Profit Shifting within Multinational Firms: The Role of Entity Characterization Profiles

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Abstract

This paper analyzes the impact of corporate taxation on interest allocation among affiliates of multinational firms. Inspired by common transfer pricing practice and, in particular, the OECD Transfer Pricing Guidelines, we argue that the extent to which a foreign-owned subsidiary may shift interest payments to other affiliates depends on its role ('*characterization profile*') within the multinational group. We derive testable hypotheses on the relationship between corporate taxation and interest-to-sales ratios of foreign-owned subsidiaries for two types of characterization profiles, i.e., firms performing *routine* and *non-routine* activities. Using a dataset of 10,000 European foreign-owned affiliates between 1999 and 2007, we apply propensity score matching techniques to identify whether interest allocation among foreign-owned affiliates is affected by corporate taxation. Our findings suggest that non-routine firms bear significantly more interest payments than their routine counterparts. They also react sensitively to international tax rate differentials.

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1 Introduction

There is a broad research on the taxation of multinational enterprizes (MNEs) observing a substantial difference in reported pre-tax profits between foreign-owned subsidiaries in low- and high-tax countries (see Hines 1997, 1999, and Devereux 2006, for comprehensive surveys). Such profit shifting activities might be rooted in tax planning with regard to capital structures ('debt shifting'), to the manipulation of transfer prices for goods and services (including financial transactions), and to over-/underreporting of royalties for intellectual properties.[1] One element that is missing in this literature is a stronger tax law/tax practitioner perspective on profit shifting. In particular, it is well recognized by tax authorities that an MNE's ability to shift profits across countries depends on the role of a foreign-owned subsidiary within a multinational group (see, e.g., Schadewald and Misey 2005, Cole 2009). Foreign subsidiaries are often established to perform only specific tasks (e.g., sales activities or assembling), and then, they neither participate in an MNE's strategic decision making nor act locally as independent business units. In this case, their opportunities to engage in profit shifting activities are only limited.

This paper investigates the impact of corporate taxation on profit shifting by explicitly accounting for the common transfer pricing practices as formulated in the OECD Transfer Pricing Guidelines (OECD 1999), which are the most influential statutory regulation on transfer pricing issues at the international level. These guidelines require that affiliates' profits have to be allocated across countries according to the functions performed, assets employed and intangibles used by the transaction parties – also known as

[1] Desai, Foley and Hines (2004), for example, analyzing debt ratios of foreign-owned affiliates of U.S. multinationals, find support for tax-induced debt shifting (see Altshuler and Grubert 2003, for similar evidence; Jog and Tang 2001, and Mintz and Smart 2004, for evidence from Canada; see also Huizinga, Laeven and Nicodème 2008, and Egger, Eggert, Keuschnigg and Winner 2010, for European studies). With regard to transfer pricing, Grubert and Mutti (1991), for instance, suggest that foreign-owned affiliated companies report lower profits in high tax locations and vice versa (see, e.g., Clausing 2003, Bartelsman and Beetsma 2003, or Huizinga and Laeven 2008, for similar evidence). Addressing royalty payments, Hines (1994) relies on data from the U.S. Department of Commerce and the Bureau of Economic Analysis. He finds a significantly positive relationship between tax rates and local research and development activities, suggesting that these are substitutes to imported technologies (see also Grubert 1998). A comprehensive empirical analysis of all channels of profit shifting is given by Grubert, Goodspeed and Swenson (1993), Grubert (1997) and Altshuler and Grubert (2005).

the *characterization profile* of an affiliated party in transfer pricing terms. In practice, characterization profiles affect the allocation of profits and the recognition of expenses from intercompany transactions decisively.[2] They are one of the core issues of discussion in any transfer pricing audit (see, e.g., Bell 2010).

Characterization profiles consist of standardized firm types which have evolved over time and which are widely acknowledged by the tax authorities. They are used to benchmark the profitability of foreign-owned affiliates and, hence, to show that an MNE's intercompany transactions comply with the arm's length principle. In this regard, common transfer pricing practice and tax authorities typically distinguish between *routine* and *non-routine* firms (see, e.g., the administration principles and procedures in the U.S., Canada or Germany).[3] While the latter ones operate as regional or local headquarters and perform functions similar to comparable lone-standing firms, the former ones do not perform all operations observed in comparable lone-standing firms. Specifically, the difference between these two firm types is that non-routine firms hold (valuable) tangible and intangible assets (e.g., intellectual property rights), bear costs typically associated with sales and supplier financing, and hold significant inventories. This, in turn, implies that routine firms are only allowed to incur interest payments that are directly associated with their operating activities.

We use balance sheet information from European firms to identify characterization profiles of foreign-owned affiliates accounting for the difference in functions performed, assets employed and intangibles used. Following Froot and Hines (1995) and Desai, Foley and Hines (2004), we estimate an MNE's ability to shift profits among its affiliates by means of interest allocation. Under systematic differences between non-routine and routine firms, one would expect that non-routine firms can more easily shift profits via intercompany interest allocation and, therefore, bear higher interest payments

[2]For instance, the OECD Transfer Pricing Guidelines (OECD 1999: 4) state that *" ... [the] application of the arm's length principle is generally based on a comparison of the conditions in a controlled transaction with the conditions in transactions between independent enterprises. [...] In dealings between two independent enterprises, compensation usually will reflect the functions that each enterprise performs ... ."*

[3]For example, according to the German adminstration procedures, "*... it is in general absolutely necessary to perform a characterization of enterprises with respect to the audited transaction in order to find out whether and which of the enterprises involved performs routine functions ...*"; see International Bureau of Fiscal Documentation, International Transfer Pricing Journal, July/August 2005, p. 173.

than routine firms. To identify this effect empirically, we account for the fact that firms are systematically selected into an MNE network and, therefore, cannot be viewed as a random draw from a given firm population. For this purpose, we compare interest payments of routine and non-routine foreign affiliates with entities that are, by definition, unable to shift profits abroad, i.e., domestically-owned firms. Econometrically, we apply propensity score matching techniques to obtain the appropriate control group.

The remainder of the paper is organized as follows. In Section 2, we employ a simple model of interest allocation among foreign-owned affiliates to derive theoretical hypothesis on the effects of corporate taxation on the interest allocation policies of routine and non-routine foreign-owned subsidiaries. Section 3 describes the empirical approach to analyze the behavior of non-routine and routine MNEs. Section 4 presents the data and some descriptive statistics. Section 5 discusses the empirical results, and Section 6 concludes.

2 A simple model of interest allocation among routine and non-routine foreign-owned affiliates

Similar to the debt shifting models of Mintz and Smart (2004) and Huizinga, Laeven and Nicodème (2008) we assume the following profit equation for a subsidiary i that is part of a multinational group, selling a homogeneous good in a competitive market

$$\pi_i = (1 - \tau_i) \left[S_i(k_i) - z_i \right]. \tag{1}$$

Accordingly, total revenues are given by $S_i(k_i)$. For simplicity, the output price is given and capital k_i is the only factor of production. Since we are interested in the allocation of interest payments among affiliated parties we leave capital exogenous and skip the argument from S_i. To finance its operations, a subsidiary raises capital via external and/or internal debt. External debt is borrowed from a third party (e.g., a bank) at a given market interest rate. Internal debt comes from another affiliated party at an interest rate that may not necessarily comply with the market interest rate (e.g., intercompany loans might be associated with lower agency costs or risk premia). The corresponding overall interest payments are denoted by

z_i, as the two types remain unidentified in the income statements of the firms. In both cases, interest payments depend on the amount of debt and the corresponding interest rate.[4]

Profits of each subsidiary are subject to the statutory corporate tax rate τ_i. Generally, a multinational group has two possibilities to influence taxable profits, i.e., (i) to alter the capital structure of foreign-owned affiliates, and to (ii) manipulate the interest rate on internal finance transactions. Both activities affect interest payments z_i.

