Ifo Institute for Economic Research at the University of Munich

The Impact of Thin-Capitalization Rules on External Debt Usage – A Propensity Score Matching Approach

Georg Wamser

Ifo Working Paper No. 62

October 2008

Ifo Working Paper No. 62

The Impact of Thin-Capitalization Rules on External Debt Usage – A Propensity Score Matching Approach*

Abstract

This paper analyzes how multinational enterprises respond to a restriction on interest deductions incurred for internal borrowing. The emphasis of the study is on a firm's response with respect to external borrowing. The empirical investigation applies propensity score matching techniques and exploits the 2001 reform of the German thin-capitalization rule to solve endogeneity problems. The results suggest that restrictions on internal debt are associated with expansions in external debt finance, indicating a substitutional relationship. Since multinational enterprises can use internal debt to shift profits from high- to low-tax countries, this finding implies that policies aimed at securing corporate tax revenue possibly fail and should be subject to careful scrutiny by policymakers.

JEL Code: G32, H25.
Keywords: Corporate finance, propensity score matching, thin-capitalization rules, firm-level data.

Georg Wamser
Ifo Institute for Economic Research
at the University of Munich
Poschingerstr. 5
81679 Munich, Germany
Phone: +49(0)89/9224-1606
wamser@ifo.de

* I am grateful to the Deutsche Bundesbank for granting access to the FDI database. I thank Chang Woon Nam and Fédéric Holm-Hadulla for helpful comments and discussions. All errors, omissions, and conclusions remain the sole responsibility of the author.

1 Introduction

Once corporate income taxation is introduced in models of capital structure choice, a firm can increase its value by using debt instead of equity finance, making use of interest deductions. This is one essential finding of the corporate finance literature (for surveys, see Graham, 2003; Myers, 2001). A firm's capital structure choice, however, involves not only the debt-equity decision. Some companies also have the choice between internal and external debt finance. In the context of multinational firms, for instance, this choice entails complex issues of international tax planning.

Several existing empirical research papers consider both internal and external debt and find that corporate debt policy reflects differences in international taxation (e.g., Desai et al., 2004a; Mintz and Weichenrieder, 2005; Ramb and Weichenrieder, 2005). If multinational enterprises use internal loans to shift profits from high- to low-tax countries, high-tax countries lose corporate tax revenue. As a consequence, many governments have focused attention on countermeasures such as thin-capitalization rules which restrict the deductibility of interest expenses associated with internal debt. For example, from 1996 to 2005, the number of EU member countries that relied on some form of debt-equity restriction increased from 8 to 17. Only recently, the issue has appeared on the agenda of the European Commission, as "[...] there is clearly a perceived need for the introduction of a common thin capitalization rule." (Dourado and de la Feria, 2008, p.1). It is questionable, however, whether European countries will agree on harmonizing thin-capitalization rules in the near future, because a common rule may reduce welfare in some countries (see Haufler and Runkel, 2008).

In a recent study, Buettner et al. (2008) find that thin-capitalization rules are effective in restricting internal borrowing. Overesch and Wamser (2008) confirm this result by investigating a reform of the German thin-capitalization rule. However, whether corporate tax revenue simultaneously goes up remains unclear. In fact, the analyses of Desai et al. (2004a) and Ruf (2008) suggest that internal and external debt are substitutes, and thus, tax revenue may be unaffected. If firms are able to substitute external for internal debt, they still make use of interest deduction, because external debt is usually not affected by thin-capitalization rules. While consequences for corporate tax revenues ultimately depend on the elasticity of substitution between external and internal debt, on interest costs for external debt and, in the medium term, on firms' investment response, the goal of securing the domestic corporate tax base possibly fails in the first place.

