Universität St.Gallen

Corporate Taxation, Debt Financing and Foreign Plant Ownership

Peter Egger, Wolfgang Eggert, Christian Keuschnigg, and Hannes Winner

February 2009 Discussion Paper no. 2009-01

Department of Economics University of St. Gallen

Editor: Martina Flockerzi
University of St. Gallen
Department of Economics
Varnbüelstrasse 19
CH-9000 St. Gallen
Phone +41 71 224 23 25
Fax +41 71 224 31 35
Email vwaabtass@unisg.ch

Publisher: Department of Economics
University of St. Gallen
Varnbüelstrasse 19
CH-9000 St. Gallen
Phone +41 71 224 23 25
Fax +41 71 224 31 35

Electronic Publication: http://www.vwa.unisg.ch

Corporate Taxation, Debt Financing and Foreign Plant Ownership

Peter Egger, Wolfgang Eggert, Christian Keuschnigg, and Hannes Winner

Author's address:

Prof. Christian Keuschnigg
IFF-HSG, Varnbüelstrasse 19
9000 St. Gallen
Tel. +41 71 224 25 20
Fax +41 71 224 26 70
Email christian.keuschnigg@unisg.ch
Website www.iff.unisg.ch

Prof. Peter Egger
University of Munich and Ifo Institute

Prof. Wolfgang Eggert
University of Paderborn

Prof. Hannes Winner
University of Innsbruck

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.

Keywords

Corporate taxation; Multinational firms; Financial structure; Debt shifting; Propensity score matching.

JEL Classification

H25, G32, F23, C21.

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 depend 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 (2008) 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 may be influenced by the non-random selection of a sample of multinational firms.

This paper is rooted in the aforementioned 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 debt-to-asset ratio (henceforth 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 adapt a standard model of taxation and financing

[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.

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 display a 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 enterprises (MNE) operating through subsidiaries in $j = 0, \ldots, n$ locations. Tax rates differ across countries, opening up possibilities for tax arbitrage and global tax savings. In particular, a subsidiary in a low tax country can give a credit to a subsidiary in a high tax country to shift profits to locations where they are subject to the lowest tax rates. The (period 2) value of a subsidiary firm in location j is $\bar{\pi}^j = \pi_2^j + (1+r)\,\pi_1^j$ where r is a given worldwide interest rate. Dividends of a subsidiary in country j are

$$\begin{aligned}
\pi_1^j &= \left(1-\tau^j\right) f_1 - \left(K^j - B^j - D^j\right), \\
\pi_2^j &= f\left(K^j\right) + K^j - (1+r)(D^j + B^j) - (e^j + i^j) r K^j - \tau^j \left[f\left(K^j\right) - r\left(D^j + B^j\right)\right].
\end{aligned} \tag{1}$$

Cash-flow f_1 in period 1 is exogenous while cash-flow $f\left(K^j\right)$ in period 2 is concave increasing with investment. For simplicity, we assume that there is initially no outstanding debt. A subsidiary can borrow an amount of debt B^j

at the external capital market and D^j internally, leaving an amount $K^j - B^j - D^j$ of equity financing from retained earnings.[2] The terms e^j and i^j refer to 'agency costs' of managing external and internal debt that are assumed not tax deductible. We assume that all countries apply a source based corporate tax at rate τ^j.[3] Interest on debt is tax deductible, the opportunity cost of equity is not. Let us refer to the country with the lowest tax rate as $j = 0$ so that $\tau^0 < \tau^j$.

A company may resort to internal debt to arrange investment financing in a tax efficient way. The external debt ratio is always positive, $\beta^j \equiv B^j/K^j > 0$. Following the standard approach in the tax literature (see Auerbach, 1979, and Davies and Gresik, 2003, in the context of a multinational firm), agency costs of external debt progressively increase when the debt ratio deviates from some natural value $\bar{\beta}^j$ which is chosen in the absence of taxes. We thus assume $e'\left(\beta^j\right) \gtrless 0$ for $\beta^j \gtrless \bar{\beta}^j$ and $e''\left(\beta^j\right) > 0$. As a normalization, $e\left(\bar{\beta}^j\right) = 0$. This form of agency cost may be rationalized by the fact that a lower level of debt disciplines management; but a high level is costly as it leads to an increase in the risk of bankruptcy. The ratio of internal debt to capital, in contrast, may be positive or negative depending on whether the subsidiary is a borrower or a lender in the MNE's internal capital market, $\delta^j \equiv D^j/K^j$. We assume that there are no agency costs associated with lending, hence, $i\left(\delta^j\right) = 0$ for $\delta^j \leqslant 0$, while $i'\left(\delta^j\right) > 0$ and $i''\left(\delta^j\right) > 0$ for $\delta^j > 0$. The agency costs of internal debt may arise because tax authorities attempt to prevent profit shifting and firms must thus spend effort to rationalize the use of internal debt.[4]