In the presence of different corporate tax rates across countries, an MNE has an incentive to use intercompany loans at an interest rate that deviates from the market interest rate (i.e., the arm's length price in OECD terms) to minimize its global tax burden. It will set a higher (lower) intercompany interest rate and pile up a higher (lower) level of intercompany debt if the tax rate of the borrowing subsidiary is high (low). An independent domestic counterpart to subsidiary i, in contrast, cannot engage in cross-border internal financing activities to reduce its tax burden. Its operations are financed on the domestic credit markets leading to interest payments z_i^*. Interest payments on intercompany loans might be considered as a nifty instrument to shift profits, since it minimizes the governments' claim on profits and maximizes the amount of income flowing to private investors. Further, intercompany interest payments are not visible to tax authorities at first sight as both internal and external debt are considered in the individual financial statements of each subsidiary. However, the tax authorities are able to obtain evidence on this type of intercompany trade by comparing interest payments of foreign-owned entities to the ones of domestically-owned firms. From a tax practitioners perspective, it is, therefore, reasonable to treat z_i^* as a benchmark against which one can compare tax-induced interest payments of foreign-owned affiliates (including intercompany loans at non-market interest rates).

Following the previous literature, we maintain that the cost of external and internal debt financing for a subsidiary i increases in the interest-to-sales ratio (which is, technically speaking, some sort of a reciprocal interest coverage ratio). Specifically, these costs are positively related to the firm-wide

[4] A foreign-owned firm's interest payments would be negative if it borrows to other affiliated parties within the multinational group. Then, z_i positively contributes to its profits.

leverage ratio and, therefore, increase an MNE's risk of going bankrupt. Besides, we also constrain the allocation of interest payments to a single affiliate assuming that there exists a benchmark related to the amount of financing expenses that tax authorities obtain from the financial statements of (domestic) non-shifters. Substantial deviation from this benchmark increases the cost of internal interest shifting either because of the increased probability of detection or because of the additional efforts that the MNE needs to take to conceal manipulative financing activities from local tax authorities (see, e.g., Kant 1988, and Haufler and Schjelderup 2000). Hence, an MNE weighs the returns of intercompany tax shifting against the cost of manipulating intercompany interest payments, or, more generally, the conditions applied to intercompany financial transactions.

According to the OECD Transfer Pricing Guidelines (OECD 1999) we consider two types of foreign-owned affiliates. The first type performs *routine operations*, exhibiting only limited ability to pile up internal debt at non-market interest rates. The second type runs *non-routine businesses*, holding substantial intangible assets and is able to shift higher amounts of interest payments. The former is indexed by R, the latter by N. Further, we assume that θ percent of the affiliates in a multinational group are routine ones (as measured in terms of sales). An affiliate's interest-to-sales ratio in the absence of the possibility to shift debt and to manipulate interest payments is defined as $\lambda_r^* = z_r^*/S_r^*$, $r = N, R$. Naturally, the interest-to-sales ratio is lower for routine firms as tax authorities know that these firms have smaller amounts of valuable assets in their books, i.e., $\lambda_R^* < \lambda_N^*$ (say, $\lambda_N^* = \lambda_R^* + \delta$, with $\delta > 0$). Following Huizinga, Laeven and Nicodème (2008), the local costs of internal debt financing are quadratic in the ratio of interest payments over sales and proportional to the sales of the subsidiary

$$c_{i,r} = \frac{\mu}{2}\left(\frac{z_{i,r}}{S_{i,r}} - \lambda_r^*\right)^2 \cdot S_{i,r}, \;\; r = N, R. \tag{2}$$

The local costs increase the further the subsidiary deviates from the benchmark interest-to-sales ratio of comparable non-shifters. Accordingly, there is a penalty (along with double taxation) on willful manipulation of intercompany finance transactions, which is an increasing function of μ. Further, at a given deviation from the benchmark, the cost of intercompany interest shifting increases in the size of the individual subsidiary, suggesting

that it is more costly to pile up debt or credits at a large affiliate, risking painful tax controversy issues on a local subsidiary level and increasing the chance of this subsidiary going bankrupt.

The additional expected group-wide costs of a multinational network from tax avoiding intercompany finance transactions are denoted by C and are likewise assumed to be quadratic

$$C = \frac{\gamma}{2}\left(\sum_{i=1}^{n_R}\frac{z_{i,R}}{S} + \sum_{i=1}^{n_N}\frac{z_{i,N}}{S}\right)^2 \cdot S, \tag{3}$$

where we define total sales of the multinational group as $S = \sum_{i=1}^{n_R} S_{i,R} + \sum_{i=1}^{n_N} S_{i,N}$. n_R (n_N) denotes an MNE's number of routine (non-routine) foreign-owned affiliates. From eq. (3) we can see that cost of tax-induced interest allocation depends on cost parameter γ and increases in the company-wide interest-to-sales ratio and, given that ratio, in the overall firm size (see also Huizinga, Laeven and Nicodème 2008). A high amount of intercompany loans increases the risk of bankruptcy of the whole group.

Taking into consideration the overall financing strategy with respect to intercompany interest shifting opportunities, the multinational group of affiliated firms maximizes its overall profits

$$\pi = \sum_{i=1}^{n_R}(\pi_{i,R} - c_{i,R}) + \sum_{i=1}^{n_N}(\pi_{i,N} - c_{i,N}) - C. \tag{4}$$

Let $\lambda_{i,r}$ denote $z_{i,r}/S_{i,r}$ and define $\rho_{i,r} = S_{i,r}/S$ as the sales weight of an affiliate in total sales of the multinational group. Using $\sum_{i=1}^{n_R}\rho_{i,R}\lambda_{i,R} + \sum_{i=1}^{n_N}\rho_{i,N}\lambda_{i,N} = \left(\sum_{i=1}^{n_N} z_{i,N} + \sum_{i=1}^{n_R} z_{i,R}\right)/S$, the first order conditions with respect to $z_{i,r}$ are given by

$$\frac{d\pi}{dz_{i,R}} = \tau_i - 1 - \mu\left(\frac{z_{i,R}}{S_{i,R}} - \lambda_R^*\right) - \gamma\left(\sum_{l=1}^{n_R}\rho_{l,R}\lambda_{l,R} + \sum_{l=1}^{n_N}\rho_{l,N}\lambda_{l,N}\right) \tag{5}$$

$$\frac{d\pi}{dz_{i,N}} = \tau_i - 1 - \mu\left(\frac{z_{i,N}}{S_{i,N}} - \lambda_N^*\right) - \gamma\left(\sum_{l=1}^{n_R}\rho_{l,R}\lambda_{l,R} + \sum_{l=1}^{n_N}\rho_{l,N}\lambda_{l,N}\right) \tag{6}$$

Solving these conditions with respect to $\lambda_{i,R}$ and $\lambda_{i,N}$, we obtain

$$\begin{aligned}\lambda_{i,R} &= \beta_0 + \beta_1 (\tau_i - 1) + \beta_2 \sum_{l=1}^{n} \rho_l (\tau_l - 1) + \beta_3 \lambda_R^* \\ \lambda_{i,N} &= \beta_0 + \beta_1 (\tau_i - 1) + \beta_2 \sum_{l=1}^{n} \rho_l (\tau_l - 1) + \beta_3 \lambda_N^* + \delta,\end{aligned} \tag{7}$$

where

$$\begin{aligned}\beta_0 &= -\frac{\gamma (1-\theta)}{\mu + \gamma} \delta \\ \beta_1 &= \frac{1}{\mu} \\ \beta_2 &= -\frac{\gamma}{\mu (\mu + \gamma)} \\ \beta_3 &= \frac{\mu}{(\mu + \gamma)}.\end{aligned}$$

δ measures the difference in interest-to-sales ratios of non-routine and routine domestically owned firms (in the Appendix we provide a full derivation of eq. (7)).