This paper investigates how a firm's external debt usage responds to restrictions on internal borrowing. Thereby, the analysis also reveals how internal debt generally relates to external debt. Any investigation of this relationship is challenging, because firms simultaneously decide on both internal and external debt. To obtain reliable estimates, we therefore make use of a more sophisticated identification strategy, where we first exploit a reform of the German thin-capitalization rule. Second, we adopt a counterfactual perspective and apply propensity score matching methods. The analysis is based on an affiliate-level database on foreign direct investment in Germany (inbound FDI), provided by the Deutsche Bundesbank (the German Central Bank). The findings support the hypothesis that affiliates of foreign multinationals partially substitute external for internal borrowing if they are affected by a tighter thin-capitalization rule. The estimations imply that affected firms increase their external-debt-to-capital ratio by approx. 2.5 percentage points compared to the counterfactual outcome. With regard to the external debt level,

we estimate an average treatment effect on the treated (ATT) that suggests that treated firms expand their external debt usage by 8%. These findings imply a limited effectiveness of thin-capitalization rules in terms of shielding tax revenue.

The study proceeds as follows. Section 2 provides institutional details about the German thin-capitalization rule. Some theoretical considerations are presented in Section 3. The empirical investigation approach is developed in Section 4. Section 5 describes the data. Section 6 reports and interprets the results. Section 7 concludes.

2 The German Thin-Capitalization Rule

While multinational firms can use their internal capital markets for a number of reasons – for instance to overcome shortcomings associated with external credit markets (e.g., Desai et al., 2004a) – internal financial policies can also support multinationals' efforts in reducing their overall tax liabilities. In a very simple scenario, in which a multinational firm is active in a low- and a high-tax country, we would expect the subsidiary in the high-tax country to borrow from the subsidiary in the low-tax country. Since interest payments are usually deductible from the corporate tax base, the difference in national statutory tax rates determines the potential gain (see, e.g., Buettner and Wamser, 2007).

To secure their corporate tax bases, many countries have introduced some form of debt-equity restriction. Referring to excessive debt-to-equity ratios, i.e. companies are thinly capitalized, such restrictions are commonly known as thin-capitalization rules. In Germany, a thin-capitalization rule was first introduced in 1994. After having been subject to amendments in 2001 and 2004, it was replaced by a so-called earnings-stripping rule in

2008 (see also Section 7). Up to and including 2007, Section 8(a) of the German corporate income tax law (KStG) limited interest deduction if a firm's internal-debt-to-equity ratio exceeded a certain threshold level. The rule applied to two different types of incorporated affiliates. The first group of affiliates included ordinary corporations that were not classified as holding companies. For these corporations, interest deduction was allowed up to an internal-debt-to-equity ratio (equity inclusive of internal debt) of 3:1 before 2001. The threshold level for holdings – defined as a firm where more than 75% of total assets consist of shares in other corporations – was even less restrictive at an internal-debt-to-equity ratio of 9:1. In 2001, the thresholds were significantly reduced to 1.5:1 in the case of an ordinary corporation and to 3:1 in the case of a holding corporation. Note that if the internal-debt-to-equity ratio of a firm was in excess of the threshold defined by the thin-capitalization rule, only interest expenses for the internal borrowing above the allowed threshold were non-deductible.

3 Theoretical Framework

Corporate financial decisions are a relevant aspect of firm policy affecting the value of a company (for surveys, see Auerbach, 2002; Graham, 2003). Nevertheless, investigations on capital structures typically start from the Modigliani-Miller irrelevance theorem. Assuming a frictionless capital market, Modigliani and Miller's (1958) result states that the capital structure is irrelevant for the company value. In the presence of taxes, however, companies would generally favor debt, because the debt tax shield generated by debt interest deductions increases the company value (Modigliani and Miller, 1963).[1]

[1]The irrelevance theorem is no longer valid in the presence of various capital market imperfections (see Fama, 1978, for a discussion of the Modigliani-Miller assumptions). Kemsley and Nissim (2002) estimate

The following model considers two multinational enterprises (A and B). Each multinational has a subsidiary in Germany. The subsidiaries are identical, except that one is affected by the reform of the German thin-capitalization rule (subsidiary of multinational B), the other is not (subsidiary of multinational A).

