difference bewteen tax rates on cross-border interest and tax rates on cross-border dividends. We wish to thank Luc Laeven and Gaetan Nicodeme for providing us with their tax rate dataset.

company's tax rate reduces the tax benefit of shifting debt from the parent company to its subsidiary. On the other hand, the tax rate increase leads to an increase in the MNC's overall tax rate, thereby increasing the tax benefit of interest deductibility. This latter effect encourages both the parent and the subsidiary to raise debt. As we have shown, using realistic parameter values, this latter effect is expected to dominate the former and therefore, a higher parent tax rate can increase a subsidiary's leverage.

In the empirical part we have tested this theoretical finding. Using the AMADEUS dataset we have shown that a one percentage point increase in the foreign country tax rate causes on average a 0.2 percentage points increase in the subsidiary leverage, but that the size of the effect goes from 0.29 pp for those subsidiary whose tax rate is lower than parent tax rate and reports positive earnings to zero for those whose tax rate are higher than their global ultimate owner tax rate and reported negative earnings. At the same time, a one percentage point increase in the parent company tax rate causes a 0.07 percentage points rise in of the subsidiary leverage in case $\tau_B < \tau_A$ and $EBIT_{t-1} > 0$. This latter effect, usually ignored in the relevant literature, is fully consistent with our theoretical model and suggests that there are cases in which, when the parent company tax rate increases, the positive effect on leverage due to the overall increase in the tax rate prevails on the debt shifting incentives. In this case, evidence supports our idea that an increase in the parent company's tax rate can positively affect a subsidiary's leverage.

A The derivation of (5)

Let us first calculate the value of debt under the assumption that, before default, the lender is tax exempt.[25] When, in the event of default, the lender becomes shareholder however, it is subject to the source-based tax levied on the subsidiary. Using dynamic programming, debt can be written as

$$D(\Pi) = \begin{cases} (1-\widehat{\tau})\,\Pi dt + e^{-rdt}\xi\left[D(\Pi + d\Pi)\right] & \text{a.d.,} \\ Cdt + e^{-rdt}\xi\left[D(\Pi + d\Pi)\right] & \text{b.d.,} \end{cases} \tag{15}$$

where $\xi[.]$ is the expectation operator, and a.d. and b.d. mean 'after default' and 'before default', respectively. Expanding the RHS of (15), applying Itô's Lemma and rearranging gives

$$rD(\Pi) = L + \mu\Pi D_{\Pi}(\Pi) + \frac{\sigma^2}{2}\Pi^2 D_{\Pi\Pi}(\Pi), \tag{16}$$

where $L = (1-\widehat{\tau})\,\Pi, C$, $D_{\Pi}(\Pi) \equiv \frac{\partial D(\Pi)}{\partial \Pi}$ and $D_{\Pi\Pi}(\Pi) \equiv \frac{\partial^2 D(\Pi)}{\partial \Pi^2}$. The general closed-form solution of function (16) is

$$D(\Pi) = \begin{cases} \frac{(1-\widehat{\tau})\Pi}{\delta} + \sum_{i=1}^{2} B_i \Pi^{\beta_i} & \text{a.d.,} \\ \frac{C}{r} + \sum_{i=1}^{2} D_i \Pi^{\beta_i} & \text{b.d.,} \end{cases} \tag{17}$$

where $\delta = r - \mu$ and

$$\begin{aligned} \beta_1 &= \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} > 1, \\ \beta_2 &= \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{\mu}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} < 0 \end{aligned}$$

are the two roots of the characteristic equation $\frac{\sigma^2}{2}\beta(\beta-1) + \mu\beta - r = 0$. To calculate B_i and D_i for $i = 1, 2$, we need three boundary conditions. First of all we assume that whenever Π goes to zero, the lender's claim is nil, namely condition $D(0) = 0$ holds. This implies that $B_2 = 0$. Secondly, we assume that financial bubbles do not exist. This means that $B_1 = D_1 = 0$.[26] Thirdly,

[25] It is well-known that effective tax rates on capital income are fairly low. For simplicity we assume that the lender's pre-default tax burden is nil.

[26] For further details on these boundary conditions see Dixit and Pindyck (1994).

we must consider that at point $\Pi = \overline{\Pi}$, the pre-default value of debt must be equal to the post-default one, net of the default cost. Applying Assumption 6 and using the two branches of (17) we therefore obtain

$$\frac{(1-\widehat{\tau})\,\overline{\Pi}}{\delta} - \underbrace{\left[\frac{\upsilon\,(1-\widehat{\tau})\,\overline{\Pi}}{\delta}\right]}_{\text{default cost}} = \frac{C}{r} + D_2 \overline{\Pi}^{\beta_2}.$$

Solving for D_2 gives

$$D_2 = \left[\frac{(1-\upsilon)\,(1-\widehat{\tau})\,\overline{\Pi}}{\delta} - \frac{C}{r}\right] \overline{\Pi}^{-\beta_2}.$$

We can therefore write the value of debt as follows:

$$D(\Pi) = \begin{cases} \frac{(1-\widehat{\tau})\Pi}{\delta} & \text{a.d.,} \\ \frac{C}{r} + \left[\frac{(1-\upsilon)(1-\widehat{\tau})\overline{\Pi}}{\delta} - \frac{C}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} & \text{b.d.} \end{cases} \tag{18}$$

Before default, $D(\Pi)$ consists of two terms. The first one, $\frac{C}{r}$, is the present value of a perpetual rent with the discount rate r. The second term accounts for any future expected change in profitability caused by default. In particular, the term $\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2}$ measures the present value of 1 Euro contingent on the event default. After default, the lender becomes shareholder and her credit is therefore converted into equity. The firm's value is therefore equal to $\frac{(1-\widehat{\tau})\Pi}{\delta}$.