The internal capital market of an MNE restricts internal borrowing to the level of internal lending by other affiliates,

$$\sum\nolimits_j D^j = 0. \tag{2}$$

For *given* investment and external debt (K^j and B^j), internal debt $D^j > 0$ artificially inflates debt financing and reduces equity financing. Internal lending $D^j < 0$ is an alternative investment with a return rD^j next period and is financed out of retained earnings, just like the affiliate's equity investment

[2] We are not interested in the payout policy of the firm and, therefore, do not distinguish between new share issues and retained earnings (see Zodrow, 1991, and Sørensen, 1995, for comprehensive surveys).

[3] This means that international dividend payments are only taxed in the country where the subsidiary operates. See Davies and Gresik (2003) and the literature cited therein for alternative tax schemes and methods to avoid double taxation of repatriated income. The exemption principle is the most common of these methods.

[4] See Mintz and Smart (2004) for such deadweight costs of internal borrowing. These authors to not allow for the simultaneous use of external debt.

$K^j - B^j$ in physical capital. While lending one Euro from a subsidiary in a low tax country causes a relatively small tax burden of $\tau^0 r$ on next period's interest earnings, borrowing the very same Euro by another affiliate in a high tax country generates large tax savings $\tau^j r$ from interest deductions, resulting in a reduction of the global tax bill by $\left(\tau^j - \tau^0\right) r$. The presence of convex increasing agency costs for internal debt limits the extent of tax arbitrage. This means that internal debt completely disappears from consolidated (domestic plus repatriated) dividends in the absence of opportunities for profit shifting. In our simple model, internal debt is used to reduce tax payments.

The MNE chooses investment and external as well as internal debt to maximize end of period value. Using (1), $B^j = \beta^j K^j$ and $D^j = \delta^j K^j$ gives the maximization problem in Lagrange form where the multiplier λ relates to the constraint (2), i.e., $-\lambda r \sum_j \delta^j K^j$,

$$\begin{aligned} \bar{\pi} &= \max_{K^j,\beta^j,\delta^j} \sum\nolimits_j \bar{\pi}^j, && \text{(3a)} \\ \bar{\pi}^j &= \left(1-\tau^j\right) R f_1 + \left(1-\tau^j\right) f\left(K^j\right) - c^j r K^j, && \text{(3b)} \\ c^j &\equiv \left(1-\beta^j-\delta^j\right) + \left(1-\tau^j\right)\beta^j + \left(1-\tau^j+\lambda\right)\delta^j + e\left(\beta^j\right) + i\left(\delta^j\right). && \text{(3c)} \end{aligned}$$

The cost of finance $c^j r$ consists of agency costs plus a weighted average of the cost of equity and debt. The ratios of equity $1-\beta^j-\delta^j$, external debt β^j, and internal debt δ^j serve as weights. The return on equity is not tax deductible; this means that the cost of equity is r. The cost of external debt is $\left(1-\tau^j\right) r$ and reflects the value of the interest deduction. The cost of internal debt is similarly reduced by the tax savings from interest deduction in the borrowing company, but is increased by the shadow price of interest payments which will be shown below to be equal to the extra tax on the interest earnings of the lending company. The optimality conditions of the multinational firm are

$$\begin{aligned} \left(\beta^j\right) &: e'\left(\beta^j\right) = \tau^j, && \text{(4a)} \\ \left(\delta^j\right) &: i'\left(\delta^j\right) = \tau^j - \lambda, && \text{(4b)} \\ \left(K^j\right) &: \left(1-\tau^j\right) f'\left(K^j\right) = c^j r. && \text{(4c)} \end{aligned}$$

In the absence of taxes, $\lambda = 0 = \delta^j$ (see eq. 5 below), $\beta^j = \bar{\beta}^j$ and $c^j = 1$, giving first best investment $f'\left(K^j\right) = r$. We emphasize five implications of the MNE's investment and financial policies in the presence of taxes:

(i) By condition (4a), the external debt ratio β^j of affiliate companies increases with a country's tax rate. Since interest on debt is tax deductible while the opportunity cost of equity is not, the corporate tax favors debt over equity financing (see Gordon and Lee, 2001, and also Fuest, Huber, and Mintz, 2005).