3.1 Multinational Firm A

Consider a multinational firm A which is active in a parent country (country 1) and in Germany (country 2). The multinational's after-tax profits are given by

$$\begin{aligned}\pi^A = & f\left(k_1^A\right)(1-t_1) + f\left(k_2^A\right)(1-t_2) \\ & - \left[i_1 \lambda_1^A k_1^A\right](1-t_1) \\ & - \left[i_2 \lambda_2^A k_2^A\right](1-t_2) \\ & + \left[i_2 \mu_2^A k_2^A\right](t_2 - t_1) \\ & - \left[\left(1-\lambda_1^A\right) k_1^A + \left(1-\lambda_2^A\right) k_2^A\right] r^A \\ & - \left[c\left(\lambda_1^A\right) k_1^A + c\left(\lambda_2^A, \mu_2^A\right) k_2^A\right].\end{aligned} \tag{1}$$

Output is given by the production functions $f\left(k_1^A\right)$ and $f\left(k_2^A\right)$, where k_1^A units of capital are employed at the parent's location, and k_2^A units of capital in Germany. The firm is subject to the corporate tax rates t_1 and t_2. The relevant interest rates are given by i_1 and i_2. The second and the third line capture the net-of-tax interest costs related to external

the value of the debt tax shield. Their findings suggest that the debt tax shield is equal to approx. 40% of debt balances, or 10% of total firm value. Graham (2000) estimates that the tax benefit of debt equals 9.7% of firm value.

debt, where λ_1^A and λ_2^A denote the respective shares of capital financed with external debt.[2] Moreover, let μ_2^A be the share of internal debt provided by the parent firm. If we assume that Germany is always the high-tax country ($t_2 > t_1$), the multinational can increase π^A by shifting profits from the high-tax affiliate to the low-tax parent firm. Note that internal loans are equity refinanced and do not increase external debt. The fourth line captures the multinational's cost of equity, where the rate of return on equity is denoted by r^A. Finally, $c(\lambda_1^A)$ and $c(\lambda_2^A, \mu_2^A)$ are the cost of borrowing.[3] The cost function is assumed to be convex in both types of debt.[4] Furthermore, if the cross-partial derivative is positive, external and internal debt are substitutes.[5] The firm chooses λ_2^A and μ_2^A to maximize profits, which yields the following optimality conditions

$$c_\lambda\left(\lambda_2^A, \mu_2^A\right) = r^A - i_2\left(1 - t_2\right), \tag{2}$$

$$c_\mu\left(\lambda_2^A, \mu_2^A\right) = i_2\left(t_2 - t_1\right). \tag{3}$$

The convexity of the cost function implies that λ_2^A is positive if $r^A > i_2\left(1 - t_2\right)$.[6] While external debt is determined by the local tax rate, the optimal μ_2^A is determined by the tax-rate differential between Germany and the parent country $(t_2 - t_1)$.

---

[2]Note that Equation (1) implicitly assumes that the firm is not experiencing losses and that debt interest expenses are fully deductible.

[3]On the one hand, these costs may be associated with financial distress (Kraus and Litzenberger, 1973; Scott, 1976). Agency cost models, on the other hand, introduce costs which relate to conflicting interests between debt and equity owners (Jensen and Meckling, 1976; Myers, 1977).

[4]$c_{\lambda_1^A} \equiv \frac{\partial c}{\partial \lambda_1^A} > 0,\ c_{\lambda_2^A} \equiv \frac{\partial c}{\partial \lambda_2^A} > 0,\ c_{\mu_2^A} \equiv \frac{\partial c}{\partial \mu_2^A} > 0,\ c_{\lambda_1^A \lambda_1^A} \equiv \frac{\partial^2 c}{\partial \lambda_1^{A2}} > 0,\ c_{\lambda_2^A \lambda_2^A} \equiv \frac{\partial^2 c}{\partial \lambda_2^{A2}} > 0,\ c_{\mu_2^A \mu_2^A} \equiv \frac{\partial^2 c}{\partial \mu_2^{A2}} > 0.$

[5]$c_{\lambda_2^A \mu_2^A} \equiv \frac{\partial^2 c}{\partial \lambda_2^A \partial \mu_2^A} > 0.$

[6]For notational simplicity, c_λ and c_μ refer to the first derivatives of the cost function with respect to λ_2^A and μ_2^A.