Let us next calculate the value of equity. Applying dynamic programming we can write:

$$E(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ \Pi^N(\Pi)\,dt + e^{-rdt}\xi\left[E(\Pi + d\Pi)\right] & \text{b.d.} \end{cases} \tag{19}$$

Expanding the RHS of (19), applying Itô's Lemma, eliminating all terms multiplied by $(dt)^2$ and dividing by dt gives:

$$rE(\Pi) = \Pi^N(\Pi) + \mu\Pi E_\Pi(\Pi) + \frac{\sigma^2}{2}\Pi^2 E_{\Pi\Pi}(\Pi), \tag{20}$$

where $E_\Pi(\Pi) \equiv \frac{\partial E(\Pi)}{\partial \Pi}$ and $E_{\Pi\Pi}(\Pi) \equiv \frac{\partial^2 E(\Pi)}{\partial \Pi^2}$. Substituting (2) into (20) and solving gives

$$E(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ \frac{(1-\widehat{\tau})\Pi}{\delta} - \frac{(1-\tau_C(a))C}{r} + \sum_{i=1}^{2} A_i \Pi^{\beta_i} & \text{b.d.} \end{cases} \tag{21}$$

Let us next calculate A_i with $i = 1, 2$. In the absence of financial bubbles, we have $A_1 = 0$. Moreover, to calculate A_2 we let the two branches of (21) meet at point $\Pi = \overline{\Pi}$, thereby obtaining

$$E\left(\overline{\Pi}\right) = \frac{(1-\widehat{\tau})\,\overline{\Pi}}{\delta} - \frac{(1-\tau_C(a))\,C}{r} + A_2\overline{\Pi}^{\beta_2} = 0. \tag{22}$$

Solving (22) for A_2 gives

$$A_2 = -\left[\frac{(1-\widehat{\tau})\,\overline{\Pi}}{\delta} - \frac{(1-\tau_C(a))\,C}{r}\right]\overline{\Pi}^{-\beta_2},$$

so that the value of equity is equal to:

$$E(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ \frac{(1-\widehat{\tau})\Pi}{\delta} - \frac{(1-\tau_C(a))C}{r} \\ -\left[\frac{(1-\widehat{\tau})\overline{\Pi}}{\delta} - \frac{(1-\tau_C(a))C}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} & \text{b.d.} \end{cases} \tag{23}$$

Summing (18) and (23) gives the value function (5).

B The MNC's choices

Differentiating $V(C, a; \Pi)$ with respect to a and C gives the following first order conditions:

$$\begin{aligned} \frac{\partial V(C,a;\Pi)}{\partial a} &= \frac{C}{r}\frac{\partial \tau_C(a)}{\partial a} - \left[\frac{\upsilon(1-\widehat{\tau})}{\delta}\frac{\partial\overline{\Pi}}{\partial \tau_C(a)}\frac{\partial \tau_C(a)}{\partial a} + \frac{C}{r}\frac{\partial \tau_C(a)}{\partial a}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} \\ &\quad + \beta_2\left[\frac{\upsilon(1-\widehat{\tau})\,\overline{\Pi}}{\delta} + \frac{\tau_C(a)\,C}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2}\frac{\partial\overline{\Pi}}{\partial \tau_C(a)}\frac{\partial \tau_C(a)}{\partial a}\overline{\Pi}^{-1} \\ &= 0 \end{aligned} \tag{24}$$

and

$$\begin{aligned} \frac{\partial V(C,a;\Pi)}{\partial C} &= \frac{\tau_C(a)}{r} + \beta_2\left[\frac{\upsilon(1-\widehat{\tau})\,\overline{\Pi}}{\delta} + \frac{\tau_C(a)\,C}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2}\frac{\partial\overline{\Pi}}{\partial C}\overline{\Pi}^{-1} \\ &\quad - \left[\frac{\upsilon(1-\widehat{\tau})}{\delta}\frac{\partial\overline{\Pi}}{\partial C} + \frac{\tau_C(a)}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2} \\ &= 0. \end{aligned} \tag{25}$$

Using (24) and rearranging gives:

$$\frac{\partial V(C,a;\Pi)}{\partial a} = \Phi\langle\cdot\rangle \frac{\partial \tau_C(a)}{\partial a} = 0,$$

with

$$\Phi\langle\cdot\rangle \equiv \underbrace{\left[\frac{C}{r} + \frac{\upsilon}{\delta}C - \frac{C}{r}\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2}\right]}_{>0}$$
$$+\left\{\beta_2\left[\tfrac{\upsilon}{\delta}(1-\tau_C(a))C + \tfrac{\tau_C(a)C}{r}\right]\left(\tfrac{\Pi}{\overline{\Pi}}\right)^{\beta_2} \underbrace{\frac{\partial\overline{\Pi}}{\partial\tau_C(a)}\overline{\Pi}^{-1}}_{\frac{-1}{1-\tau_C(a)}<0}\right\} > 0.$$

This means that the optimal value of a is such that:

$$\frac{\partial \tau_C(a)}{\partial a} = \tau_A - \tau_B + n(\chi - a) = 0 \text{ with } \frac{\partial \tau_C^2(a)}{\partial a^2} < 0,$$

and therefore,

$$a^* = \chi + \frac{\tau_A - \tau_B}{n}.$$

Recall now f.o.c. (25). Rearranging one obtains:

$$C^* = \frac{1-\widehat{\tau}}{1-\tau_C(a)}\left[\frac{\tau_C(a)}{(1-\beta_2)\left[\frac{r}{\delta}(1-\tau_C(a)) + \tau_C(a)\right]}\right]^{-\frac{1}{\beta_2}}\Pi.$$

