Corporate Taxation, Debt Financing and Foreign Plant Ownership

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Abstract

This paper compares domestically and foreign-owned plants with respect to their debt-to-assets ratio and analyzes to which extent the difference is systematically affected by corporate taxation. To derive hypotheses about influence of corporate taxation on a firm's debt financing we adapt a standard model of taxation and financing decisions of firms for the case of international debt shifting activities of foreign owned firms. We estimate the average difference between a foreign-owned and a domestically-owned firm's debt ratio, treating the mode of ownership as endogenous. Using data from 32,067 European firms, we find that foreign-owned firms on average exhibit a significantly higher debt ratio than their domestically-owned counterparts in the host country. Moreover, this gap in the debt ratio increases with the host country's statutory corporate tax rate.

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1 Introduction

There is a large body of literature indicating that the financial decisions of firms are systematically affected by company taxation (see Graham, 2003, for a comprehensive survey). Most importantly, interest on debt is deductible from the tax base, while the return on equity is not and, therefore, firms have an incentive to raise leverage above the optimal level without taxation. The tax-induced advantage of debt increases with the statutory corporate tax rate, and it exists irrespective of whether a firm is owned by a domestic or a foreign shareholder. A multinational firm, however, is able to minimize its tax payments by allocating debt over all locations where it operates. The tax savings due to debt shifting depends on the differential between the parent and the host country statutory corporate tax rates. Accordingly, multinationals can reduce their tax payments by shifting debt from a low-tax jurisdiction to a high-tax jurisdiction taking advantage of the high-interest deduction in the high-tax jurisdiction (see, e.g., Mintz and Smart, 2004, for a theoretical analysis).

To identify the existence and the extent of debt shifting, previous empirical research relied on a sample of multinational firms exclusively (Hines, 1997, and Devereux, 2006, provide comprehensive surveys). For instance, Desai, Foley, and Hines (2004) use a dataset of U.S.-owned foreign companies, and Huizinga, Laeven, and Nicodème (2006) focus on a large dataset of European multinationals. Both studies find that the financing decisions of multinational firms are systematically affected by corporate taxation.[1] One concern with this evidence is that the estimates might have been influenced by the non-random selection of a sample of multinational firms.

This paper is rooted in the above mentioned research, but the identification strategy is different. Taking into account that multinational firms have more opportunities to exploit tax-induced advantages of debt financing than national firms, we argue that a comparison of the DR of comparable foreign- and domestically-owned firms provides an estimate of the extent to which debt financing is influenced by foreign-plant ownership. Hence, in contrast to previous empirical work, we explicitly use national firms as a reference category to assess the effect of foreign plant ownership on debt financing decisions. We

[1] Earlier evidence from the U.S. is presented by Collins and Shackelford (1992), Altshuler and Mintz (1995), Froot and Hines (1995), Newberry and Dhaliwal (2001), Altshuler and Grubert (2002) and Mills and Newberry (2004). Jog and Tang (2001) analyze the debt shifting behavior of Canadian subsidiaries of U.S. based corporations and of Canadian-controlled corporations with U.S. affiliates. Moore and Ruane (2005) focus on a sample of European firms.

adapt a standard model of taxation and financing decisions of firms for the case of international debt shifting activities of foreign-owned firms. The theoretical framework delivers testable hypotheses on (i) the average difference between the DR of national and multinational firms, and (ii) how this difference is influenced by the corporate tax burden in the host country. We test these predictions using a large data-set of 32,067 European firms. In line with a large body of theoretical and empirical research, we treat foreign plant ownership as endogenous. Technically, we use propensity score matching techniques to avoid the potential bias of the treatment effect of foreign plant ownership on firm level DR. Our findings suggest that foreign-owned firms have higher DR than their domestically-owned counterparts. Further, we observe that this difference increases with the corporate tax burden of the host country. These results point to the potential importance of debt shifting as a widely used practice in international tax planning of multinational firms.

The remainder of the paper is organized as follows. In the next section we employ a model with financing decisions to derive the main hypothesis regarding the effects of taxation on the debt policy of domestically and foreign-owned firms. Section 3 discusses the estimation approach, presents the data and the estimation results. Finally, Section 4 concludes.

2 The model

To motivate our empirical analysis we provide a simple model based on King (1974) and Auerbach (1979), in which the financial decisions of firms are influenced by corporate taxation. We extend this framework to account for financial decisions of multinational firms and profit shifting. Consider a multinational firm operating in $i = 1, \ldots, n$ locations. In each location the firm uses a production technology which is quasi-concave in capital. The cash flow of the firm in location i from production in period t is $\pi_{i,t}(K_{i,t})$. Thus, the overall cash flow of the firm amounts to $\Pi_t(K_t) := \sum_{i=1}^{n} \pi_{i,t}$, where $K_t = (K_{1,t}, \ldots, K_{n,t})$ is the stock of capital employed in different locations. In period $t = 0$ the firm operates with capital $K_0 = (K_{1,0}, \ldots, K_{n,0})$ that is predetermined by the investment decision in the previous period. The capital stock in period t is given by

$$K_{i,t+1} = K_{i,t} + I_{i,t}, \tag{1}$$

where I is investment. For the sake of brevity, we ignore depreciation in (1). Investment is financed through a mix of new debt, B^N, and equity, E

$$\sum_{i=1}^{n} I_{i,t} = \sum_{i=1}^{n} \left(E_{i,t} + B_{i,t}^{N} \right) \tag{2}$$