Eq. (7) contains two tax-related terms. First, the interest-to-sales ratio depends positively on the statutory corporate tax rate $(\tau_i - 1)$ at its location. This is intuitive as MNEs are able to use interest allocation strategies to reduce a high local tax burden. Second, the amount of interest shifting is captured by $\sum_{l=1}^{n} \rho_l(\tau_l - 1)$, which indicates that the reciprocal interest coverage ratio depends on the sum of weighted tax rates of all other subsidiaries of the multinational group. Intuitively, subsidiary i will exhibit a lower ratio of interest payments to sales relative to the benchmark if the average tax rates of all other affiliates are high. In that way, it is able to balance the overall tax burden by shifting interest payments from low tax to high tax countries. This term further implies that a decrease of the tax rate in one country, say country c, increases the interest payments of the affiliates in all other countries proportional to the size of the affiliates in c. Further, the interest-to-sales ratios of both types of foreign-owned subsidiaries should deviate from the benchmark values, λ^*, indicating additional financing opportunities via internal debt, which exist irrespective of whether there are international tax rate differentials or not. However, eq. (7) also suggests that

we have to account for differences in characterization profiles, δ, since the tax-induced interest allocation activities among affiliated companies depend on their respective role within the multinational group. Routine subsidiaries are expected to hold smaller capital stocks and, therefore, exhibit a lower optimal interest-to-sales ratio as indicated by δ.

3 Empirical specification and estimation

As discussed above, eq. (7) suggests that the interest-to-sales ratio of a foreign-owned affiliate i in industry k depends on the statutory corporate tax rate in host country c, the weighted average tax rate of the multinational group j it belongs to, and its role within that group (routine or non-routine). Combining the related equations for non-routine and routine foreign-owned affiliates, our empirical specification reads as

$$\lambda_{ijkc} = \beta_0 + \beta_1 \tau_c + \beta_2 \sum_{l=1}^{n_j} \rho_l \tau_l + \beta_3 \lambda^*_{c,r} + \delta D_i + \mathbf{x}_c \boldsymbol{\vartheta} + \epsilon_{ijkc}. \tag{8}$$

λ represents the dependent variable as measured by the log of the interest-to-sales ratio. τ_c denotes the statutory corporate tax rate in country c, and $\sum_{l=1}^{n_j} \rho_l \tau_l$ is the sales-weighted average tax rate of all subsidiaries of the same global ultimate owner. n_j denotes the number of affiliates of the j^{th} MNE. $\lambda^*_{c,r}$ accounts for the benchmark interest-to-sales ratio obtained from comparable domestic non-shifters that applies to subsidiary i. D_i is a dummy variable with entry one if a foreign-owned affiliate performs non-routine operations, and zero for routine firms (below, we provide more details on the measurement of both firm types). $\mathbf{x}_c$ is a vector of country-specific control variables capturing transfer pricing matters. It includes information on the existence of penalty regimes in case of non-compliance with local transfer pricing regulations, the time past since the introduction of statutory transfer pricing regulations, and country-specific creditor rights (a detailed discussion of the controls is given below). ϵ_{ijkc} is the remainder error term.

One important issue is the construction of the benchmark interest-to-sales ratio λ^*. Ideally, λ^* should be inferred from a counterfactual where the affiliates cannot engage in tax-induced interest allocation strategies. By definition, such entities are represented by domestically-owned firms (i.e., ones that are not member of a multinational group and reside in a single

country). To obtain this benchmark, one has to consider that selection into foreign-ownership is not random but rather systematically affected by a firm's strategic choices (see, e.g., Girma and Görg 2007, or Egger, Eggert and Winner 2010). To avoid such a potential endogeneity bias, we apply a matching procedure based on propensity scores (see, e.g., Rosenbaum and Rubin 1983, Rosenbaum 2002, Rubin 2006). Basically, for each foreign-owned affiliate we are looking for a domestic firm that exhibits the same probability of being part of a multinational group and, therefore, has (nearly) identical observable characteristics. Technically, this is obtained by estimating a binary model of the predicted probability of a firm being part of a multinational network. The corresponding predictions serve as the matching metric. The interest-to-sales ratio of the best match then defines our benchmark λ^*.

This leaves us with the final step of defining *routine* and *non-routine* foreign-owned firms in our sample. According to common transfer pricing practice and, especially, the OECD Transfer Pricing Guidelines (OECD 1999), routine subsidiaries (in contrast to non-routine ones) depend on guaranteed (production) orders given by affiliated transaction partners. Further, routine entities do not develop or own significant intangible assets and do not require specific know-how. Finally, we have to consider that routine firms are faced with fewer sources of financing (e.g., they are not able to engage in sales and supplier purchase financing). Consequently, we define an indicator variable for non-routine operations based on five balance sheet items: (i) accounts receivable, (ii) accounts payable, (iii) inventories, (iv) intangible assets, and (v) tangible assets. We classify a foreign-owned affiliate's operations as routine ones if the sum of these five items is small. For each of these balance sheet items, we define industry-level thresholds based on the median using the NACE 2-digit classification (Rev. 2). If a foreign-owned affiliate exceeds the industry-level threshold in at least four out of five items, we classify it as non-routine.[5] Interest payments of routine

[5]In the sensitivity analysis, we provide evidence for non-routine dummy classification of three out of five items. According to the descriptives below, around two thirds of firms within a representative network of multinational firms performs only routine activities, hence earning solid, less volatile profits. Around one third of firms, however, act as non-routine parties, typically operating as regional or local headquarters. These non-routine entities regularly serve as the direct contact and 'supervisor' of the connected routine contract manufacturers, operating as the leader of a small network within the global network of the same ultimate parent company.

subsidiaries reflect operating-related investments only (e.g., investment in new machinery). From eq. (7), we expect that interest payments of non-routine subsidiaries additionally reflect tax-induced interest allocation and, therefore, significantly differ from that of routine ones, i.e., $\delta > 0$.

Below, we use (i) a cross section and (ii) a panel of European firms to estimate Eq. (8). With regard to panel data, it should be noticed that the dummy variable for the non-routine status is not varying over time. Therefore, we apply a random effects panel estimator as proposed by Mundlak (1978) and include the unit specific means of all time varying explanatory variables as additionally controls. Mundlak (1978) shows that such a specification allows to obtain consistent within estimates for the parameters of the time varying variables. Further, the Mundlak-approach allows to include time invariant variables (like the dummy for non-routine affiliates), which is not possible in a fixed effects approach. In addition to the firm-specific random effects, we also include time specific influences common to all firms (e.g., to control for the business cycle).