C Comparative statics

Given (8) and (7), it is equal to $C_S = (1-a^*)C^*$. Applying logs leads to:

$$\begin{aligned}
\log C_S &= \log(1-a^*) + \log C^* \\
&= \log \Pi + \log(1-\widehat{\tau}) - \log[1-\tau_C(a^*)] \\
&\quad -\frac{1}{\beta_2}\left\{\log\tau_C(a^*) - \log(1-\beta_2) - \log\left[\frac{r(1-\tau_C(a^*))\upsilon}{\delta} + \tau_C(a^*)\right]\right\}.
\end{aligned}$$

Differentiating $\log C_S$ w.r.t. τ_A gives:

$$\frac{1}{C^*}\frac{dC^*}{d\tau_A} = \underbrace{\left[\frac{1-\tau_B-\chi\left(\frac{\tau_A-\tau_B}{2}\right)}{\left[1-\tau_B-\chi\left(\tau_A-\tau_B\right)\right]\left[1-\tau_B-\chi\left(\tau_A-\tau_B\right)-\frac{\left(\tau_A-\tau_B\right)^2}{2n}\right]}\right]}_{>0}\cdot\underbrace{\frac{\tau_A-\tau_B}{n}}_{\propto(\tau_A-\tau_B)}$$
$$+\underbrace{\left[-\frac{1}{\beta_2}\frac{\frac{rv}{\delta}\left(\chi+\frac{\tau_A-\tau_B}{n}\right)}{\tau_C\left(a^*\right)\left[\frac{r(1-\tau_C(a^*))v}{\delta}+\tau_C\left(a^*\right)\right]}\right]}_{>0}.$$

If $\tau_A > \tau_B$, we have $\frac{dC^*}{d\tau_A} > 0$. Otherwise the effect is ambiguous.

D The subsidiary's leverage

D.1 The subsidiary's debt

To calculate the subsidiary debt value we follow the same procedure as before. The debt value function has therefore the following form:

$$D_S\left(\Pi\right) = \begin{cases} \frac{(1-\chi)(1-\tau_B)\Pi}{\delta}+\sum_{i=1}^{2} F_i\Pi^{\beta_i} & \text{a.d.,} \\ \frac{(1-a)C}{r}+\sum_{i=1}^{2} M_i\Pi^{\beta_i} & \text{b.d.} \end{cases}$$

Remember that whenever Π goes to zero, the lender's $D_S\left(\Pi\right)$ is nil. Moreover, ruling out financial bubbles gives $F_1 = F_2 = M_1 = 0$. To calculate M_2 we need to apply the value matching condition at point $\overline{\overline{\Pi}}$:

$$\frac{\left(1-\chi\right)\left(1-\tau_B\right)\overline{\overline{\Pi}}}{\delta}-\underbrace{\left[\frac{v\left(1-\chi\right)\left(1-\tau_B\right)\overline{\overline{\Pi}}}{\delta}\right]}_{\text{default cost}}=\frac{\left(1-a\right)C}{r}+M_2\overline{\overline{\Pi}}^{\beta_2}.$$

Therefore we obtain:

$$D_S\left(\Pi\right) = \begin{cases} \frac{(1-\chi)(1-\tau_B)\Pi}{\delta} & \text{a.d.,} \\ \frac{(1-a)C}{r}+\left[\frac{(1-v)(1-\chi)(1-\tau_B)\overline{\overline{\Pi}}}{\delta}-\frac{(1-a)C}{r}\right]\left(\frac{\Pi}{\overline{\overline{\Pi}}}\right)^{\beta_2} & \text{b.d.} \end{cases}$$

D.2 The subsidiary's equity

As shown in (2), the subsidiary's after-tax profit is

$$\Pi_S^N(\Pi) = (1-\tau_B)\left[(1-\chi)\Pi - C_S\right]. \tag{26}$$

Using (26) and applying dynamic programming we can calculate the subsidiary's equity value:

$$E_S(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ (1-\tau_B)\left[(1-\chi)\frac{\Pi}{\delta} - \frac{C_S}{r}\right] + \sum_{i=1}^{2} G_i \Pi^{\beta_i} & \text{b.d.} \end{cases} \tag{27}$$

As usual, in the absence of financial bubbles, we have $G_1 = 0$. To find G_2 we apply the following boundary condition, which states that, at point $\overline{\Pi}$, the subsidiary's equity value is nil, i.e.,

$$E_S\left(\overline{\Pi}\right) = (1-\tau_B)\left[(1-\chi)\frac{\overline{\Pi}}{\delta} - \frac{C_S}{r}\right] + G_2\overline{\Pi}^{\beta_2} = 0.$$

We therefore obtain

$$G_2 = -(1-\tau_B)\left[(1-\chi)\frac{\overline{\Pi}}{\delta} - \frac{C_S}{r}\right]\overline{\Pi}^{-\beta_2},$$

so that the value of equity is equal to:

$$E_S(\Pi) = \begin{cases} 0 & \text{a.d.,} \\ \begin{array}{l} (1-\tau_B)\left\{\left[(1-\chi)\frac{\Pi}{\delta} - \frac{C_S}{r}\right]\right. \\ \left. -\left[(1-\chi)\frac{\overline{\Pi}}{\delta} - \frac{C_S}{r}\right]\left(\frac{\Pi}{\overline{\Pi}}\right)^{\beta_2}\right\} \end{array} & \text{b.d.} \end{cases} \tag{28}$$