This means that we should observe that the debt ratio DR is positively related to the corporate tax rate in the econometric analysis.

(ii) Condition (4b) points to the incentive of MNEs to use internal debt to shift profits from high tax to low tax affiliates, thereby reducing the global tax liability. Intuitively, tax savings are largest if borrowing occurs in affiliates subject to high tax rates while internal lending is done by the affiliate subject to the lowest tax rate, τ^0. By assumption, lending $\delta^0 < 0$ does not give rise to agency costs so that $i'\left(\delta^0\right) = 0$ and $\lambda = \tau^0$ in (4b). The opportunity cost of internal borrowing in a high tax country is, thus, equal to the tax rate in the lowest tax location, giving

$$i'\left(\delta^j\right) = \tau^j - \tau^0, \quad j = 1, \ldots, n. \tag{5}$$

Therefore, MNE affiliates in a country with a low tax rate close to τ^0 take on little internal debt but affiliates located in high tax countries borrow a lot. The demand for internal debt by all locations $j \geqslant 1$ pins down internal lending by the lowest tax affiliate.

For the following conclusions one should note: once the shadow price of interest expenses from internal debt is fixed at $\lambda = \tau^0$, optimal investment and financing are determined independently of MNE decisions in other locations.

(iii) Optimal financing minimizes the cost of capital as given in (3c). Using the minimized value in (4c) yields $f'\left(K^j\right) = c^j r / \left(1 - \tau^j\right)$. It is now straightforward to show that profit shifting facilitates investment in high tax locations. Noting $\lambda = \tau^0$ yields $dc^j/d\tau^0 = \delta^j > 0$ by the envelope theorem. Suppose the lending affiliate in the lowest tax country is taxed even less. In exploiting this and borrowing more internally, subsidiaries in other locations are able to reduce their cost of capital and invest more.

(iv) Knowing $\lambda = \tau^0$, we can also determine the value of a subsidiary in locations $j \geqslant 1$. By the envelope theorem, $d\bar{\pi}^j/d\tau^j = -Rf_1 - \left[f\left(K^j\right) - r\left(D^j + B^j\right)\right] < 0$ where the square bracket is the corporate tax base. Hence, as country j raises its tax rate, the value of a subsidiary in that country declines relative to other locations. Discrete location choice implies that such a country should attract less foreign direct investment. Hence, the composition of nationally and foreign-owned firms in country j is endogenous with taxation.[5] It is important to take account of selection effects in the empirical analysis of tax induced changes of capital structures.

(v) National firms naturally miss the opportunity to reduce their tax liability

[5] See Keuschnigg (2008) for a detailed analytical treatment and Devereux and Griffith (1998) for empirical evidence on the tax motivated locational choices by firms.

through profit shifting. Setting δ^j and i^j to zero in (3c) yields investment and financing policies of a national firm according to (4a) and (4c). In particular, facing the same type of agency costs of external debt, the MNE subsidiary and a nationally owned firm choose the same external debt ratio given by $e'\left(\beta^j\right) = \tau^j$, but MNE affiliates raise additional debt on the internal capital market for tax reasons, giving a total debt asset ratio of $\beta^j + \delta^j$. Hence, the debt-to-asset ratio of foreign-owned subsidiaries exceeds the debt ratio of national firms by the internal debt ratio δ^j. Not only have MNE subsidiaries a higher total debt-to-asset ratio, the difference also increases with the statutory corporate tax rate, $d\delta^j/d\tau^j > 0$ by (5).[6]

The empirical analysis in the next section tests the two statements in (v), namely foreign-owned firms have a higher debt ratio and this ratio increases with the statutory corporate tax rate. In doing so, the analysis appropriately takes account of the selection effects referred to in (iv).[7]

3 Empirical analysis

3.1 Econometric approach

According to statement (iv) from above, 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).

[6] One should finally note that the incentives to use internal debt for profit shifting would be much reduced under the proposal of the European Commission (2001) to introduce a consolidated company tax base and formula apportionment. See Gordon and Wilson (1986) and Nielsen, Raimondos-Møller, Schjelderup (2001) for rigorous analyses on the economics of formula apportionment and Eggert and Haufler (2006) for a review of related literature.