4 Data and descriptive statistics

We use the AMADEUS database compiled by Bureau van Dijk which provides financial statements and ownership information for private and publicly-owned firms of European countries (including Eastern European economies) over the period 1999 to 2007. For each firm, the database provides time invariant information on the ultimate owner so that we are able to identify all affiliates of an ultimate owner that form a multinational network. We estimate eq. (8) both in a cross-section and in a panel. Although panel estimation methods are to be preferred as they account for heterogeneity across firms, we also provide cross-sectional evidence for two compelling reasons. First, the ownership information (and thus the foreign affiliate dummy used below) is time invariant. Second, the database exhibits substantial attrition and lots of missing observations. Missing data are frequently interpolated giving a somewhat misleading picture of the time variation in the data. Below, it is described how we apply some plausibility checks to detect and to exclude such observations (in addition, we exclude outlying observations in the subsequent sensitivity analysis).

We confine our analysis to affiliates of MNEs and use domestically-owned lone-standing firms as a comparison (control) group. The latter group comprises firms operating only in a single country. In contrast, an MNE's subsidiary at least has one sister company in another country (the ultimate owners themselves are excluded from the sample). We focus on active companies in the manufacturing sector (NACE 2-digit classification codes 10-33; see Table A.2 in the Appendix for a list of the included industries and the corresponding sample coverage) and exclude consolidated accounts. Therefore, the unit of observation is an affiliate of an MNE or a lone-standing firm in the control group whose balance sheet positions are separately identified.

The resulting panel covers a sample of 10,518 foreign-owned affiliates that are compared to 60,901 domestically-owned firms observed (at least once) between 1999 and 2007. Table A.1 in the Appendix summarizes the distribution of the included firms across 20 European economies. On average, there are around 553 (438) foreign-owned affiliates, and about 3,045 (2,538) domestic firms per country (industry). Each MNE has about 21 subsidiaries, on average, which are located all over Europe. The largest host countries of subsidiaries of multinational groups are France, Italy, Germany and the United Kingdom, all being home to more than 1,000 foreign-owned affiliates. Portugal, Romania and Spain are the countries with the most domestic firms. As with many studies using AMADEUS firm-level accounting data, Eastern European economies are usually the smallest host countries of firms belonging to a multinational network. The same is true in our sample with Bulgaria, Hungary, Latvia and Slovakia at the bottom of the table of host countries of foreign-owned affiliates. In total, our sample of foreign-owned firms reports global ultimate owners from 57 countries all over the world, whereas France, Germany and the United States are the most frequently reported global headquarter countries.

Table 1 presents the summary statistics of our main variables, focusing on foreign-owned affiliates only. Our dependent variable – defined as the share of interest paid to operating revenue – amounts to 1.7 for the foreign-owned firms in our sample of foreign affiliates. The country averages, not reported in the table, range from around one percent in Latvia and Slovakia to more than nine percent in Denmark. By definition, it is not possible for individual observations to have a negative interest-to-sales ratio. Hence, a few observations with negative entries were dropped from the sample. In our

Table 1: Summary statistics (cross section of firms)

Variable	**Mean**	**Std.Dev.**	**Min.**	**Max.**
Dependent variable				
Interest-to-sales ratio	1.713	3.668	0.000	49.804
Variables of interest				
Non-routine [D]	0.314	0.464	0.000	1.000
SCTR	32.620	4.584	13.333	50.079
Weighted SCTR	32.978	3.199	15.993	50.079
TP country risk [D]	0.811	0.392	0.000	1.000
TP introduction	6.326	3.672	0.000	11.000
Creditor rights	1.968	1.425	0.000	4.000
Matching variables				
Firm size	9.830	1.784	1.946	16.591
Age	2.985	0.828	0.000	5.720
Age squared	9.598	4.935	0.000	32.722
Firms per industry	6.277	1.048	0.000	8.494
Worker compensation	3.633	0.733	-2.729	7.900
Cost of work-in-progress	15.305	1.152	7.174	18.794

Notes: All variables are defined as in Table A.3. All matching variables are converted into (natural) logarithms. [D] indicates a dummy variable. 'SCTR' denotes statutory corporate tax rate and 'TP' is the abbreviation for transfer pricing.

benchmark case, we also imposed an additional restriction on the interest-to-sales ratio, dropping observations with highly implausible entries above 50. Further, we drop observations for which AMADEUS reported implausible entries for the leverage ratio (i.e., negative debt ratios or ones above 300 percent).

Data on corporate tax rates are taken from KMPG International (2009). The mean statutory corporate tax rate is 32.6 percent, ranging from 13.3 percent (Bulgaria) to 50.1 percent (Germany). In addition to the individual statutory corporate tax rate, we also use the sales-weighted tax rate within a multinational network to measure the intensity of profit shifting within the multinational group (i.e., $\sum_{l=1}^{n_j} \rho_l \tau_l$ in eq. (8)). The corresponding value is around 33 percent in our sample. Further, Table 1 shows that 31.4 percent of all foreign-owned firms have been assigned to the non-routine group (based on the selection criteria discussed above), whereas 68.6 percent performs routine activities within their respective multinational network.

The variable transfer pricing country risk accounts for the existence of statutory transfer pricing regulations along with stringent penalty regimes. In general, these regulations form the legal basis for tax authorities to ad-

just the income, deductions, credits, or allowances of controlled taxpayers to prevent the evasion of taxes. Along the introduction of transfer pricing documentation requirements, many countries introduced stringent penalties for non-compliance with domestic transfer pricing regulations. In Germany, for example, penalty assessments may amount to up to ten percent of the income adjustment. To account for country-specific transfer pricing regulations, countries have been grouped into "low risk" and "high risk" countries. 'High' risk implies that, besides statutory transfer pricing regulations, penalties for non-compliance are incorporated into law. Irrespective of legal transfer pricing documentation requirements, low risk countries are characterized by an absence of penalties. As can be seen from Table 1, slightly more than 80 percent of all subsidiaries are located in so-called high risk countries. The high share of 80 percent is not surprising, given that transfer pricing regulations became effective in Europe relatively early (e.g., in 1996 in France). We also incorporate the time past since the introduction of statutory transfer pricing regulations (e.g., statutory transfer pricing documentation requirements) that captures MNEs' and tax authorities' experience with transfer pricing matters. Ernst & Young (2009) provides a comprehensive overview of all countries that have already incorporated detailed transfer pricing regulations into law.

Finally, we follow Desai, Foley and Hines (2004) including borrowing costs as reflected by the creditor rights index as developed by LaPorta, Lopez-de-Silanes, Shleifer and Vishny (1998) and published in Djankov, McLiesh und Shleifer (2007). The index is scaled between zero and four, the latter indicating relatively stronger legal protections of creditors in case of bankruptcy.

5 Empirical results

Before we turn to the analysis of the impact of characterization profiles and corporate taxation on the allocation of interest payments, we need to determine the selection into foreign ownership. As discussed above, the reference value for the interest-to-sales ratio, λ_i^*, is derived from a sample of domestically-owned firms that are not able to engage in profit shifting. Strictly speaking, the idea is to compare the interest payments of an MNE's

affiliate to a firm that is domestically-owned and that exhibits as similar characteristics as possible to those of foreign-owned subsidiaries.