E Sample Correlation Matrix

	$Leverage$	τ_B	τ_A	$1(\tau_B > \tau_A)$	$\ln \mathrm{Re}\, venue_{t-1}$
$Leverage$	1				
τ_B	0.0297*	1			
τ_A	−0.0095*	0.1178*	1		
$1(\tau_B > \tau_A)$	0.0163*	0.3916*	−0.5579*	1	
$\ln \mathrm{Re}\, venue_{t-1}$	0.0349*	0.1094*	0.0820*	−0.0225*	1
ROA_{t-1}	−0.1450*	0.0015	0.0040	0.0053*	0.0385*
$\left(\frac{\text{Fixed Assets}}{\text{Total Assets}}\right)_{t-1}$	−0.0877*	−0.0420*	−0.0193*	−0.0047	−0.0184*
$1(EBIT_{t-1} < 0)$	0.2550*	−0.0219*	−0.0082*	−0.0140*	−0.1375*
$Zscore_{t-1}$	−0.0282*	0.0001	0.0025	−0.0031	−0.0264*
$GDP\ growth\ rate$	−0.0431*	−0.4272*	0.0152*	−0.2160*	−0.0768*

	ROA_{t-1}	$\left(\frac{\text{Fixed Assets}}{\text{Total Assets}}\right)_{t-1}$	$1(EBIT_{t-1} < 0)$	$Zscore_{t-1}$	GDP $growth\ rate$
ROA_{t-1}	1				
$\left(\frac{\text{Fixed Assets}}{\text{Total Assets}}\right)_{t-1}$	−0.0394*	1			
$1(EBIT_{t-1} < 0)$	−0.2629*	0.0727*	1		
$Zscore_{t-1}$	0.0018	0.0221*	0.0057*	1	
$GDP\ growth\ rate$	0.0181*	0.0765*	−0.0265*	−0.0048	1

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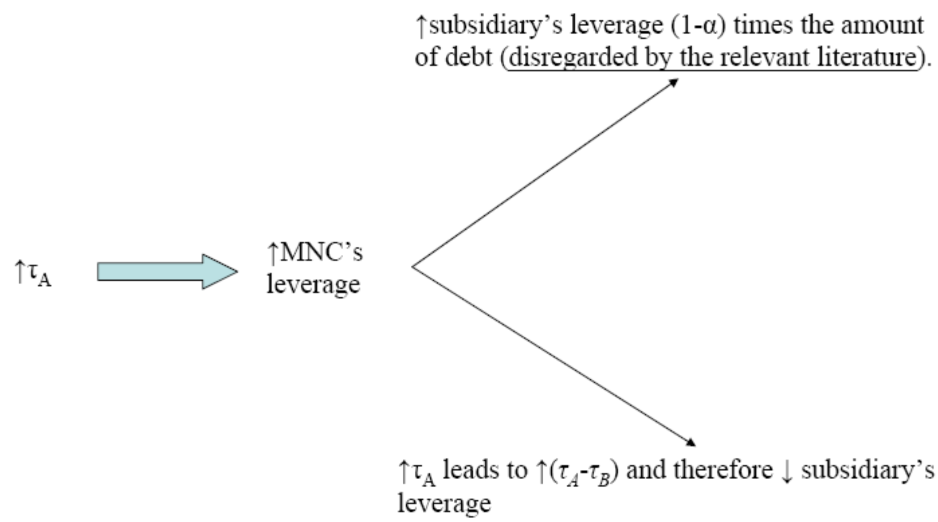

Figure 1: Tax effects on subsidiary's leverage.

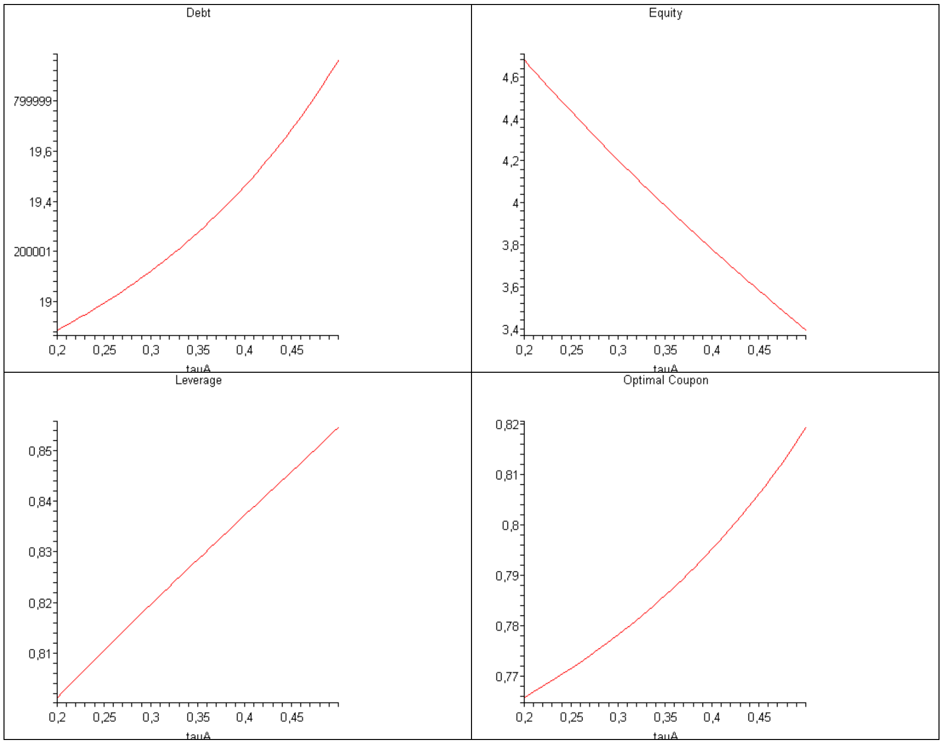

Figure 2: Simulated Equity, Debt, Optimal Coupon, Leverage. Parameter values: $\Pi = 1$, $r = 0.04$, $\sigma = 0.2$, $\mu = 0$, $\upsilon = 0.4$, $\chi = 0.5$, $n = 2$, $\tau_B = 0.2$.