We are not interested in the payout policy of the firm and, therefore, we do not distinguish between new share issues and retained earnings (see Zodrow, 1991, and Sørensen, 1995, for comprehensive surveys on this issue). The stock of debt in location i evolves according to

$$B_{i,t+1} = B_{i,t} + B_{i,t}^{N}. \tag{3}$$

In choosing the financial structure, the firm takes both tax and non-tax factors into account. The non-tax costs of borrowing include the interest premium a firm has to pay to outside investors. We assume that this premium, m, is an increasing function of the debt ratio (DR), so that $m_t := m_t(b_t)$ and $m_t'(b_t) \geq 0$, where $b_t := \sum_i^n B_{i,t} / \sum_i^n K_{i,t}$ is the DR of the firm (see Auerbach, 1979, p. 438). Costs are strictly convex and $m_t(0) = 0$. With regard to tax factors, we only consider a corporate income tax on retained earnings at location i. After tax profits in a location, G, are either retained, E, or distributed via dividends, D. Taking into account the deductibility of debt from tax liabilities, operating profits of a firm in i are determined by

$$G_{i,t} := (1 - \tau_i) \left[\pi_{i,t} - (r_t + m_t) B_{i,t} \right] = E_{i,t} + D_{i,t}, \tag{4}$$

where r denotes the interest rate for domestic and foreign debt and τ is the statutory corporate tax rate. Note that we allow for the deductibility of the interest premium to capture the idea that increased debt raises the probability of bankruptcy even for profitable firms. We solve (4) to determine dividends

$$D_{i,t} = (1 - \tau_i) \left[\pi_{i,t} - (r_t + m_t) B_{i,t} \right] - E_{i,t}. \tag{5}$$

No arbitrage for an equity holder implies that the return to capital of an alternative investment on the international capital market is equal to the return received from investment

$$(1 + r_t) V_{i,t} = D_{i,t} + V_{i,t+1}, \tag{6}$$

where V is the value of equity. The objective of the firm is to choose a debt and investment policy such that this value is maximized.

In the following, we illustrate the general solution to the maximization problem using a two period characterization, where economic activity stops at the end of $t = 1$ (i.e., the capital stock is disinvested and all debt is repaid so that the firm value at the beginning of $t = 2$ is zero). In this case, (6) implies

$$\max_{I_{i,0},\, B^N_{i,0}} \quad \sum_{i=1}^{n} \left[(1 + r_0) V_{i,0} = D_{i,0} + \frac{D_{i,1}}{1 + r_1} \right]. \tag{7}$$

Using (2), the terminal conditions $I_{i,1} = -K_{i,1}$, $B^N_{i,1} = -B_{i,1}$ and $V_{i,2} = K_{i,2} = B_{i,2} = 0$ in (5) and inserting the resulting expressions for dividends in (7), we obtain the following derivatives of the objective function

$$(B^N_{i,0}): \quad (1 - \tau_i)\left(r_1 + m_1 + b_1\, m_1'\right) - r_1 - \frac{\sum_{j=1, j\neq i}^{n} B_{j,1}\,(\tau_j - \tau_i)}{\sum_{i=1}^{n} K_{i,1}} m_1' \;\forall i \tag{8}$$

$$(I_{i,0}): \qquad (1 - \tau_i)\left(\pi_{i,1}' + b_1^2 m_1'\right) - r_1 - \frac{\sum_{j=1, j\neq i}^{n} B_{j,1}\,(\tau_j - \tau_i)}{\sum_{i=1}^{n} K_{i,1}} b_1 m_1' \;\forall i. \tag{9}$$

Expression (8) illustrates the gains and costs of new debt. The costs include the interest on debt, r_1, the premium itself plus the change in the premium provoked by new debt, $m_1 + b_1 m_1'$. The term $(1 - \tau)$ reflects the fact that these costs are typically deductible from the tax base. The gain of new debt consists of two components. First, an increase in new debt causes an increase of dividends at the end of period $t = 0$, yielding an interest of r_1. Second, the last term in (8) indicates the firm's ability to shift profits abroad. This gain increases with the tax rate differential, $\tau_j - \tau_i$. Expression (9) informs about the optimal level of investment which is closely related to standard optimality conditions. Note that a higher capital stock lowers the DR and thereby costs, thus causing an increase in the return to equity.

In the empirical analysis below, we compare the DR of foreign-owned firms with the ones of domestically-owned ones (national firms). For this purpose, we first analyze the debt policy of a national firm with no access to internal debt. In this case, condition (2) reduces to $E_{i,t} = I_{i,t} - B^N_{i,t}$. Letting (8) be equal to zero and using the resulting expression to substitute out for m_1' in (9), we obtain the DR for the national firm in the absence of an internal market for

debt as the solution of

$$\pi_1' = b_0 \left(r_0 + m_0\right) + \left(1 - b_0\right) \frac{r_1}{1 - \tau} \tag{10}$$

in all jurisdictions. (10) shows that the marginal costs of debt per unit of capital, $b_0(r_0 + m_0)$, are independent of the level of the corporation tax, whereas the marginal costs of equity per unit of capital, $(1 - b_0)r_1/(1 - \tau)$, increase with the corporate tax rate. The model thus replicates the argument in Gordon and Lee (2001) that the deductibility of debt from the tax base reduces the costs of debt financing and thus leads to a higher level of debt to finance real investment (see also Fuest, Huber, and Mintz, 2005). Therefore, we should observe that the DR is positively related to the corporate tax rate.