5.1 Selection into foreign ownership

We employ a propensity score matching approach to derive the benchmark level interest-to-sales ratio taking into account that selection into an MNE-network and, thus, foreign affiliate status is not random (see Blundell and Costa Dias 2002, Wooldridge 2002, Cameron and Trivedi 2005, Caliendo and Kopeinig 2008, for an overview). In a first step, we apply a binary choice model to estimate the propensity of a firm being member of a multinational group. In this regard, we closely follow Egger, Eggert, Keuschnigg and Winner (2010), who, in a similar context, analyze domestically and foreign-owned firms with respect to their debt-to-assets ratios. In particular, we include firm size (as measured by the log of operating revenue), firm age and the quadratic term of firm age as explanatory variables in the probit selection equation (see, e.g., Helpman, Melitz and Yaeple 2004, for a theoretical background). Further, our selection equation contains industry specific variables (according to NACE 3-digit classification, Rev. 2), i.e., the number of firms in an industry and intermediate goods intensity (material cost per industry). The wage cost per employee enters at the country-industry level. Finally, we include 17 country dummy variables.[6]

In a second step, the estimated propensities to be foreign-owned for both the treated (foreign-owned) and the untreated (domestically-owned) firms are used to establish a control group of domestic firms that (ideally) share the same characteristics as the foreign affiliates and exhibit the same probability to be a member of a multinational network. In this way, we are able to avoid a sample selection bias in the outcome equation. More importantly, this makes the control group comparable to the group of foreign affiliates along several dimensions (balancing property). In addition, we enforce the propensity score to lie within the common support region, ensuring that there are no domestically-owned firms in the control group whose propensity score is smaller (larger) than the minimum (maximum) of those of the foreign-owned affiliates.

[6]This number does not equal the number of countries in our final sample as we combined countries with a small firm coverage into one dummy variable (see Table A.1). These countries include Hungary, Iceland, Luxembourg and Latvia (i.e., 81 firms).

Table 2: Selection equation

	Cross section	**Panel**
Firm size	0.387 ***	0.389 ***
	(0.005)	(0.002)
Age	−0.122 ***	−0.313 ***
	(0.048)	(0.027)
Age squared	0.011	0.043 ***
	(0.008)	(0.004)
Number of firms per industry	−0.138 ***	−0.137 ***
	(0.009)	(0.004)
Worker compensation per country/industry	0.182 ***	0.148 ***
	(0.024)	(0.009)
Material cost per industry	0.124 ***	0.117 ***
	(0.008)	(0.004)
Observations	71,419	327,903
Common support	71,407	327,861
Pseudo-R^2	0.448	0.445
Log-Likelihood	16,484.7	86,913.9

Notes: Constant not reported. Standard errors are in parenthesis. *, **, and *** denote significance at 10%, 5% and 1% levels, respectively.

Table 2 summarizes the estimation results for two variants of the probit model. The first one refers to the cross-section and the second one to the panel of European firms between 1999 and 2007. Note however, that the dependent variable of the probit equation is time invariant, so we apply a pooled probit model in the panel data case. The selection equation shown in Table 2 performs well in terms of explanatory power. Most of the estimated parameters are significant at conventional levels and their signs are in line with theoretical expectations.[7]

The estimates of the probit model ensure that the matching procedure is applicable and delivers reliable results in the outcome equation. Further, Table A.4 in the Appendix indicates that the balancing property is fulfilled, implying negligible differences in the control variables of the probit between the group of foreign-owned affiliates and the matched control group

[7]We do not discuss the signs of the estimated parameters here as our primary interest is to estimate the propensity of being foreign-owned for both foreign-owned and domestically owned firms.

of domestically-owned firms.[8] Overall, the matching procedure reduces the differences between these means by more than 90 percent (see Table A.4).

Altogether, there are 71,419 (327,903) observations in the common support region in our cross-sectional (panel) data set accounting for the aforementioned restrictions. Of those observations, 60,901 are domestic firms and 10,518 are MNEs. Our preferred specification below is based on a nearest neighbor approach with $k = 3$ (i.e., for each firm in the treatment group, we use three very similar firms out of the control group to measure λ^*). In the robustness section below, we demonstrate that our estimation results are not sensitive to the choice of the matching procedure.

5.2 The outcome equation: Interest allocation among routine and non-routine foreign-owned affiliates

With the interest-to-sales benchmark for each affiliate from comparable non-shifting domestic firms at hand, we are able to estimate our econometric specification, as given in eq. (8). The corresponding regression results are presented in Table 3. The first column refers to the cross-section of affiliate specific averages between 1999 and 2007. The second one refers to panel data between 1999 and 2007. Finally, we obtain standard errors from 200 bootstrap replications in both the cross section and panel regressions.

Generally, the model fit seems well, the R^2 is reasonable, given the firm-specifics we already controlled for in the benchmark λ^*. In the panel, the time dummies are highly significant. With regard to our variables of interest, we observe a highly significant λ^*. In other words, increasing the benchmark interest-to-sales ratio of domestic non-shifters also increases the interest-to-sales ratio of foreign-owned affiliates. The size of the coefficient (0.077 in the cross section and 0.062 in the panel data set) further suggests that affiliates of MNEs react to material changes in the benchmark interest-to-sales ratio sensitively. In the cross-section (panel model), a ten percent increase in the benchmark interest-to-sales ratio increases the interest-to-sales ratio of MNEs by 0.74 (0.59) percent (calculated as $1.1^{0.077}$ and $1.1^{0.062}$, respectively).

[8] In the cross-section, the $t-$tests comparing the means of the control variables of the foreign affiliates and the matched controls are not rejected. In the panel, we observe nearly the same differences in means as in the cross-section, but some of the $t-$tests are now significant due to the increased sample size and, therefore, due to the increased power of the $t-$tests.

Table 3: Regression results

	Cross section	**Panel**[1)]
Non-routine [D]	0.601 ***	0.567 ***
	(0.031)	(0.014)
SCTR	0.021 ***	0.021 ***
	(0.004)	(0.002)
Weighted SCTR	−0.014 **	−0.005 **
	(0.006)	(0.002)
Interest benchmark	0.077 ***	0.062 ***
	(0.018)	(0.007)
TP country risk [D]	−0.364 ***	−0.418 ***
	(0.034)	(0.017)
TP introduction	0.006	0.005 ***
	(0.004)	(0.002)
Creditor rights	0.070 ***	0.087 ***
	(0.011)	(0.005)
Observations	10,501	60,251
R^2	0.046	0.051
Year dummies	–	68.158 ***

Notes: [1)]Estimation results based on Mundlak (1978); estimates of unit specific means, constant and year dummies not reported. Bootstrapped standard errors from 200 replications in parentheses. [D] indicates a dummy variable. 'SCTR' denotes the statutory corporate tax rate, and 'TP' transfer pricing. *, **, and *** denote significance at 10%, 5% and 1% levels.

We also observe that both relevant tax parameters derived from our theoretical model (i.e., the statutory corporate tax rate and the sales-weighted tax rate of all affiliated European subsidiaries) enter our model significantly, with the size of the coefficient of the individual statutory corporate tax rate being about twice as large as the one of the weighted average tax rates. In the cross-section, our results indicate that an increase in the statutory corporate tax rate in the host country of an affiliated subsidiary (weighted tax rates) by one percentage point increases (decreases) the interest-to-sales ratio by 2.12 (1.41) percent (calculated as $e^{0.021}$ and $e^{0.014}$, respectively). The corresponding elasticities, evaluated at the mean values reported in Table 1, are 0.69 and -0.46, respectively.

With regard to the generic characterization profiles – accounted for by a dummy variable coded one if the foreign affiliate performs non-routine activities – we observe a significant positive coefficient of considerable size: Being characterized as a non-routine affiliate within a multinational group increases the interest-to-sales ratio by 82.4 percent in the cross section and by

76.3 percent in the panel model (calculated as $e^{0.601}$ and $e^{0.567}$, respectively). Accordingly, non-routine operations lure interest payments and may be used to efficiently minimize taxes within a multinational network. In more general parlance, non-routine characterization features clearly appear to facilitate tax-induced interest allocation strategies.