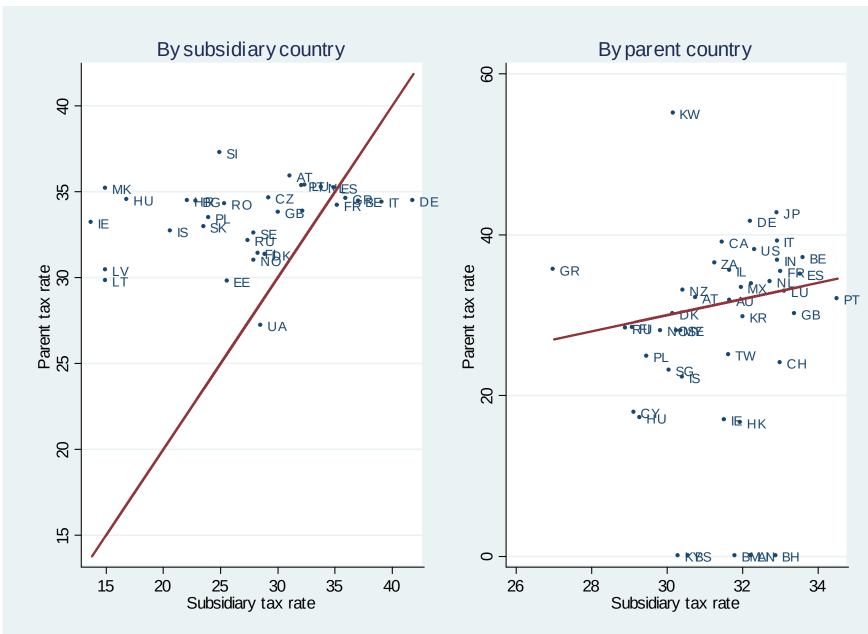

Figure 3: Average subsidiary and parent tax rates, by subsidiary (left panel) or parent country (right panel).

Subsidiary country	Number of subsidiaries	Number of years per subsidiary	Subsidiary tax rate (%)	Parent tax rate (%)	$\tau_B > \tau_A$ (%)
Austria	32	5.6	31.12	35.89	26.8
Belgium	2057	7.2	37.12	34.41	64.58
Bulgaria	74	6.5	22.93	34.43	6.61
Czech Republic	516	6.4	29.29	34.62	20.6
Germany	987	5.7	41.87	34.44	78.99
Denmark	751	2.9	28.97	31.3	47.48
Estonia	316	7	25.63	29.76	5.4
Spain	2777	7.3	35	35.18	50.35
Finland	719	7.4	28.37	31.38	42.05
France	5892	7.2	35.25	34.18	52.75
Great Britain	8761	7	30.11	33.77	22.7
Greece	312	7.4	36.02	34.57	65.92
Croatia	176	6.5	22.19	34.43	7.28
Hungary	137	4.4	16.9	34.51	2.16
Ireland	550	4.7	13.77	33.19	2.38
Iceland	3	5.6	20.67	32.67	22.22
Italy	1870	7.1	39.16	34.37	84.13
Lithuania	77	5.1	15	29.79	1.31
Luxembourg	33	5.6	32.42	35.35	22.12
Latvia	133	7.2	15	30.42	3.08
Macedonia	2	2	15	35.16	0
Netherlands	733	6.1	33.89	35.21	43.5
Norway	1074	7.4	28	30.96	46.6
Poland	903	5.5	24.04	33.47	10.26
Portugal	353	6.6	32.16	35.33	23.23
Romania	689	6.6	25.42	34.26	14.62
Russia	100	6	27.48	32.13	29.41
Sweden	1319	7	28	32.56	23.9
Slovenia	13	7.3	25	37.23	1.33
Slovakia	110	5.3	23.59	32.94	19.12
Ukraine	181	5	28.56	27.18	51.36
Total	31650	7	32.25	33.81	41.27

Table 1: Number of subsidiaries, average numebr of years available per subsidiary, average statutory tax rates the subsidiaires (τ_B) and their parents (τ_A), percentage of subsidiaries whose statutory tax rate is higher than their parent company's statutory tax rate.