Consider now the case of a foreign-owned firm. Specifically, suppose jurisdiction 1 is the high-tax country among the n locations, $\tau_1 = \max\{\tau_1, \ldots, \tau_n\}$. It can then be seen from (8) that the firm maximizes its firm value by financing all investment in this location and by transferring debt to the other ones. Setting (8) to equal zero for $i = 1$, substituting out for m_1' in (9), we have the optimal debt policy of this firm type from the solution of

$$\pi_{1,1}' = b_0 \left(r_0 + m_0\right) + \left(1 - b_0\right) \frac{r_1}{1 - \tau_1}, \tag{11}$$

$$\pi_{i,1}' = b_0 \left(r_0 + m_0\right) \frac{1 - \tau_1}{1 - \tau_i} + \left(1 - b_0\right) \frac{r_1}{1 - \tau_i}, \qquad i = 2, \ldots, n. \tag{12}$$

Obviously, since $(1 - \tau_1)/(1 - \tau_i) < 1$ by assumption, the firm always has an incentive to shift debt abroad. As discussed above, this incentive increases with the tax rate differential.

In sum, our model predicts that the DR increases with the corporate tax rate irrespective of whether a firm has access to an internal capital market or not. The reason is that debt is tax deductible. More importantly, we should observe a higher DR for foreign-owned subsidiaries as compared to national firms. Finally, we expect that the tax induced incentive to shift profits abroad increases with the international tax rate differential. The latter motivates a positive interaction term between foreign plant ownership and the statutory corporate tax rate in our empirical application.

3 Empirical analysis

3.1 Econometric approach

It seems natural to think of the decision to participate in (be part of) a multinational network as being endogenous. In this case, the unconditional comparison of DR between national and multinational firms leads to a biased estimate of the effect of multinational ownership on DR. There are several econometric procedures available to restore unbiased causal effects of some binary treatment such as multinational ownership on some outcome such as DR. One such approach is matching based on the propensity score. The underlying set of assumptions maintains that observable variables can be found so that, after conditioning on these variables, the effect of treatment (multinational ownership) on outcome (DR) is randomized (see Rosenbaum and Rubin, 1983; Wooldridge, 2002). Accordingly, "*selection is solely based on observable characteristics and ... all variables that influence treatment assignment and potential outcomes simultaneously are observed by the researcher*" (Caliendo and Kopeinig, 2005).

Matching based on the propensity score works as follows. In a first step, we determine the probability of treatment participation (selection into multinational ownership) by using a non-linear probability model, which employs the mentioned set of observable variables on the right-hand-side of the model. The predicted probability of treatment participation serves as the matching metric. In a second step, we determine for each treated (multinationally owned) unit one or more comparable untreated (nationally owned) ones, according to the estimated propensity score. Once comparable untreated units are identified, we can compare the average difference between the outcome vector of the treated (DR_1) with that one of the comparable untreated firms (DR_0). The average difference between DR_1 and DR_0 may be referred to as the average treatment effect of the treated (ATT). Hence, ATT is the average treatment effect conditional on a unit's actual participation in treatment (in our case, conditional on the treated being actually foreign-owned). One can compute a similar treatment effect for the untreated units (national firms). Then, we would compare the vector of DR of the matched foreign-owned firms with that of the national ones. The corresponding estimate is referred to as the average treatment effect of the untreated (ATU). Similar to ATT, ATU conditions on actual (non-)treatment status. By way of contrast, the average treatment effect (ATE) is a weighted average of ATT and ATU, using the fractions of treated and untreated units in all observations. Hence, we might think of ATE as a

treatment effect, which does not condition on actual treatment status.

3.2 Data

Our database is based on financial and ownership statements of private and publicly-owned European firms as covered by the Amadeus database.[2] We only include manufacturing firms according to the NACE industry codes reported in the database. Generally, the data are available for consolidated and non-consolidated accounting statements. To identify each subsidiary's balance sheet positions separately, we exclude the consolidated ones from the sample. This enables us to compare similar units that are foreign- versus domestically-owned. We rely on a cross-section of the data with averages for the years between 1996 and 2004. This ensures that we can use information about plants that are only recorded once in these years. The resulting data-set includes $32,067$ observations. Table 1 summarizes the distribution of the included plants across 27 European economies, 936 regions,[3] and 270 NACE 4-digit industries. On average, there are around $1,190$ (34) firms per country (region), and about 119 firms per industry.