3.2 Multinational Firm B

We observe a second multinational with a subsidiary in Germany. Multinational B is identical to firm A, except that the German subsidiary of firm B is affected by the reform of the thin-capitalization rule. Thus, it is restricted in the use of internal debt.[7] In fact, thin-capitalization rules imply that interest expenses above a certain threshold of the internal-debt-to-equity ratio are no longer deductible for tax purposes (see Section 2). The profit function for B can then be written as

$$\begin{aligned}\pi^B = & f\left(k_1^B\right)(1-t_1) + f\left(k_2^B\right)(1-t_2) \\ & - \left[i_1 \lambda_1^B k_1^B\right](1-t_1) \\ & - \left[i_2 \lambda_2^B k_2^B\right](1-t_2) \\ & + \left[i_2 \mu_2^B k_2^B\right](t_2 - t_1 - \phi t_2) \\ & - \left[\left(1-\lambda_1^B\right)k_1^B + \left(1-\lambda_2^B\right)k_2^B\right] r^B \\ & - \left[c\left(\lambda_1^B\right)k_1^B + c\left(\lambda_2^B, \mu_2^B\right)k_2^B\right].\end{aligned} \tag{4}$$

The share ϕ of interest expenses associated with internal debt is not deductible and therefore does not add value to the debt tax shield of the multinational (see line four).[8] Although Equation (4) implies that there is a reduced benefit from using internal debt, interest expenses for external debt remain fully deductible.

[7] Note that all notations and assumptions from above apply also for multinational B.

[8] The non-deductibility is captured by $\phi\left(i_2 \mu_2^B k_2^B t_2\right)$, where we assume $0 < \phi < 1$. The actual ϕ depends on the thin-capitalization threshold and on the firm's internal-debt-to-equity ratio. The empirical analysis exploits the exogenous variation of the threshold.

The multinational's first-order conditions are then given by

$$c_\lambda\left(\lambda_2^B, \mu_2^B\right) = r^B - i_2\left(1 - t_2\right), \tag{5}$$

$$c_\mu\left(\lambda_2^B, \mu_2^B\right) = i_2\left(t_2 - t_1 - \phi t_2\right). \tag{6}$$

Equation (6) suggests that the incentive to use internal debt is partially offset, because the marginal benefit of using internal debt is reduced by the thin-capitalization rule. As long as the tax-rate difference is sufficiently large, however, there is an incentive to use internal debt to shift profits.

Recall that the German subsidiaries of the multinationals A and B are identical, except that the subsidiary of B is affected by the reform of the thin-capitalization rule. If the subsidiaries choose μ and λ simultaneously, and if r^A is similar to r^B, the assumptions about the functional form of $c(\lambda, \mu)$ imply that $\lambda_2^{A*} < \lambda_2^{B*}$, because $\mu_2^{A*} > \mu_2^{B*}$. This means that, as a consequence of a tighter thin-capitalization rule, subsidiary B is inclined to use additional external debt, whereas subsidiary A is not.

Prediction: *A subsidiary that is affected by a tighter thin-capitalization rule increases external debt usage compared to a non-affected subsidiary.*

4 Empirical Investigation Approach

This section describes the empirical identification strategy. As noted previously, the basic goal of this study is to investigate how firms respond to a change in the thin-capitalization

threshold with respect to their external debt usage. Thereby, the analysis also reveals how internal debt generally relates to external debt.

To address the research issue, we do not use standard regression techniques, because external and internal debt are determined simultaneously. Hence, we cannot consider exogenous variation of one variable and simply regress external on internal debt or vice versa. Since exclusion restrictions are also difficult to justify, even instrumental variable techniques are not convincing and may result in biased estimates and misleading inference. We shall choose a research design that sufficiently takes into account endogeneity issues by using both a policy reform (the 2001 reform of the thin-capitalization rule) as a quasi-experimental setting and propensity score matching techniques.