The two country-specific variables accounting for experience with statutory transfer pricing regulations take the expected sign. The dummy variable indicating the existence of statutory transfer pricing regulations along with stringent penalty regimes shows a strong negative coefficient. Being located in a high risk country reduces the interest-to-sales ratio by 43.9 (51.9) percent in the cross-sectional (panel) framework (calculated as $e^{0.364}$ and $e^{0.418}$, respectively). This seems particularly plausible for foreign-owned affiliates that fear the non-deductibility of reported interest payments for tax purposes in high risk countries; in this case, they comply with local transfer pricing regulations (or the arm's length principle), and, therefore, they do not deviate significantly from the domestic benchmark. The time past since the official incorporation of transfer pricing legislation enters positively, which can be explained by the valuable experience earned by affiliated companies in previous tax audits and in handling the transfer pricing compliance burden. Over the course of time, these enterprizes might have learned to be appropriately prepared for tax audits and to what extent interest payments may be deductible for transfer pricing purposes. Finally, the creditor rights index, accounting for the fact that the level and composition of leverage are influenced by capital market conditions, is also significant and in line with Desai, Foley and Hines (2004). That is, in countries with weak creditor rights and shallow capital markets, MNEs report a smaller interest-to-sales ratio.

5.3 Sensitivity analysis

We analyze the sensitivity of our results (i) by excluding possible outliers with a remainder error in the lower/upper end one percent percentile range, (ii) by applying alternative propensity score matching techniques, and (iii) by experimenting with the threshold that defines a firm's role within the multinational group as non-routine. The results of the sensitivity analysis are depicted in Table 4. In all robustness exercises, we report the results based on the cross section in the upper part of the table; the panel data

results are shown in the lower part of Table 4. As before, standard errors are obtained from 200 bootstrap replications in all five variants of robustness checks. For the sake of brevity, we only report the four main variables of interest along with the sample size.

In the first robustness exercise, we reduce the number of firms by dropping observations with a remainder error in the lower and upper end one percentile range. In doing so, we are left with 10,289 firms in the cross section and 59,045 observations in the panel. The corresponding regression results are reported in the first column of Table 4. As can be seen, there is no indication that the regression results in our baseline specification are driven by influential outliers. The maximum absolute difference in coefficients (not reported in the table below) is a mere 0.061 for the non-routine dummy in the cross section in Table 3 (which corresponds to approximately ten percent of the coefficient in the baseline specification). With respect to all other variables, the difference in coefficients is even lower, both in absolute and relative terms. We observe a similar pattern for the panel data set. In other words, we continue to observe a positive and significant relationship between the interest-to-sales ratio and the three explanatory variables non-routine operations, the statutory corporate tax rate and the benchmark interest-to-sales ratio. The coefficient of the weighted tax rate remains negative and significant.

In the second set of sensitivity checks, we apply alternative propensity score matching techniques in deriving the benchmark interest-to-sales ratio from domestic non-shifters.[9] More specifically, we experiment with the number of neighbors used to calculate the matched outcome in our nearest neighbor matching approach. Thereby, we firstly maximize the number of exact matches by using only the single nearest neighbor and, secondly, maximize the number of treated cases by including the five nearest neighbors; the corresponding regression results are reported in columns two and three of Table 4. In both regressions, we use exactly the same number of observations as in the baseline specification in Table 3 (i.e., 10,501 observations in the cross section and 60,251 observations in the panel, respectively).

[9]For the sake of brevity, we only report the results of the outcome equation and not the ones of the selection equation. The selection equation and information on the balancing property are available from the authors upon request.

Table 4: Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)
Cross section					
Non-routine [D]	0.660 ***	0.600 ***	0.603 ***	0.597 ***	0.519 ***
	(0.031)	(0.032)	(0.031)	(0.029)	(0.032)
SCTR	0.024 ***	0.020 ***	0.021 ***	0.017 ***	0.023 ***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Weighted SCTR	−0.017 ***	−0.015 **	−0.014 **	−0.014 **	−0.023 ***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Interest benchmark	0.078 ***	0.020 **	0.133 ***	0.103 ***	0.115 ***
	(0.016)	(0.010)	(0.024)	(0.011)	(0.021)
Observations	10,289	10,501	10,501	10,513	10,792
Panel					
Non-routine [D]	0.657 ***	0.596 ***	0.595 ***	0.595 ***	0.523 ***
	(0.028)	(0.029)	(0.030)	(0.030)	(0.035)
SCTR	0.019 ***	0.019 ***	0.019 ***	0.019 ***	0.020 ***
	(0.005)	(0.005)	(0.005)	(0.004)	(0.006)
Weighted SCTR	−0.009 **	−0.010 **	−0.010 **	−0.009 **	−0.010 **
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
Interest benchmark	0.012 ***	0.006 **	0.019 ***	0.031 ***	0.021 ***
	(0.005)	(0.003)	(0.006)	(0.004)	(0.006)
Observations	59,045	60,251	60,251	60,280	62,260

Notes: Table 4 shows five robustness exercises. In (1), we exclude observations with a remainder error in the upper and lower end one percent percentile range. Column two to four report the results obtained from different matching techniques, where (2) is obtained from nearest neighbor matching, (3) from five-nearest neighbor matching and (4) from Mahalanobis matching. In (5), we reduce the non-routine threshold from four to three criteria. Constant not reported. Standard errors are obtained from 200 bootstrap replications. [D] indicates a dummy variable. 'SCTR' stands for statutory corporate tax rate. *, **, and *** denote significance at 10%, 5% and 1% levels, respectively.

In the fourth column, we then show the regression results obtained from full Mahalanobis matching. In performing Mahalanobis matching, the number of observations increases slightly to 10,513 in the cross section (increase of 12 observations) and 60,280 in the panel (increase of two observations), as a few more observations now lie in the common support area.[10] Altogether, we conclude that the results regarding our main variables of interest are qualitatively very similar to the ones in our baseline specification.

In the last series of sensitivity exercises, we use a lower threshold for the definition of non-routine firm activities; i.e., a foreign affiliate is considered to be performing non-routine operations if three out of the five above-mentioned balance sheet criteria lie above the industry median. In practice, this robustness exercise could, for example, be motivated by less restrictive tax authorities.The corresponding results are reported in the fifth column of Table 4. This exercise increases the sample by 288 (2,008) foreign-owned affiliates in the cross section (panel). Obviously, the parameter estimates from Table 4 do not contradict the findings of our baseline specification. However, and not very surprisingly, we now observe a somewhat lower effect of non-routine operations on the interest-to-sales ratio of foreign-owned affiliates. Being characterized as a non-routine firm within a multinational group now increases the interest-to-sales ratio by only 68 percent in the cross section and by 68.7 percent in the panel model (calculated as $e^{0.519}$ and $e^{0.523}$, respectively). Compared to the 82.4 (76.3) percent increase in the cross-sectional (panel) baseline specification, this is a reduction of 14.4 (7.6) percentage points.

6 Conclusions

This paper studies interest allocation strategies used by foreign-owned affiliates in Europe by examining nine years of data from the annual reports of more than 10,000 foreign-affiliated manufacturing firms. Following the literature, we argue that interest allocation strategies used by affiliated parties are particularly affected by corporate taxation, but extend this common understanding by linking it to crucial transfer pricing specific aspects discussed

[10] While nearest neighbor matching only allows to either maximize exact matches (i.e., narrowing down the common support area) or maximize cases (i.e., widening the common support area), Mahalanobis matching repeats its matching metric until matches are found for all participants in the treatment. See Imbens (2004) for further details.

and advocated to be incorporated into law by the OECD (1999). Thereby, we investigate the role of entity characterization profiles to account for differences in functions performed, assets employed and intangibles used by affiliated parties of the same multinational group. We also categorize countries as either high risk or low risk depending on the existence of statutory transfer pricing regulations and penalty regimes. To evaluate tax-induced interest allocation strategies of affiliated parties, we apply a coherent peer group analysis and use the interest-to-sales ratio of domestic non-shifters as a benchmark.