> Table 1 <

Table 2 presents the descriptive statistics on our main variables. As can be seen from the table, around 19 percent of all plants in the sample are foreign-owned. In our sample, the largest host countries of foreign-owned plants are Sweden (54.8 percent), the United Kingdom (37.8 percent) and Denmark (31.4 percent). The DR, defined as the sum of current and non-current liabilities over a firm's total assets (short and long term debt), amounts to about 60 percent, on average. The country averages in DR range from 11.1 percent in Cyprus to about 74 percent in Italy (these figures are not reported in the table). In the original data-set, there are about $1,870$ firms with a DR of more than 100 percent.[4] We drop all these observations from the sample (see also Ramb and

[2]The Amadeus database is compiled by Bureau van Dijk. It contains firm level information of about 250,000 firms in 34 European countries since 1991. For the United Kingdom, Germany, France, Italy, Ukraine, and the Russian Federation a firm is covered by the Amadeus database if at least one of the following criteria is fulfilled: operating revenue equals at least 15 million Euros (10 million Euros), total assets equal at least 30 million Euros (20 million Euros for the other countries), and the number of employees equals at least 200 (150).

[3]The regional aggregates roughly correspond to NUTS 4-digit units.

[4]Basically, this is possible under current losses and/or negative loss carry-forwards.

Weichenrieder, 2005; Huizinga, Laeven, and Nicodème, 2006).

> Table 2 <

The mean of the statutory corporate tax rate is about 34.2 percent, ranging from zero to 55.2 percent. The country averages, not reported in the table, are lying between 10 (Ireland) and 47.4 percent (Germany). In addition to the statutory corporate tax rate, we also use a loss carry-forward-corrected tax burden measure equal to the statutory corporate tax rate (CTR) if the earnings before interest and taxes (EBIT) in the last year were positive, and otherwise zero (see Graham, 1996).[5] For instance, MacKie-Mason (1990) has found that firms with high loss carry-forwards have less tax-induced incentives to raise their debt position. To account for this reasoning, Graham (1996) proposes a simulated marginal effective tax rate as the appropriate loss carry-forward corrected tax burden concept, but he also demonstrates that the above defined tax burden measure is a good approximation to the simulated one. The regional average of the loss carry-forward-corrected tax measure in our data is around 30 percent; the country average lies at 30 percent, with a minimum of 6.9 percent (Republic of Macedonia) and a maximum of 40.5 percent (Germany).

3.3 Empirical results

Before we can turn to an analysis of the impact of endogenous foreign plant ownership on the DR at the host market plant level, we need to determine the selection into foreign ownership (i.e., the probability of treatment participation). From a theoretical perspective, firm/plant characteristics, local market characteristics, industry characteristics, and country characteristics are natural candidates for observable determinants of foreign plant ownership. For instance, we suspect that older plants face a higher probability of exhibiting a foreign owner. The reason is that multinationals tend to be older, more productive, and larger than national firms (see Helpman, Melitz, and Yeaple, 2004) so that, with the evolution of an industry, non-multinational plants should have a

[5] Alternatively, we calculate a second loss carry-forward-corrected tax burden measure as proposed by Graham (1996). In this case, the tax burden is equal to the statutory corporate tax rate if the current and last year EBIT are positive, equal to 0.5·CTR, if the current or past year EBIT are negative, and zero else (see also Plesko, 2003). It turns out, however, that our qualitative results remain unchanged when applying this tax burden measure. We do not report these results here, but they are available from the authors upon request.

higher probability of being crowded out of the market. Empirically, it turns out that the functional relationship between plant age and the probability of being foreign-owned involves a quadratic term of plant age, which is significantly different from zero. Furthermore, market thickness within the same industry and region, the exposition of the same industry and region to foreign firms as such, regional labor market size in the same industry and region, average plant size in the same region and industry as a measure of scale economies and average productivity are candidates of crucial determinants at the regional level within the same industry. At the regional level, we control for total compensation of workers (wage bill) as a cost variable.[6] Finally, we include three determinants that vary across industries, only: wage cost per employee, intermediate goods usage, and the average tax rate of foreign-owned affiliates relative to domestically-owned ones as a measure of a tax-related industry-specific disadvantage of foreign ownership.[7]

In Table 3, we estimate three variants of a model of endogenous selection into foreign plant ownership based on these determinants. While we experimented with other specifications, the one reported in the table performs best in terms of explanatory power, irrespective of which cumulative density function is assumed with the non-linear probability model. The three variants of the nonlinear probability model in Table 3 are distinguished by the choice of the underlying cumulative density function. In the first column, we assume a normal cumulative density function. In the second column, we consider a logistic one. In the third column, we use a complementary log-log model. Let us denote the assumed data-generating process for the (unknown) latent variable of the advantage of being foreign-owned for plant i by $f_i = \gamma_0 + \sum_{k_1=1}^{K_1} \gamma_{k_1} x_{k_1,i} + u_{f,i}$. There, $x_{k_1}, ..., x_{K_1}$ are the explanatory variables in the model, γ_{k_1} for $k_1 = 0, ..., K_1$ are model parameters, and $u_{f,i}$ is a disturbance term. While f_i is unknown, we observe an indicator variable of foreign plant ownership $M_i = 1\{f_i > 0\}$, which is unity, whenever a plant is foreign-owned, and zero else. In the non-linear probability model for foreign plant ownership, M_i serves as an observable substitute for the unobservable f_i, using the determinants x_{k_1} to predict the probability of $M_i = 1$ (i.e., that a plant is foreign-owned). With estimates of the non-linear probability model parameters for γ_{k_1} at hand, using hats for estimates, we may determine $\hat{f}_i = \hat{\gamma}_0 + \sum_{k_1=1}^{K_1} \hat{\gamma}_{k_1} x_{k_1,i}$. However, the functional

[6] Including compensation per worker instead of the wage bill for all workers leads to a high level of multicollinearity among this variable and wage cost per employee at the industry level.