Our data contains information on the capital structure of foreign subsidiaries in Germany, including information on internal borrowing. We can use this data in combination with information about the German thin-capitalization threshold level $\bar{\theta}$ to identify firms for which interest deduction is denied because the thin-capitalization rule is binding. According to the evaluation literature we refer to these firms as the treatment group (see, e.g., Blundell and Costa Dias, 2002). The change in the outcome variable due to the treatment is called the treatment effect. If subsidiaries are not subject to treatment, they are assigned to the control group. The treatment status of firm j is indicated by the binary variable T_j, defined as

$$\begin{aligned} T_j = 1 \qquad & \text{if} \quad \theta_{j,t} < \bar{\theta}_{t-1} \quad \text{and} \quad \theta_{j,t} > \bar{\theta}_t, \\ T_j = 0 \qquad & \text{if} \quad \theta_{j,t} < \bar{\theta}_{t-1} \quad \text{and} \quad \theta_{j,t} < \bar{\theta}_t. \end{aligned}$$

The year t refers to the reform year 2001. We look at a single firm j that can be affected

by the legal thin-capitalization rule $\bar{\theta}$. $\bar{\theta}$ corresponds to the allowed internal-debt-to-equity ratio (equity inclusive of internal debt), and $\theta_{j,t}$ is the internal-debt-to-equity ratio of the firm.[9] Note that above definition implies that, although a treated firm would have been below the pre-reform threshold ($\bar{\theta}_{t-1}$) level in t, it is above the post-reform threshold. Using this definition, we ensure that a firm is affected by an exogenous reform. We allow $\bar{\theta}$, the German thin-capitalization rule, to differ according to the legal form of the firm, because different threshold levels apply (see Section 2; note, though, that we abstract from using an index for the legal form, for the sake of simplicity). With respect to the theoretical model, Equation (4) refers to cases where $T = 1$. If θ_j is sufficiently low, then Equation (1) applies and $T = 0$.

We define the outcome variable as the change in the share of external debt $\Delta\lambda$, calculated as $\lambda_{t+1} - \lambda_t$.[10] We expect that affected subsidiaries are adjusting their capital structure during the period after the shock. In particular, we expect a positive treatment effect, indicating that treated firms increase external debt usage compared to non-treated firms.

The optimal setting to investigate the effect of the reform is described by the counterfactual framework (Heckman, 2005; Heckman, 2008). A real counterfactual would require observing each subsidiary in both states (with and without treatment). Since this is not possible, the aim is to choose the control group such that control units are as similar as possible to the treatment group. A perfect control group would only differ in terms of the treatment status. Whether a company is affected by a stricter thin-capitalization rule, however, is not

[9] A thin-capitalization rule of 3:1 translates into an internal-debt-to-equity ratio $\bar{\theta}$ of 0.75. The post-reform ratio of 1.5:1, hence, corresponds to $\bar{\theta} = 0.6$.

[10] Since the empirical analysis is concerned with the 2001 reform, $\Delta\lambda$ refers to $\lambda_{2002} - \lambda_{2001}$. The intuition for this definition is that the exogenous shock is at the beginning of 2001; from 2001 to 2002, the firms may adjust their capital structure. The share of external debt λ is defined as external liabilities relative to total capital. The latter consists of nominal capital, capital reserves, profit reserves, and total debt.

random. Since both groups presumably differ also without treatment, comparing the mean values of the change in external debt between treated and non-treated firms would bias the results. For instance, financially constrained or financially distressed firms may have a higher probability to be treated, because they potentially depend on internal loans from the parent company (Gopalan et al., 2007) and may only have limited access to external debt. A strategy for overcoming this problem is to find a group of non-affected companies that is similar to the treated firms in relevant pre-treatment characteristics X.