[7] In our theory, internal debt is only used to save taxes. The reason is that the Amadeus database used in the empirical analysis below does not allow to distinguish between internal and external debt financing. Davies and Gresik (2003) provide a comprehensive discussion over alternative functions of internal debt.

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 of 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 privately- and publicly-owned European firms as covered by the Amadeus database.[8] 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 $32,067$

[8]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).

observations. Table 1 summarizes the distribution of the included plants across 27 European economies,[9] 936 regions,[10] 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.[11] We drop all these observations from the sample.

> 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).[12] For instance, MacKie-Mason (1990) has found that firms with high loss carry-forwards have less tax-induced incentives to raise

[9] The sample includes Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Netherlands, Poland, Portugal, Republic of Macedonia, Romania, Serbia and Montenegro, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine and United Kingdom.

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

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

[12] 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.

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 debt ratio at the host market plant level, we need to determine the selection into foreign ownership. 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 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.[13] 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.[14]

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

[13] 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.

[14] 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.

terms of explanatory power, irrespective of which cumulative density function is assumed with the non-linear probability model. The three model variants 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 a logistic one, and in the third column 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 form of $\hat{f}_i$ and, hence, the probability for a plant to be foreign owned given the observable determinants (i.e., $P(m_i = 1 | x_{k_1,1}, ..., x_{K_1,1})$ 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.[15] Hence, older firms face a higher likelihood of being owned by foreign firms. Furthermore, thicker 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 probability to be foreign owned. However, the respective variables should probably not interpreted as measuring sheer labor cost, but rather as reflecting the abundance of skilled labor at the regional/industry level.[16] 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, 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

[15] 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.

[16] 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.

the group of foreign-owned firms and the domestically 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.[17] 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 reduces from about 256 percent (for *Foreign MNE affiliates to national firms 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. 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. Obviously, there is a positive selection bias of foreign ownership on debt ratios: the expected debt ratio is generally higher for a foreign-owned firm than for a domestically-owned one, but ignoring self-

[17] 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.

selection into foreign ownership over-estimates the effect of foreign ownership on the debt ratio by almost one percentage point. Hence, only firms with a above-average debt ratio 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.

> Table 5 <

The estimates in Table 4 assumed that the impact of foreign ownership on debt ratio 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 debt ratio 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 debt ratio which is about two percentage points higher than that of (comparable) domestically-owned ones. In countries with a corporate tax rate above (below) the European average, the debt ratio rises (declines) with roughly 0.65 percentage points per percentage point gap in the statutory tax rate.[18] This result is quite robust across the three tax rate concepts.

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;[19] 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.

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

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

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 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 as an additional control variable when estimating the treatment effect of foreign ownership on the debt ratio. This is to ensure that we do not attribute the impact of a variable to foreign ownership that is obviously relevant for the tax ratio but omitted from the specification (see, e.g., Titman and Wessels, 1988). The results indicate that including non-debt tax shields somewhat reduces the average treatment effect of foreign ownership on debt ratios, while rendering the interaction effect between corporate tax rates and foreign ownership unaffected. Overall, there is no qualitative change from including non-debt tax shields in the specification.

Third, 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 obtaining more reliable results than nearest neighbor matching, and particularly so in small samples. Here, we use a radius of 2 percentage points to enure 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' debt ratios 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.

Finally, in Table 7 we assess the question of how the average treatment effect of foreign plant ownership on a firm's debt policy varies across companies. More precisely, we rely on the same selection equation as before, but allow the treatment effect to vary across quartiles of the age distribution of firms. Alternatively, we allow for variation in the treatment effect across quartiles of the statutory corporate tax rate. The corresponding results are summarized in Table 7, where we report effects not only of the main effect of foreign plant ownership but also the interaction term with the corporate tax rate for three moments of the age (in the upper panel) and tax rate distributions (in the lower panel), respectively: the first (lower) quartile, the interquartile range (i.e., between the first and third quarter of the distribution), and the fourth quartile.