[7] For instance, this disadvantage could be industry-specific due to the specific factor requirements/costs of foreign plant ownership in the 27 European countries, on average.

form of $\hat{f}_i$ and, hence, the probability for a plant to be foreign-owned given the observable determinants, $P(m_i = 1|x_{k_1,i}, ..., x_{K_1,i})$, inherently depends on the assumed cumulative density function, $F(\hat{f}_i)$. With a normal density function we have $F(\hat{f}_i) = \int_{-\infty}^{\hat{f}_i}(2\pi)^{-\frac{1}{2}}e^{-\hat{f}_i^2/2}d\hat{f}_i$ (referred to as the probit model), with a standard logistic density function we have $F(\hat{f}_i) = \frac{e^{\hat{f}_i}}{1+e^{\hat{f}_i}}$ (referred to as the logit model), and with a complementary log-log density function, we have $F(\hat{f}_i) = 1 - e^{-e^{\hat{f}_i}}$. Among the mentioned functions, the logistic density function exhibits the thickest tails. Which cumulative density function fits the data best is principally testable (see Davidson and MacKinnon, 2004). In Table 3, the explanatory power is highest for the probit model (see the pseudo R^2 figures), followed by the logit model. A likelihood ratio test with one degree of freedom indicates that the probit model – and, hence, the assumption about a normal distribution of the latent variable determining the decision about foreign plant ownership – works significantly (at one percent) better than the other models. Hence, we may focus on this model in the subsequent analysis.

> Table 3 <

The results underlying the table support the following conclusions. First the marginal effect of plant age is positive when being evaluated at the mean of the data.[8] Hence, older firms face a higher likelihood of being foreign-owned. Furthermore, thinner producer markets (a larger number of plants per region and industry) and a higher exposure of the local market to foreign firm ownership measured by the share of foreign-owned firms in all firms per region and industry work in favor for a particular firm to be foreign-owned. Also, a firm is more likely foreign-owned in a region and industry, where average firm size is large and, hence, economies of scale are important. The results point to a higher probability of a firm's being foreign-owned in industries where employment is higher than the regional average (see the positive coefficients of *Firms per region and industry* and *Number of employees per firm in the same region and industry* and the negative one of *Employees per region* in Table 3). A high level of worker compensation at the regional or the industry level also increases a firm's

[8] We are aware of the fact that including age and age squared in the specification implicitly involves an interaction effect which needs to be taken into account when computing marginal effects (see Ai and Norton, 2003). However, the marginal effect of age at the data mean is positive.

probability to be foreign-owned. However, the respective variables should probably not be interpreted as measuring sheer labor cost, but rather as reflecting the abundance of skilled labor at the regional/industry level.[9] Moreover, firms are less likely foreign-owned in industries with a particularly high dependence on intermediate goods. The latter indicates that multinational activity mainly takes place in high-value-added sectors. Finally, in sectors where the average tax rate of a foreign-owned firm is particularly high as compared to national firms (e.g., due to limited opportunities of applying transfer prices in an industry or due to the typical composition of the capital stock and its consequences for the tax base), it is not surprising that firms are less likely foreign-owned than elsewhere.

In the sequel, we will use the vector of estimated probabilities of being foreign-owned from the probit model to construct a control group of domestically-owned firms that are very similar to the foreign-owned ones with respect to the estimated probabilities that were estimated conditional on the aforementioned observable variables. While the probit model does a good job in explaining the probability of being foreign-owned, as said before, this is not sufficient for rendering matching on the estimated response probabilities a valid approach to estimating the effect of foreign plant ownership on a firm's debt policy. Additionally, we need to know whether the observables determining the response probabilities are 'balanced' – i.e., whether they are similar enough between the group of foreign-owned firms and the domestically-owned matched control firms. The latter means that the difference between the foreign-owned firms and the domestically-owned ones should be considerably smaller after matching than before (i.e., unconditional on the observable variables). To see whether this is the case in our application, let us use a nearest neighbor matching estimator which searches for each foreign-owned firm its closest 'twin' in the group of domestically-owned firms based on the estimated response probability.[10] For the nearest neighbor matching estimator the average absolute bias in the observable variables – i.e., the absolute difference of the values in the variables in the probit model – is almost 40 percent before matching and only about 2 percent after matching. The maximum bias in an observable variable is reduced from about 256 percent (for *Foreign MNE affiliates to national firms*

[9]There is no direct information on the skill composition at the firm level in this large data-set; this information is even not available at the regional/industry level at the required detail.