Subsidiary country	Parent company country							
	Germany	France	Great Britain	Other EU	Other Europe	United States	Other OECD	Rest of the World
Austria	46.9	6.3	3.1	15.6	9.4	6.3	6.3	6.3
Belgium	8.7	24	7.6	29.4	4.9	19.2	3.8	2.4
Bulgaria	17.6	5.4	4.1	36.5	16.2	14.9	5.4	0
Czech Republic	17.3	13.2	5.4	33.1	6.4	18.2	4.7	1.7
Germany	-	15.1	10	28.8	7.7	24.4	11.3	2.7
Denmark	8.1	7.1	7.3	39.2	11.3	21	3.2	2.8
Estonia	5.7	4.1	4.8	72.2	7.6	4.4	1.3	-
Spain	14.5	18.4	10.3	28.4	4.7	16.2	5.4	2.1
Finland	4.6	7	4.5	56.9	6.3	16.1	3.1	1.7
France	11.1	-	13.2	35.1	7.8	23.8	6	3
Great Britain	8.2	10.2	-	22.7	6.4	34	10.1	8.4
Greece	8.7	19.9	10.6	29.8	5.8	19.9	3.9	1.6
Croatia	21.6	10.8	6.3	42.1	6.8	11.4	1.1	-
Hungary	19	8.8	0.7	45.3	7.3	15.3	0.7	2.9
Ireland	7.5	5.6	26.7	17.3	4.4	29.3	5.3	4
Iceland	-	-	33.3	-	-	66.7	-	-
Italy	10.4	21.2	7.4	22.5	7.5	25	3.4	2.5
Lithuania	6.5	2.6	-	71.4	14.3	5.2	-	-
Luxembourg	21.2	21.2	12.1	36.4	-	9.1	-	-
Latvia	7.5	7.5	2.3	72.9	3	4.5	0.8	1.5
Macedonia	50	-	-	50	-	-	-	-
Netherlands	9.8	9.6	12.4	18	6.4	27	8.9	7.9
Norway	5.2	5.1	7.5	60.5	4.1	13.8	1.3	2.4
Poland	16.9	13.6	6.3	39.1	5.8	12.4	3.4	2.4
Portugal	10.2	22.4	2.3	40.8	4.8	13.3	4.8	1.4
Romania	16.6	14.5	7	42.4	4.9	9.9	2.9	1.9
Russia	22	7	1	52	6	6	3	3
Sweden	8.8	9.9	6.2	38.4	15.3	17.1	2.4	1.9
Slovenia	15.4	38.5	7.7	15.4	7.7	15.4	-	-
Slovakia	12.7	13.6	1.8	41.8	2.7	23.6	2.7	0.9
Ukraine	7.7	3.9	7.2	52.5	13.3	7.2	2.8	5.5
Total	9.9	10.6	6.9	31.8	6.9	23.5	6.2	4.2

Table 2: Percentage of subsidiaries in the "Subsidiary country" (row) by parent company's country of residence (column). -: not applicable or no companies in the dataset.

Subsidiary country	Leverage (%)	Operating revenues	ROA (%)	$\frac{\text{Fixed Assets}}{\text{Total Assets}}$ (%)	Z-score	$EBIT_{t-1} < 0$ (%)	GDP growth rate (%)
Austria	51.3	80,390	9.75	34.67	3.76	11.34	1.84
Belgium	73.72	13,416	4.24	19.25	2.58	23.76	1.63
Bulgaria	67.28	6,806	7.22	40.53	3.56	20.72	5.87
Czech Republic	55.2	19,341	7.52	39.42	3.04	15.93	3.59
Germany	74.59	89,708	5.4	27.39	2.98	23.54	1
Denmark	64.85	15,293	6.27	16.23	3.49	22.96	2.04
Estonia	56.68	4,552	9.4	29.33	3.31	15.43	7.5
Spain	67.92	15,307	5.8	21.84	4.5	20.55	2.29
Finland	59.87	6,527	10.28	12.62	3.99	19.37	2.78
France	69.41	11,122	4.34	17.82	2.69	27.92	1.46
Great Britain	70.29	14,102	4.51	15.65	2.58	29.45	2.26
Greece	75	13,597	8.06	11.51	3.84	18.22	3.54
Croatia	67.81	6,899	6.47	23.37	2.9	20.92	4.43
Hungary	67.38	6,366	5.32	39.65	2.58	24.69	4.42
Ireland	67.55	12,011	4.82	15.01	2.81	25.69	3.4
Iceland	56.75	271,651	18.59	63.39	3.56	0	3.93
Italy	77.23	17,925	5.13	13.28	2.95	20.03	0.76
Lithuania	64.25	4,915	6.41	22.94	3.45	17.47	7.3
Luxembourg	64.48	58,537	4.07	29.51	4.08	14.42	3.4
Latvia	71.06	6,327	6.96	27.08	2.95	21.43	7.83
Macedonia	9.7	104,335	32.89	50.9	14.85	0	3.79
Netherlands	64.44	50,570	6.48	24.96	5.23	19.77	1.7
Norway	72.92	6,546	7.07	14.35	4	24.75	1.71
Poland	63.61	15,544	6.72	37.71	3.27	22.73	3.59
Portugal	64.34	25,924	5.82	22.97	3.74	19.82	1.01
Romania	70.5	4,708	8.96	34.15	4.11	22.19	5.05
Russia	60.1	39,093	18.11	42.54	3.81	10.59	6.52
Sweden	69.49	11,443	5.64	22.57	3.12	26.61	2.78
Slovenia	35.57	30,011	8.46	45.53	4.41	0	3.74
Slovakia	51.71	22,453	9.04	48.09	3.31	12.94	4.72
Ukraine	51.6	13,828	4.09	58.61	3.09	29.98	7.7
Total	69.79	13,254	5.23	18.67	3.07	25.22	2.2

Table 3: Median values of leverage, operating revenues (th Euro, 2005 prices), ROA, fixed to total assets ratio and Z-score; percentage of subsidiaries recording negative EBIT in the past year, average PPP real per capita GDP growth rate.

	(1) Linear	(2) Linear	(3) Polynomials
log(Revenue$_{t-1}$)	1.261***	1.267***	1.270***
	(0.1395)	(0.1393)	(0.1377)
ROA$_{t-1}$	-0.0808***	-0.0801***	-0.0799***
	(0.0162)	(0.0163)	(0.0162)
$\left(\frac{\text{Fixed Assets}}{\text{Total Assets}}\right)_{t-1}$	0.0322***	0.0322***	0.0324***
	(0.0115)	(0.0116)	(0.0116)
Zscore$_{t-1}$/1000	-0. 225**	-0. 215**	-0. 218**
	(0.1077)	(0.103)	(0.1035)
GDP growth rate	-0.409***	-0.376***	-0.381***
	(0.1032)	(0.1026)	(0.1095)
$\mathbf{1}\left(EBIT_{t-1} < 0\right)$	6.699***	14.54***	3.026
	(0.3665)	(2.5292)	(7.407)
$\mathbf{1}(\tau_B \geq \tau_A)$		7.959***	24.04**
		(2.3366)	(7.7483)
R_o^2	0.05	0.05	0.05
Observations		157,227	
Num. companies		31,650	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 4: Subsidiary fixed effects estimates. Home country cluster-robust standard errors in parentheses. All specifications include year dummies. $R_o^2 = \rho^2(L_{it}, \hat{L}_{it})$ where $\hat{L}_{it}$ is predicted without taking into account the individual fixed effect. Column 1: linear effects of τ_A and τ_B. Column 2: linear effects of τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 3: second order polynomials in τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$.