> Table 7 <

For the three moments of the firm age distribution, both the main effect and the interaction effect are of a magnitude which is statistically insignificantly different from the original results in Table 5. However, the point estimate of foreign ownership on firm-level debt policy is largest for the oldest quartile of firms, according to the point estimate. The parameter of both the foreign ownership main effect and the tax interaction term are much harder to identify across quartiles of the distribution of tax rates. It is possible to estimate a significant parameter of foreign ownership in the interquartile range but not the outer quartiles of the distribution. However, the matter is mainly one of efficiency, and the sign of the point estimate does never contradict the original findings.[20]

Overall, the findings reported in Tables 6 and 7 suggest that the estimated impact of foreign ownership on the debt ratio 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)

[20]Notice that it is not surprising that the parameters can not be estimated as precisely as before, since we account for some heterogeneity of the treatment effect with regard to tax rates in any case by including the corporate tax interaction term.

and the choice of matching estimators. Moreover, they are robust across quartiles of the age distribution of firms, but there is some evidence that foreign ownership matters for tax policy the most for old firms. Finally, the heterogeneity of the impact of foreign ownership with regard to corporate tax rates can be captured by an interaction term. Splitting the sample with regard to corporate tax rates suggests that the effect of foreign ownership is smallest for the sub-sample of countries with the lowest tax rates. The latter is consistent with the parameter of the tax interaction term in estimations we pursued on the full sample of firms.

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).

Acknowledgements

We are very grateful to editor Thomas A. Gresik and two anonymous referees for very helpful comments on an earlier version of the paper. Further, we would like to thank the participants at the annual meeting of the IIPF in Warwick for comments and suggestions. Financial support from the Austrian Fond zur Förderung der wissenschaflichen Forschung (FWF, grant no. P17713-G05) is gratefully acknowledged.

References

Ai, C. and E.C. Norton, 2003. Interaction terms in logit and probit models, *Economics Letters* 80, 123-129.

Altshuler, R. and H. Grubert, 2003. Repatriation taxes, repatriation strategies and multinational financial policy, *Journal of Public Economics* 87, 73-107.

Altshuler, R. and J.M. Mintz, 1995. US interest allocation rules: Effects and policy, *International Tax and Public Finance* 2, 7-35.

Auerbach, A.J., 1979. Wealth maximization and the cost of capital, *Quarterly Journal of Economics* 21, 107-127.

Blundell, R.W. and M. Costa Dias, 2002. Alternative approaches to evaluation in empirical microeconometrics, *Portuguese Economic Journal* 1, 91-115.

Caliendo, M. and S. Kopeinig, 2005. Some practical guidance for the implementation of propensity score matching, *IZA Discussion Paper* No. 1588.

Collins, J.H. and D.A. Shackelford, 1992. Foreign tax credit limitations and preferred stock issuances, *Journal of Accounting Research* 30, 103-124.

Davidson, R. and J.G. MacKinnon, 2004. *Econometric Theory and Methods*, New York: Oxford University Press.

Davies, R.B. and T.A. Gresik, 2003. Tax competition and foreign capital, *International Tax and Public Finance* 10, 127-145.

DeAngelo, H. and R.W. Masulis, 1980. Optimal capital structure under corporate and personal taxation, *Journal of Financial Economics* 8, 3-29.

Desai, M.A., F.C. Foley, and J.R. Hines, 2004. A multinational perspective on capital structure choice and internal capital markets, *Journal of Finance* 59, 2451-2488.

Devereux, M.P., 2006. The impact of taxation on the location of capital, firms and profit: A survey of empirical evidence, *Oxford University Centre for Business Taxation Working Paper* No. 07/02.

Devereux, M.P. and R. Griffith, 1998. Taxes and the location of production: evidence from a panel of US multinational firms, *Journal of Public Economics* 68, 335-367.

Diamond, A., 2006a. *Thoughts on SUTVA (Part I)*, Social Science Statistics Blog, The Institute for Quantitative Social Science at Harvard University.

Diamond, A., 2006b. *Thoughts on SUTVA (Part II)*, Social Science Statistics Blog, The Institute for Quantitative Social Science at Harvard University.

Eggert, W. and A. Haufler, 2006. Company-tax coordination cum tax-rate competition in the European Union, *FinanzArchiv* 62, 579-601.

European Commission, 2001. *Towards an internal market without tax obstacles. A strategy for providing companies with a consolidated corporate tax base for their EU-wide activities*, Document COM(2001) 582, Brussels.

Froot, K.A. and J.R. Hines, 1995. Interest allocation rules, financing patterns, and the operations of US multinationals, in M. Feldstein, J.R. Hines and R.G. Hubbard (eds.), *The Effects of Taxation on Multinational Corporations*, Chicago: University of Chicago Press, 277-307.

Fuest, C., B. Huber and J. Mintz, 2005. Capital mobility and tax competition, *Foundations and Trends in Micoeconomics* 1, 1-62.