[10]The nearest neighbor matching estimator for debt policy is then the average difference between the foreign-owned and the matched domestically-owned firms debt policy.

per region and industry) to about 4 percent. Hence, the chosen model is very powerful in eliminating the difference between foreign-owned and domestically-owned comparison firms in the sample. Consequently, the propensity of being foreign-owned conditional on the observable variables in the model should be a useful compound measure of similarity in our application and we may use it to construct a control group of domestically-owned firms to estimate the 'treatment effect' of foreign ownership on debt policy in the underlying sample of European firms.

> Table 4 <

Table 4 reports estimates of the *exogenous* as compared to the *endogenous* effect of foreign firm ownership on firm-level debt policy in the host market. The *exogenous* treatment effect compares the debt policy of the foreign-owned to all domestically-owned firms, no matter how different they are with respect to the aforementioned determinants of foreign ownership in Europe. The *endogenous* treatment effect compares the debt policy of the foreign-owned firms only to the respective most similar domestically-owned ones, using nearest neighbor matching. The reported estimates reflect the average treatment effect (ATE). Hence, they are expected effects of foreign ownership on debt policy for a randomly selected firm from the sample, irrespective of whether the firm is actually foreign- or domestically-owned. According to Table 4, ATE amounts to about 1.7 percentage points of DR, assuming endogenous foreign plant ownership. By way of contrast, ATE is about 2.5 percentage points when ignoring endogenous selection into foreign plant ownership. Hence, there is a positive selection bias of foreign ownership on DR. According to the sign of the selection bias, firms with a below-average DR face a high probability of being foreign-owned. Ignoring the latter leads to upward-biased estimates of foreign-ownership on the debt-ratio by about 50 percent. Notice that previous work did not estimate such an effect, since the firm sample typically excluded national firms as a reference group.

> Table 5 <

The estimates in Table 4 assumed that the impact of foreign ownership on DR was identical across all units (the latter flows from the stable-unit-

treatment-value assumption à la Rubin, 1990). However, we hypothesize that the effect varies systematically with the host country corporate tax rate. In particular, we expect multinationals to shift debt to high-tax countries, while acknowledging selection into foreign ownership. To explore this issue empirically, we follow Diamond (2006a,b) and allow for a variable treatment effect of foreign ownership on the DR in Table 5. There, we employ three tax rate measures, where *Statutory corporate tax rate* and the *Loss-carryforward corrected tax burden - country average* vary across 27 countries and the *Loss-carryforward corrected tax burden - regional average* varies across 936 regions. However, to ensure that the main effect of foreign ownership can still be interpreted as an average treatment effect, the interacted tax variables are demeaned (see Wooldridge, 2002). Hence, on average we expect foreign-owned firms to exhibit a DR which is about two percentage points lower than that of (comparable) domestically-owned ones. In countries with a corporate tax rate above (below) the European average, the DR rises (declines) with roughly 0.6 percentage points per percentage point gap in the statutory tax rate.[11] This result is quite robust across the three tax rate concepts. Previous work based on samples of multinational firms only pointed to a much smaller impact of tax rates on debt policy (e.g., Huizinga, Laeven, and Nicodème, 2006).

3.4 Sensitivity analysis

In the sequel, we explore the robustness of the above findings along three lines: a potential remaining bias from unbalanced observable variables in the selection model;[12] the usage of non-debt tax shields as an additional control to ensure that there is no attribution of its possible impact to foreign ownership; alternative matching estimators instead of nearest neighbor matching.

In the first sensitivity analysis, we use the number of firms per region and industry (the remaining bias is 4.3 percent), the number of employees per region as additional controls after matching (the remaining bias is 1.4 percent), and the share of foreign-owned firms in all firms per region and industry (the remaining bias is 0.5 percent). This is to ensure that the unbalanced observables do not bias the matching estimates (this procedure is suggested by Blundell and Costa Dias, 2002). However, as the block of results at the top of Table 6

[11] For estimates of the DR effect of foreign ownership for countries with extremely low/high statutory tax rates, we recommend logistically transforming the DR variable.

[12] We know from the last sub-section that there is a remaining bias after matching of up to 4 percent.

indicates, the small remaining unbalancedness in some of the observables does not distort the treatment effect estimates (compare the respective coefficients to their counterparts in Table 5).

> Table 6 <

In the second robustness check, we use non-debt tax shields (NDTS) as an additional control variable when estimating the treatment effect of foreign ownership on the DR. This is to ensure that we do not attribute the impact of a variable to foreign ownership that is obviously relevant for the DR but omitted from the specification (see DeAngelo and Masulis, 1980, for a theoretical analysis). Following Titman and Wessels (1988), NDTS are measured as the difference between a firm's operating profits, OP_i, interest payments, I_i, and the ratio of tax payments, T_i, to the statutory corporate tax rate, τ: $NDTS_i = OP_i - I_i - \frac{T_i}{\tau}$. The results indicate that including NDTS somewhat reduces the average treatment effect of foreign ownership on DR, while rendering the interaction effect between corporate tax rates and foreign ownership unaffected. Overall, there is no qualitative change from including NDTS in the specification.