4.1 Propensity Score Matching

Rosenbaum and Rubin (1983, 1984) describe how one can bundle firm characteristics in a single-index variable, the propensity score. On the basis of this propensity score we can match treated and non-treated firms such that they are comparable with respect to relevant observable characteristics. One advantage of this non-parametric approach is that it is a very intuitive way to estimate treatment effects, because we determine treated firms by a set of observable variables, and then compare firms to appropriate matches (firms which are not affected, but similar in other respects). Formally, the propensity score can be described as the probability of receiving a treatment given pre-treatment characteristics

$$p(X) \equiv Pr\{T = 1|X\} = E\{T|X\}.$$

$T = \{0, 1\}$ is the treatment variable as defined above and X is the multidimensional vector of pre-treatment characteristics. If the exposure to treatment is random within cells defined by X, it is also random within cells defined by the values of the mono-dimensional variable

$p(X)$. Then, the Average effect of Treatment on the Treated (ATT) can be estimated as

$$\begin{aligned}
\text{ATT} &\equiv E\{\Delta\lambda_{1j} - \Delta\lambda_{0j}|T_j = 1\} \\
&= E\{E\{\Delta\lambda_{1j} - \Delta\lambda_{0j}|T_j = 1, p(X_j)\}\} \\
&= E\{E\{\Delta\lambda_{1j}|T_j = 1, p(X_j)\} - E\{\Delta\lambda_{0j}|T_j = 0, p(X_j)\}|T_j = 1\},
\end{aligned}$$

where the variable $\Delta\lambda_{0j}$ denotes the counterfactual outcome. Note that the real counterfactual outcome for treated firms is not observed; we do not know how the firms would have chosen their financial structure without treatment. Yet we can use the control group as a substitute and condition on the propensity score. However, we need two additional assumptions to obtain the result for the ATT. First, pre-treatment variables of the two groups have the same distribution given the propensity score (balancing property). If this assumption holds, the treatment is considered to be random. The second assumption is called the unconfoundedness assumption. It requires that, given the propensity score, potential outcomes are independent of treatment assignment (see the Appendix, Lemma 1 and Lemma 2, for more details on the assumptions).

Estimating the ATT using propensity score matching involves a two-step procedure, where we predict the probability of being affected by the 2001 reform of the thin-capitalization rule in a first step (using a probit or logit regression). The binary dependent variable corresponds to T_j as defined above. In a second step, we match treated and control units and estimate the treatment effect. If we were observing exactly the same propensity score for two firms, we could simply compare these two observations. However, the propensity score is a continuous variable and the probability of observing the same value for two firms is infinitely small. For this reason, we do need methods to match comparable firms.

4.2 Matching Methods

We make use of four different matching methods: nearest neighbor matching, radius matching, stratification matching, and kernel matching.[11] *Nearest neighbor matching* matches to each treated company the control unit with the closest propensity score. Untreated firms can be used more than once as a match. Subsequently, the difference in the outcome variable between matched units is computed to obtain the ATT. Note that one match is assigned to every treated firm, no matter how close propensity scores actually are. This can result in a rather unsatisfying matching quality. We can overcome this problem, to some extent, when we use *radius matching*. This method matches treatment units with control units only if the propensity score falls into a certain range. The smaller we define the radius – the tolerable distance within which units are matched – the better is the quality of the matches. The *stratification method* splits the sample according to the value of the propensity score into intervals. Within each interval, treated and control units have on average the same propensity score. We obtain the ATT by calculating the difference between average outcomes of the treated and the controls within each interval. However, we possibly lose observations if we do not find comparable firms within one interval. *Kernel matching*, finally, does not only use some of the control observations. Rather, this matching estimator constructs the counterfactual outcome by using weighted averages of all controls. The weights proportionally decrease with an increasing distance between the propensity scores of treated firms and controls.

To evaluate different matching methods, we need to take into account the trade-off between quantity and quality of matches. Whereas more information can improve the efficiency

[11] For more details about matching algorithms, consult, for example, Morgan and Harding (2006), Dehejia and Wahba (2002).

of the estimates, a higher matching quality can reduce the bias. Radius matching, for example, rather avoids bad matches compared to nearest neighbor matching.