Gordon, R. and Y. Lee, 2001. Do taxes affect corprate debt policy? Evidence from U.S. corporate tax return data, *Journal of Public Economics* 82, 195-224.

Gordon, R.H. and J.D. Wilson, 1986. An examination of multijurisdictional corporate income taxation under formula apportionment, *Econometrica* 43, 1357-1373.

Graham, J., 1996. Proxies for the corporate marginal tax rate, *Journal of Financial Economics* 42, 187–221.

Graham, J., 2003. Taxes and corporate finance: A review, *Review of Financial Studies* 16, 1075-1129.

Helpman, E., M.J. Melitz, and S.R. Yeaple, 2004. Export versus FDI with heterogeneous firms, *American Economic Review* 94, 300-316.

Hines, J.R., 1997. Tax policy and the activities of multinational corporations, in A.J. Auerbach (ed.), *Fiscal policy: lessons from economic research*, Cambridge MA: MIT Press.

Huizinga, H., L. Laeven, and G. Nicodème, 2008. Capital structure and international debt shifting, *Journal of Financial Economics* 88, 80-118.

Jog, V. and J. Tang, 2001. Tax reforms, debt shifting and tax revenues: Multinational corporations in Canada, *International Tax and Finance* 8, 5-25.

Keuschnigg, C., 2008. Exports, foreign direct investment, and the costs of corporate taxation, *International Tax and Public Finance* 15, 460-477.

King, M.A. 1974. Taxation, investment and the cost of capital, *Review of Economic Studies* 41, 21-35.

MacKie-Mason, J.K., 1990. Do taxes affect corporate financial decisions?, *Journal of Finance* 45, 1471–1493.

Mills, L.F. and K.J. Newberry, 2004. Do foreign multinationals' tax incentives influence their U.S. income reporting and debt policy?, *National Tax Journal* 57, 89-107.

Mintz, J. and M. Smart, 2004. Income shifting, investment, and tax competition: theory and evidence from provincial taxation in Canada, *Journal of Public Economics* 88, 1149–1168.

Moore, P.J. and F.P. Ruane, 2005. Taxation and the financial structure of foreign direct investment, *IIIS Discussion Paper* 88, Institute for International Integration Studies, Dublin.

Newberry, K.J. and D.S. Dhaliwal, 2001. Cross-jurisdictional income shifting by U.S. multinationals: Evidence from international bond offerings, *Journal of Accounting Research* 39, 643-662.

Nielsen, S.B., P. Raimondos-Møller and G. Schjelderup, 2001. Tax spillovers under separate accounting and formula apportionment, *EPRU Working Paper* 2001-07, University of Copenhagen.

Plesko, G.A., 2003. An evaluation of alternative measures of corporate tax rates, *Journal of Accounting and Economics* 35, 201–226.

Rubin, D.B., 1990. Formal modes of statistical inference for causal effects, *Journal of Statistical Planning and Inference* 25, 279-292.

Rosenbaum, P.R. and D.B. Rubin, 1983. The central role of the propensity score in observational studies for causal effects, *Biometrika* 70, 41-55.

Sørensen, P.B., 1995. Changing views of the corporate income tax, *National Tax Journal* 48, 279-294.

Titman, S. and R. Wessels, 1988. The determinants of capital structure choice, *Journal of Finance* 43, 1-19.

Wooldridge, J.M., 2002, *Econometric Analysis of Cross-Section and Panel Data*, Cambridge, MA: MIT Press.

Zodrow, G.R., 1991. On the 'traditional' and 'new' views of dividend taxation, *National Tax Journal* 44, 497–509.

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
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 of foreign plant ownership	2.536 ***
	(0.321)
Assuming that foreign multinational plant ownership is endogenous (Probit in Table 3)	
Average effect of foreign plant ownership	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-ownership 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 7: Sensitivity analysis II - Average treatment effect at alternative moments of the age and tax rate distributions

	Firm age		
	1st quartile	**Interquartile range**	**4th quartile**
Average effect on foreign-owned plants	2.411 ***	1.688 *	3.198 **
	(1.584)	(0.955)	(1.559)
Tax interaction term	0.348 *	0.730 ***	0.576 ***
	(0.197)	(0.108)	(0.184)
	Statutory corporate tax rate		
	1st quartile	**Interquartile range**	**4th quartile**
Average effect on foreign-owned plants	0.053	1.710 *	1.443
	(3.327)	(1.058)	(3.242)
Tax interaction term	-0.206	1.612 ***	0.032
	(0.430)	(0.388)	(0.393)

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

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