	(1) Linear	(2) Linear	(3) Polynomials
		Effect of τ_B	
Entire sample	0.184***	0.203***	0.1581***
	(0.0417)	(0.0365)	(0.0452)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} > 0$		0.290***	0.241***
		(0.0448)	(0.0471)
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} > 0$		0.148***	0.104
		(0.0542)	(0.0696)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} \leq 0$		0.253**	0.131*
		(0.0574)	(0.0738)
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} \leq 0$		-0.0784	0.0087
		(0.1069)	(0.1318)
		Effect of τ_A	
Entire sample	0.0470*	0.0103	0.0085
	(0.0282)	(0.0467)	(0.0582)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} > 0$		0.0737**	0.0711
		(0.028)	(0.0572)
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} > 0$		-0.0135	-0.0147
		(0.0785)	(0.0737)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} \leq 0$		-0.0957	-0.0468
		(0.0701)	(0.0822)
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} \leq 0$		-0.0303	-0.107
		(0.1013)	(0.1165)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5: Sample average marginal effects of subsidiary and parent tax rates. Home country cluster robust standard errors in parentheses. Column 1: linear effects of τ_A and τ_B. Column 2: linear effects of τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 3: second order polynomials in τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$.

Subsidiary country	$\tau_B < \tau_A$ $EBIT_{t-1} \geq 0$	$\tau_B > \tau_A$ $EBIT_{t-1} \geq 0$	$\tau_B < \tau_A$ $EBIT_{t-1} < 0$	$\tau_B > \tau_A$ $EBIT_{t-1} < 0$
Austria	60.82	24.74	12.37	2.06
Belgium	26.49	49.8	8.93	14.78
Bulgaria	73.57	5.11	19.82	1.5
Czech Republic	65.82	16.37	13.57	4.23
Germany	16.36	59.21	4.65	19.78
Denmark	38.88	34.19	13.65	13.29
Estonia	77.58	4.64	17.02	0.76
Spain	39.99	39.27	9.66	11.08
Finland	46.01	34.87	11.94	7.18
France	34.3	38.04	12.96	14.7
Great Britain	54.82	16.3	22.47	6.4
Greece	27.94	53.29	6.15	12.62
Croatia	71.79	5.09	20.92	2.2
Hungary	71.91	1.85	25.93	0.31
Ireland	71.19	1.13	26.44	1.25
Iceland	77.78	22.22	0	0
Italy	12.79	67.9	3.07	16.24
Lithuania	77.73	1.31	20.96	0
Luxembourg	65.38	21.15	12.5	0.96
Latvia	73.25	1.96	23.67	1.12
Macedonia	100	0	0	0
Netherlands	45.94	34.64	10.56	8.85
Norway	38.68	35.56	14.72	11.05
Poland	68.37	7.22	21.37	3.04
Portugal	60.42	19.18	16.34	4.05
Romania	66.05	10.09	19.33	4.53
Russia	62.82	24.71	7.76	4.71
Sweden	55.14	17.54	20.96	6.36
Slovenia	98.67	1.33	0	0
Slovakia	69.41	16.47	11.47	2.65
Ukraine	33.01	34.13	15.63	17.22
Total	43.57	31.13	15.16	10.14

Table 6: Percentage of observations by sign of the differential tax rates ($\tau_B - \tau_A$) and reporting losses in the past year ($EBIT_{t-1}$).

	(1) Year × Subs Country	(2) Year × Parent. Country	(3) Linked companies	(4) Cross-border tax rates
log(Revenue$_{t-1}$)	1.296***	1.239***	1.350***	0.743**
	(0.1382)	(0.1355)	(0.1624)	(0.3131)
ROA$_{t-1}$	-0.0803***	-0.0799***	-0.0625***	-0.0532***
	(0.016)	(0.0163)	(0.0138)	(0.0135)
$\left(\frac{\text{Fixed Assets}}{\text{Total Assets}}\right)_{t-1}$	0.0332***	0.0309***	0.0335	0.0366*
	(0.0112)	(0.0115)	(0.0226)	(0.0183)
Zscore$_{t-1}$/1000	-0. 221**	-0. 216**	-1.76***	0.0044
	(0.1077)	(0.1069)	(0.6027)	(0.1041)
GDP growth rate		-0.391***	-0.392***	-0.269**
		(0.1092)	(0.1396)	(0.1046)
$\mathbf{1}\left(EBIT_{t-1} < 0\right)$	9.586***	11.84***	14.47***	4.971***
	(1.445)	(1.7524)	(4.177)	(0.3365)
$\mathbf{1}(\tau_B \geq \tau_A)$	3.420*	8.149**	5.626**	
	(1.9764)	(2.5538)	(2.3465)	
GUO leverage$_{t-1}$			-0.021	
			(0.027)	
R_o^2	0.05	0.04	0.04	0.024
Observations	157,227		64,888	60,120
Num. companies	31,650		14,567	15,628

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: Subsidiary fixed effects estimates. Home country cluster-robust standard errors in parentheses. All specifications include year dummies. $R_o^2 = \rho^2(L_{it}, \hat{L}_{it})$ where $\hat{L}_{it}$ is predicted without taking into account the individual fixed effect. Column 1: Subsidiary country × year dummies, linear effects of τ_A interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 2: Ultimate owner country × year dummies, linear effects of τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 3: sample includes only subsidiaries with information on their parent leverage. Linear effects of τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 4: sample includes only subsidiaries with available information on effective subsidiary tax rate (τ) and tax incentive to debt shifitng (φ) according to Huizinga et al. (2008). Linear effects of τ and φ.