Finally, we employ alternative matching estimates as compared to nearest neighbor matching. In particular, we use radius and kernel matching. Radius matching considers all untreated observations within an exogenously specified radius around a treated firm's propensity to be foreign-owned as control units. Hence, while nearest neighbor matching fixes the number of matched controls while leaving the matching quality (i.e., the difference between the treated and untreated observations' propensities) unspecified, radius matching does the opposite. Accordingly, we may think of radius matching with a narrow radius as eventually obtaining more reliable results than nearest neighbor matching, and particularly so in small samples. Here, we use a radius of 2 percentage points to ensure a high matching quality. Also kernel matching uses all observations within a particular range around the propensity score but – in contrast to radius matching – it weights the matched control observations' DR inversely to their difference in the estimated propensity to be foreign-owned. The range of used controls is determined by the bandwidth and a control unit's weight depends on the bandwidth and the kernel function. Here, we use an Epanechnikov kernel with a bandwidth of 0.1. The corresponding results are reported at the bottom

of Table 6. They indicate that the nearest-neighbor-based average treatment effect estimates reflect a lower bound. However, the interaction effect with corporate tax rates is again not affected significantly.

Overall, the findings reported in Table 6 suggest that the estimated impact of foreign ownership on the DR and its interactive effect with host country corporate tax rates are robust to conditioning on the considered covariates after matching (firm numbers and the share of foreign-owned firms per region and industry, regional employment size, and non-debt tax shields) and the choice of matching estimators.

4 Conclusions

In most tax systems, interest on debt is deductible from the tax base, while the return on equity is not. This tax shield of interest deduction creates an incentive to raise leverage, irrespective of whether a firm is held by a domestic or a foreign owner. In contrast to national firms, however, multinationals are able to allocate debt over the jurisdictions where they operate, giving additional tax-induced incentives for influencing a firm's financial structure. This paper investigates this aspect by comparing the debt ratios of domestically and foreign-owned firms. Theoretically, we employ a stylized model with endogenous financing decisions and, as far as foreign-owned firms are concerned, with debt shifting. Our model allows to derive two major hypotheses regarding the impact of taxation and debt shifting on debt financing. First, foreign-owned firms have higher debt ratios than domestically-owned ones. Second, the difference between the debt ratio of domestically and foreign-owned firms increases with the statutory corporate tax rate. We assess these hypotheses using a cross section of 32,067 European firms as available from the Amadeus database. Empirically, we apply propensity score matching methods to account for the fact that the plant operation mode is endogenous.

Our findings might be summarized as follows. First, there is systematic selection into foreign plant ownership in our large sample of firms. Second, in line with our expectations based on a theoretical model, foreign-owned firms have significantly higher debt ratios than their domestically-owned counterparts. The average difference in the debt-to-assets ratio between foreign- and domestically-owned firms amounts to about 1.7 percentage points. Ignoring endogenous selection into foreign plant ownership, this effect would be upward biased by about 0.9 percentage points. Third, we estimate a positive interaction

effect between the plant operation mode and the corporate tax rate. An increase of the statutory corporate tax rate by one percentage point leads to an increase in the debt ratio by about 0.7 percentage points. According to the variation of corporate tax rates in our sample, the induced variation in debt ratios amounts to almost 37 percentage points. This relationship is virtually insensitive to the choice of the tax burden concept (i.e., correcting for loss-carryforwards).

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Table 1: Allocation of firms across countries, regions, and industries

	Countries	Regions	Nace 4-digit industries
Number	27	936	270
Number of firms:			
Average	1187.67	34.36	118.77
Standard deviation	1511.13	90.66	131.77

Table 2: Descriptive statistics

Variable	Obs.	Mean	Standard deviation	Minimum	Maximum
Dependent variable					
Debt ratio (Debt to total assets)	32067	60.491	22.565	0	100
Tax variables					
Statutory corporate tax rate	32067	34.223	6.407	0	55.230
Loss-carryforward corrected tax burden[a)]					
Region average	32067	28.988	6.728	5.600	53.174
Country average	32067	28.948	6.457	6.860	40.460
Industry level average tax rate of MNE affiliates relative to national firms	32067	1.005	0.056	-0.008	2.766
Independent variables					
Foreign MNE ownership	32067	0.189	0.318	0	1
Firm age	32067	24.616	25.670	0	678
Plants per region and industry	32067	7.366	16.363	1	155.050
Foreign MNE affiliates to national firms per region and industry	32067	0.189	0.318	0	1
Employees per region and industry	32067	3040.441	10085.980	0.1	234469.100
Number of employees per firm in region and industry	32067	394.568	747.956	1	29577.200
Regional worker compensation in millions	32067	2.137	5.082	0.000005	40.700
Industry level wage cost per employee in thsd.	32067	10.985	10.089	0.038	82.893
Industry level cost of intermediate goods in millions	32067	9.754	6.671	0.006	59
Total assets in millions	32067	7.254	35.500	0.000001	1870
Employees	32067	391.421	1070.284	1	61911.750

Notes: [a)] Tax burden is equal to the statutory corporate tax rate (CITR) if last year EBIT is positive, otherwise zero (see Graham, 1996).