We provide a stylized model that gives rise to the belief that interest allocation among affiliated companies is affected by common tax considerations, whereas non-routine entity characterization features seem to facilitate tax-induced interest allocation strategies. Empirically, we rely on both a cross section and panel data obtained from the AMADEUS database covering balance sheet information from European firms over the fiscal years 1999 to 2007. Consistent with common transfer pricing practice, we find that non-routine firms bear significantly more interest payments than their routine sisters, indicating that a non-routine role within a multinational group facilitates tax minimization by means of interest allocation within that network. As expected, foreign-owned affiliates also react sensitively to the existence of statutory transfer pricing regulations and penalty regimes (e.g., in case reported interest payments are not in line with local transfer pricing regulations and local tax authorities do not recognize these as extraordinary expenses, the company is confronted with both double taxation issues as well as painful penalties). In line with previous research, we find that the interest-to-sales ratio of a foreign-owned firm increases in the statutory corporate tax rate. Further, we observe a significantly negative relation between the interest-to-sales ratio and the sales-weighted tax rates of all sister companies, which indicates the importance of tax optimization within the multinational group relative to the that at the individual subsidiary level.

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Appendix

For $r = R, N$ the first order condition are given by

$$\begin{aligned}
\frac{d\pi}{dz_{i,r}} &= \tau_i - 1 - \mu\left(\lambda_{i,r} - \lambda_r^*\right) - \gamma\left(\sum_{l=1}^{n_R}\rho_{l,R}\lambda_{l,R} + \sum_{l=1}^{n_N}\rho_{l,N}\lambda_{l,N}\right) \\
&\text{or} \\
\rho_{i,R}\frac{d\pi}{dz_{i,R}} &= \rho_{i,R}\left(\tau_i - 1\right) - \mu\rho_{i,R}\left(\lambda_{i,R} - \lambda_R^*\right) - \gamma\left(\sum_{l=1}^{n_R}\rho_{l,R}\lambda_{l,R} + \sum_{l=1}^{n_N}\rho_{l,N}\lambda_{l,N}\right) = 0 \\
&\text{and} \\
\rho_{i,N}\frac{d\pi}{dz_{i,N}} &= \rho_{i,N}\left(\tau_i - 1\right) - \mu\rho_{i,N}\left(\lambda_{i,N} - \lambda_N^*\right) - \gamma\left(\sum_{l=1}^{n_R}\rho_{l,R}\lambda_{l,N} + \sum_{l=1}^{n_N}\rho_{l,N}\lambda_{l,N}\right) = 0
\end{aligned}$$

To simplify, we define $A_r = \sum_{i=i}^{n_r}\rho_{i,r}\lambda_{i,r}$, $r = R, N$, and $T_R = \sum_{j=1}^{n_R}\rho_i\left(\tau_i - 1\right) + \mu\theta\lambda_R^*$, where $\theta = \sum_{i=i}^{n_R}\rho_{i,R}$, and $T_N = \sum_{i=1}^{n_N}\rho_i\left(\tau_i - 1\right) + \mu\left(1-\theta\right)\lambda_N^*$. Summing over n_R and n_N, respectively, we arrive at

$$\begin{aligned}
\begin{bmatrix} T_R \\ T_N \end{bmatrix} &= \begin{bmatrix} \mu + \gamma\theta & \gamma\theta \\ \gamma\left(1-\theta\right) & \mu + \gamma\left(1-\theta\right) \end{bmatrix}\begin{bmatrix} A_R \\ A_N \end{bmatrix} \\
&\text{or} \\
\begin{bmatrix} A_R \\ A_N \end{bmatrix} &= \frac{1}{\mu^2 + \theta\gamma\mu + \left(1-\theta\right)\gamma\mu}\begin{bmatrix} \mu + \left(1-\theta\right)\gamma & -\theta\gamma \\ -\left(1-\theta\right)\gamma & \mu + \theta\gamma \end{bmatrix}\begin{bmatrix} T_R \\ T_N \end{bmatrix}
\end{aligned}$$

Next, we obtain

$$\begin{aligned}
A_N + A_R &= \frac{1}{\mu^2 + \gamma\mu}\left(\mu T_R + \left(1-\theta\right)\gamma T_R - \theta\gamma T_N - \left(1-\theta\right)\gamma T_R + \left(\mu + \theta\gamma\right)T_N\right) \\
&= \frac{\mu}{\mu^2 + \gamma\mu}\left(T_R + T_N\right) = \frac{1}{\mu + \gamma}\left(T_R + T_N\right)
\end{aligned}$$

Inserting in the FOC given above and setting $\lambda_N^* = \lambda_R^* + \delta$ yields

$$
\begin{aligned}
\lambda_{i,R} &= \frac{1}{\mu}(\tau_i - 1) + \lambda_R^* - \frac{\gamma\theta}{\mu+\gamma}\lambda_R^* - \frac{\gamma(1-\theta)}{\mu+\gamma}(\lambda_R^* + \delta) \\
&- \frac{\gamma}{\mu(\mu+\gamma)}\left(\sum_{l=1}^{n_R}\rho_{l,R}(\tau_l - 1) + \sum_{l=1}^{n_N}\rho_{l,N}(\tau_l - 1)\right) \\
&= \frac{1}{\mu}(\tau_i - 1) + \left(1 - \frac{\gamma}{\mu+\gamma}\right)\lambda_R^* - \frac{\gamma(1-\theta)}{\mu+\gamma}\delta - \frac{\gamma}{\mu(\mu+\gamma)}\sum_{l=1}^{n}\rho_l(\tau_l - 1) \\
&= \frac{1}{\mu}(\tau_i - 1) + \frac{\mu}{\mu+\gamma}\lambda_R^* - \frac{\gamma}{\mu(\mu+\gamma)}\sum_{l=1}^{n}\rho_l(\tau_l - 1) - \frac{\gamma(1-\theta)}{\mu+\gamma}\delta \\
\lambda_{i,N} &= \frac{1}{\mu}(\tau_i - 1) + \lambda_R^* + \delta - \frac{\gamma\theta}{\mu+\gamma}\lambda_R^* - \frac{\gamma(1-\theta)}{\mu+\gamma}(\lambda_R^* + \delta) \\
&- \frac{\gamma}{\mu(\mu+\gamma)}\left(\sum_{l=1}^{n_R}\rho_{l,R}(\tau_l - 1) + \sum_{l=1}^{n_N}\rho_{l,N}(\tau_l - 1)\right) \\
&= \frac{1}{\mu}(\tau_l - 1) + \frac{\mu}{\mu+\gamma}\lambda_R^* - \frac{\gamma}{\mu(\mu+\gamma)}\sum_{l=1}^{n}\rho_l(\tau_l - 1) - \frac{\gamma(1-\theta)}{\mu+\gamma}\delta + \delta.
\end{aligned}
$$