	(1) Year × Subs Country	(2) Year × Par. Country	(3) Linked companies	(4) Cross-border tax rates
		Effect of τ_B		Effect of τ
Entire sample		0.2073***	0.189***	0.127**
		(0.0359)	(0.0596)	(0.0477)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} > 0$		0.344***	0.261***	
		(0.0395)	(0.0538)	
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} > 0$		0.109***	0.151*	
		(0.054)	(0.0871)	
$(\tau_B < \tau_A)$ & $EBIT_{t-1} \leq 0$		0.188**	0.209**	
		(0.061)	(0.0878)	
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} \leq 0$		-0.0559	0.0629	
		(0.0846)	(0.1886)	
		Effect of τ_A		Effect of φ
Entire sample	0.0083		-0.0306	-0.0283
	(0.0428)		(0.0428)	(0.0246)
$(\tau_B < \tau_A)$ & $EBIT_{t-1} > 0$	0.0686**		0.0484	
	(0.0208)		(0.039)	
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} > 0$	-0.0224		-0.0257	
	(0.0718)		(0.0797)	
$(\tau_B < \tau_A)$ & $EBIT_{t-1} \leq 0$	-0.00399		-0.122	
	(0.0508)		(0.0912)	
$(\tau_B \geq \tau_A)$ & $EBIT_{t-1} \leq 0$	-0.137		-0.196*	
	(0.0926)		(0.1095)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8: Sample average marginal effects of subsidiary and parent tax rates. Home country cluster robust standard errors in parentheses. Column 1: Subsidiary country × year dummies, linear effects of τ_A interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 2: Ultimate owner country × year dummies, linear effects of τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 3: sample includes only subsidiaries with information on their parent leverage. Linear effects of τ_A and τ_B interacted with the dummies of the four cases $1(EBIT_{t-1} < 0) \times 1(\tau_B > \tau_A)$. Column 4: sample includes only subsidiaries with available information on effective subsidiary tax rate (τ) and tax incentive to debt shifitng (φ) according to Huizinga et al. (2008). Linear effects of τ and φ.

	Linked companies			Effective tax rates			
Subsidiary country	% of sample	Subsidiary leverage (%)	Parent leverage (%)	% of sample	Subsidiary leverage (%)	τ (%)	φ (%)
Austria	51.55	56.34	60.35	26.8	53.13	35.02	-0.26
Belgium	55.37	73.96	66.16	47.39	75.34	39.14	4.24
Bulgaria	50.75	67.47	52.44	1.5	64.12	31.94	1.14
Czech Republic	51.9	54.92	63.75	27.5	56.83	35.93	-1.9
Germany	36.39	76.2	63.53	26.23	76.2	46.03	12.75
Denmark	51.6	65.51	63.33	0.57	61.91	30	-1.53
Estonia	61.62	55.73	58.67	53.7	58.34	6.66	-23.57
Spain	45.21	67.93	66.94	44.65	68.12	35.17	-1.89
Finland	58.83	58.15	59	48.72	59.12	29.06	-1.52
France	42.09	70.32	61.61	41.87	70.02	36.94	2.54
Great Britain	25.02	71.09	65.2	29.73	71.47	30.46	-3.65
Greece	51.92	74.66	64.01	41.99	68.73	37.31	0.76
Croatia	44.39	65.71	65.78	38.03	70.32	32.14	-4.89
Hungary	55.56	68.37	66.72	30.56	67.41	24.98	-14.83
Ireland	37.13	66.52	66.8	19.38	68.97	24.72	-7.48
Iceland	66.67	54.46	55.97	0	-	-	-
Italy	48.65	77.59	62.36	41.87	77.32	40.95	6.06
Lithuania	66.38	64.26	59.21	17.03	57.36	20.16	-9.34
Luxembourg	54.81	67.77	57.56	27.88	69.31	35.26	0.04
Latvia	59.38	70.55	58.02	41.46	72.77	25.31	-4.45
Macedonia	100	9.7	43.76	0	-	-	-
Netherlands	35.18	64.9	62.49	25.17	69.18	34.81	-0.83
Norway	54.03	73.77	60.39	53.4	72.61	28.68	-2.15
Poland	49.43	62.72	66.14	34.25	66.43	31.99	-3.78
Portugal	47.89	65.42	64.1	44.47	67.04	34.73	-2.47
Romania	49.01	69.15	64.55	43.67	74.46	33.12	-3.53
Russia	36.47	55.7	61.02	3.06	86.42	30.46	0.3
Sweden	53.53	70.26	62.07	50.25	69.81	28.17	-4.4
Slovenia	56	32.87	63.15	20	34.59	28.75	-8.5
Slovakia	45.88	52.97	58.76	0.88	53.71	31.07	14.9
Ukraine	8.29	51.27	59.53	0	-	-	-
Total	41.27	70.16	63.44	38.24	70.78	33.83	-0.55

Table 9: Descriptive statistics for robustness checks subsamples: percentage of observations with respect to the sample used in the benchmark case, median subsidiary and parent leverage, average effective tax rate (τ) and relative taxation of equity and internal debt (φ) computed by Huizinga et al. (2008). The relative taxation of equity and internal debt φ is defined as the difference bewteen tax rates on cross-border interest and tax rates on cross-border dividends.

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