Table 3: Selection equation (probability that a plant has a foreign multinational firm as the ultimate owner)

	Probit model	Logit model	Complementary log-log model
Firm age	0.295 **	0.627 ***	0.517 ***
	(0.118)	(0.222)	(0.172)
Firm age squared in thsd.	-0.002 *	-0.004 **	-0.004 **
	(0.001)	(0.002)	(0.002)
Plants per region and industry	1.284 ***	2.647 ***	2.204 ***
	(0.178)	(0.342)	(0.286)
Foreign MNE affiliates to national firms per region and industry in thsd.	0.485 ***	0.876 ***	0.636 ***
	(0.006)	(0.011)	(0.008)
Employees per region and industry	-0.002 ***	-0.005 ***	-0.005 ***
	(0.0005)	(0.001)	(0.001)
Number of employees per firm in region and industry	0.006 **	0.012 **	0.010 ***
	(0.002)	(0.005)	(0.003)
Regional worker compensation in millions	0.889 ***	1.910 ***	1.880 ***
	(0.253)	(0.469)	(0.358)
Industry level wage cost per employee in thsd.	0.247 **	0.456 *	0.507 ***
	(0.126)	(0.236)	(0.184)
Industry level cost of intermediate goods in millions	-0.536 **	-1.050 **	-0.760 **
	(0.227)	(0.426)	(0.318)
Industry level average tax rate of MNE affiliates relative to national firms in thsd.	-0.036	-0.076	-0.059
	(0.033)	(0.063)	(0.054)
Observations (number of plants)	32067	32067	32067
Pseudo R^2	0.650	0.639	0.626
Log-likelihood[a)]	-5450.26	-5622.00	-5835.67

Notes: Constant not reported. Estimation excludes all those plants that belong to domestically owned multinational firms.
Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

[a)] Specification tests: Probit model against logit model: LR = 343.47 (distributed as $\chi^2(1)$; p-value = 0.000); Probit model against complementary log-log model: LR =427.34 (p-value = 0.000).

Table 4: Average effect of foreign multinational plant ownership on debt policy

	Debt ratio
Assuming that foreign multinational plant ownership is random (exogenous)	
Average effect on foreign-owned plants	2.536 ***
	(0.321)
Assuming that foreign multinational plant ownership is endogenous (Probit in Table 3)	
Average effect on foreign-owned plants	1.682 ***
	(0.518)

Notes: Estimation excludes all those plants that belong to domestically owned multinational firms. Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

[a)] The average effect of foreign-ownerwship on plant-level tax payments is measured as the difference to domestically owned ones.

Table 5: Interaction effects with the average effect of foreign multinational plant ownership on debt policy

	Statutory corporate tax rate	Loss-carryforward corrected tax burden - regional average	Loss-carryforward corrected tax burden - country average
Average effect on foreign-owned plants	2.065 ***	2.002 ***	2.032 ***
	(0.726)	(0.725)	(0.725)
Tax interaction term	0.669 ***	0.624 ***	0.691 ***
	(0.085)	(0.076)	(0.080)

Notes: Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 6: Sensitivity analysis

	Statutory corporate tax rate	Loss-carryforward corrected tax burden	
		Regional average	Country average
Using the unbalanced observables in the outcome equation [a)]			
Average effect on foreign-owned plants	2.062 ***	1.992 ***	2.025 ***
	(0.724)	(0.724)	(0.723)
Tax interaction term	0.706 ***	0.675 ***	0.744 ***
	(0.088)	(0.079)	(0.083)
Non-debt tax shields as additional control variable			
Average effect on foreign-owned plants	1.452 **	1.340 **	1.359 *
	(0.723)	(0.723)	(0.723)
Tax interaction term	0.679 ***	0.632 ***	0.703 ***
	(0.086)	(0.079)	(0.083)
Alternative matching approaches			
Radius matching			
Average effect on foreign-owned plants	2.315 ***	2.252 ***	2.282 ***
	(0.566)	(0.565)	(0.565)
Tax interaction term	0.669 ***	0.624 ***	0.691 ***
	(0.085)	(0.076)	(0.079)
Kernel matching			
Average effect on foreign-owned plants	2.466 ***	2.466 ***	2.433 ***
	(0.560)	(0.560)	(0.558)
Tax interaction term	0.669 ***	0.669 ***	0.691 ***
	(0.085)	(0.085)	(0.079)

Notes : Standard errors in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

[a)] Plants per region and industry, foreign MNE affiliates to national firms per region and industry, and employees per region and industry.

Table A1: Balancing property of the observables included in the selection models

Variable	Mean (treated)	Mean (control)	Bias in %	Reduction of |bias| in %	t-statistic	p-value
Firm age	25.98	24.77	4.9	67.3	1.92	0.054
Firm age squared	1298.40	1202.80	2.7	62.6	1.38	0.167
Plants per region and industry	6.93	8.24	-17.0	-35.6	-5.23	0.000
Foreign MNE affiliates to national firms per region and industry	0.45	0.45	1.8	99.3	0.89	0.371
Employees per region and industry	59540	62201	-3.5	86.3	-1.52	0.129
Number of employees per firm in region and industry	394.59	353.65	5.6	1.7	2.16	0.031
Regional worker compensation	2400000	2800000	-7.4	-46.7	-2.68	0.007
Industry level wage cost per employee	11222	11550	-3.2	-614.0	-1.25	0.211
Industry level cost of intermediate goods	9600000	9300000	5.0	-262.0	2.10	0.036
Industry level average tax rate of MNE affiliates relative to national firms	1	1	0.2	83.1	1.05	0.296