Defining

$$
\begin{aligned}
\beta_0 &= -\frac{\gamma(1-\theta)}{\mu+\gamma}\delta \\
\beta_1 &= \frac{1}{\mu} \\
\beta_2 &= -\frac{\gamma}{\mu(\mu+\gamma)} \\
\beta_3 &= \frac{\mu}{(\mu+\gamma)}
\end{aligned}
$$

we arrive at eq. (7)

$$
\begin{aligned}
\lambda_{i,R} &= \beta_0 + \beta_1(\tau_i - 1) + \beta_2\sum_{l=1}^{n}\rho_l(\tau_l - 1) + \beta_3\lambda_R^* \\
\lambda_{i,N} &= \beta_0 + \beta_1(\tau_i - 1) + \beta_2\sum_{l=1}^{n}\rho_l(\tau_l - 1) + \beta_3\lambda_N^* + \delta.
\end{aligned}
$$

Table A.1: Number of firms by country

Country	**DOM**	**MNE$_N$**	**MNE$_R$**
Austria	81	39	67
Belgium	165	125	366
Bulgaria	232	13	26
Czech Republic	80	61	136
Denmark	235	39	76
France	1,628	506	1,873
Germany	5,541	372	665
Hungary	42	10	16
Iceland	1	1	0
Italy	814	226	836
Latvia	15	1	1
Luxembourg	0	4	0
Netherlands	40	88	120
Norway	3,069	121	48
Poland	3,365	192	289
Portugal	10,810	43	123
Romania	8,383	116	42
Slovakia	4	18	24
Spain	19,387	357	601
Sweden	4,222	260	464
United Kingdom	2,787	713	1,440
Total	**60,901**	**3,305**	**7,213**

Notes: Column 'DOM' reports the number of domestic non-shifters per country and the distribution of non-routine (routine) foreign-owned affiliates of multinational groups is presented in column 'MNE$_N$' ('MNE$_R$').

Table A.2: Number of firms by NACE classification (Rev. 2)

NACE	**Name**	**DOM**	**MNE$_N$**	**MNE$_R$**
10	Manufacture of food products	7,150	287	410
11	Manufacture of beverages	755	44	92
12	Manufacture of tobacco products	17	13	15
13	Manufacture of textiles	2,428	68	116
14	Manufacture of wearing apparel	3,634	42	67
15	Manufacture of leather and related products	1,841	17	30
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	4,683	63	130
17	Manufacture of paper and paper products	961	151	322
18	Printing and reproduction of recorded media	3,905	92	170
19	Manufacture of coke and refined petroleum products	65	22	51
20	Manufacture of chemicals and chemical products	1,633	264	753
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	288	79	203
22	Manufacture of rubber and plastic products	2,932	232	481
23	Manufacture of other non-metallic mineral products	3,259	191	515
24	Manufacture of basic metals	1,072	129	216
25	Manufacture of fabricated metal products, except machinery and equipment	11,241	352	720
26	Manufacture of computer, electronic and optical products	1,905	223	467
27	Manufacture of electrical equipment	1,642	186	475
28	Manufacture of machinery and equipment n.e.c.	4,705	384	983
29	Manufacture of motor vehicles, trailers and semi-trailers	860	163	387
30	Manufacture of other transport equipment	797	74	111
31	Manufacture of furniture	3,278	48	95
32	Other manufacturing	1,376	105	201
33	Repair and installation of machinery and equipment	474	76	203
Total		**60,901**	**3,305**	**7,213**

Notes: Column 'DOM' reports the number of domestic non-shifters per NACE 2-digit classification (Rev. 2) and the distribution of non-routine (routine) foreign-owned affiliates of multinational groups is presented in column 'MNE$_N$' ('MNE$_R$').

Table A.3: Definition of variables

Variable	Definition
Dependent variable(s)	
Interest-to-sales ratio	Interest paid over operating revenue
Interest-to-sales ratio (Log)	Natural logarithm of interest paid over operating revenue
Variables of interest	
SCTR	Statutory corporate tax rate (in percent)
Weighted SCTR	Sales-weighted statutory corporate tax rate of all European subsidiaries of a global ultimate owner (in percent)
Interest benchmark	Benchmark interest-to-sales ratio (in percent) derived from domestic non-shifters using country-fixed effects and a set of firm- and industry-level matching parameters
TP country risk [D]	Dummy variable indicating that a country has statutory transfer pricing regulations (e.g., legal documentation requirements, guidance on the application of transfer pricing methods, etc.) and penalty regimes in case of non-compliance [1=yes, 0=no]
TP introduction	Time elapsed from introduction of transfer pricing regulations; i.e., 2007 minus the year of introduction of statutory transfer pricing regulations
Creditor rights	2003 index of the strength of creditor rights first developed in La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) that ranges from 0 to 4, with higher levels indicating stronger legal protections
Entity characterization	
NR payables [D]	Dummy variable indicating that the ratio of accounts payable to operating revenue is higher than or equal to the median of the payables ratio within its given NACE 2-digit classification (Rev. 2) [1=yes, 0=no]
NR receivables [D]	Dummy variable indicating that the ratio of accounts receivable to operating revenue is higher than or equal to the median of the receivables ratio within its given NACE 2-digit classification (Rev. 2) [1=yes, 0=no]
NR stocks [D]	Dummy variable indicating that the ratio of inventory held to operating revenue is higher than or equal to the median of the inventory ratio within its given NACE 2-digit classification (Rev. 2) [1=yes, 0=no]
NR intangibles [D]	Dummy variable indicating that the ratio of intangible assets to operating revenue is higher than or equal to the median of the intangibles ratio within its given NACE 2-digit classification (Rev. 2) [1=yes, 0=no]
NR tangibles [D]	Dummy variable indicating that the ratio of tangible assets to operating revenue is higher than or equal to the median of the tangibles ratio within its given NACE 2-digit classification (Rev. 2) [1=yes, 0=no]
Matching parameters	
Firm size	(Natural) logarithm of operating revenue
Age	(Natural) logarithm of 2007 minus year of incorporation
Age squared	Squared natural logarithm of 2007 minus year of incorporation
Firms per industry	(Natural) logarithm of the number of firms per industry (NACE 3-digit classification, Rev. 2)
Worker compensation	(Natural) logarithm of the sum of cost of employees per country and industry (NACE 3-digit classification, Rev. 2)
Material cost	(Natural) logarithm of the sum of material cost per industry (NACE 3-digit classification, Rev. 2)

Notes: [D] indicates a dummy variable. 'NR' stands for non-routine and 'SCTR' stands for statutory corporate tax rate, 'TP' is the abbreviation for transfer pricing.

Table A.4: Balancing property

	Mean (treated)	Mean (control)	% bias	% reduction of bias	t-statistic	p-value
Cross section						
Firm size	9.831	9.812	1.0	99.4	0.77	0.439
Age	2.985	2.979	0.9	98.2	0.60	0.546
Age squared	9.598	9.572	0.6	98.9	0.39	0.696
Number of firms per industry	6.277	6.266	1.1	98.2	0.79	0.430
Worker compensation per country/industry	3.633	3.638	-0.5	99.2	-0.52	0.601
Material cost per industry	15.305	15.267	3.6	86.3	2.47	0.013
Panel						
Firm size	10.015	9.991	1.3	99.2	2.38	0.017
Age	3.123	3.140	-2.4	95.7	-3.80	0.000
Age squared	10.321	10.430	-2.6	95.5	-3.97	0.000
Number of firms per industry	6.254	6.247	0.7	98.9	1.10	0.270
Worker compensation per country/industry	3.648	3.641	0.8	98.8	1.82	0.069
Material cost per industry	15.302	15.261	3.7	86.7	6.04	0.000

Notes: Table A.4 reports the balancing property of the observables included in the selection model. The upper part summarizes the cross-sectional results, the lower one refers to the panel data set.