5 Data and Descriptive Statistics

The empirical investigation relies on the MiDi (Microdatabase Direct Investment) database collected by the Deutsche Bundesbank. Two aspects of MiDi are particularly noteworthy: first, according to the German Trade and Payments Act (Außenwirtschaftsgesetz) in connection with the Foreign Trade and Payments Regulation (Außenwirtschaftsverordnung), a German affiliate held by a foreign investor is obliged to provide balance-sheet information. Hence, above a minimum reporting threshold, we observe all foreign affiliates in Germany. Second, MiDi does not only provide information about the affiliates' total debt, it also includes information about internal borrowing. The corresponding question in the FDI stock survey asks the participants to report *liabilities to affiliated enterprises linked with the party required to report through participating interests* (Lipponer, 2007).

Table 1 provides a list of the investor countries, including means of affiliate characteristics as well as the total number of subsidiaries in a country. All statistics refer to the year 2001. Due to data protection, we only report countries with at least 5 investments. To avoid any conflicting participation interests (e.g., Desai et al., 2004b), we exclude all minority holdings. The Netherlands, Switzerland, and the United States are the most important investor countries. However, the country of the foreign investor may not always be the ultimate parent country. This explains the large number of observations from the Netherlands and also from Switzerland, because both countries are frequently used to establish intermediate holding companies (see Weichenrieder and Mintz, 2008).

Table 1: Country and Firm Characteristics

Investor Country	Fixed Assets (€1.000)	Employees (#)	Leverage (Ratio)	Subsidiaries (#)	Investor Country	Fixed Assets (€1.000)	Employees (#)	Leverage (Ratio)	Subsidiaries (#)
Australia	2,929.13	74.38	0.827	8	Italy	6,956.89	132.69	0.689	217
Austria	7,767.44	123.66	0.687	431	Japan	7,835.79	105.98	0.658	350
Belgium	16,826.55	173.68	0.682	263	Korea (South)	7,659.33	121.91	0.742	33
Bermuda (GB)	3,757.93	83.21	0.687	14	Liechtenstein	9,922.08	95.63	0.669	52
Brazil	1,909.40	114.40	0.793	5	Luxembourg	11,311.81	137.53	0.631	360
British Virgin Isl.	3,188.75	40.94	0.746	16	Malaysia	4,522.00	186.95	0.576	5
Canada	15,670.40	325.43	0.626	60	Netherlands	13,574.94	210.88	0.652	2,143
Cayman Islands	5,447.15	86.00	0.660	26	Netherlands Anti.	4,865.75	204.38	0.610	8
China	732.36	14.43	0.838	14	Norway	6,904.67	112.74	0.721	57
Croatia	271.40	394.00	0.969	5	Panama	4,125.00	231.54	0.750	13
Cyprus	30,049.44	49.67	0.779	9	Poland	344.88	190.04	0.828	24
Czech Republic	10,99	32.91	0.581	11	Portugal	11,662.25	126.63	0.725	8
Denmark	5,391.76	156.88	0.668	273	Russia	1,104.09	12.91	0.722	11
Finland	13,618.07	189.52	0.622	95	Singapore	8,036.00	77.89	0.707	9
France	12,452.87	243.65	0.643	883	Slovenia	3,149.33	21.83	0.906	12
Great Britain	11,972.90	172.68	0.641	763	South Africa	14,041.82	115.55	0.604	11
Greece	894.42	25.17	0.781	12	Spain	115,335.30	142.13	0.681	83
Hong Kong	3,465.29	62.43	0.764	7	Sweden	11,764.04	195.51	0.628	307
Hungary	2,338.14	65.14	0.710	7	Switzerland	9,108.19	172.85	0.689	1,086
Iran	3,283.82	20.18	0.894	17	Taiwan	692.20	23.07	0.702	15
Ireland	10,527.44	146.97	0.669	36	Turkey	3,741.86	116.29	0.797	21
Israel	8,979.62	20.18	0.601	21	USA	16,696.46	288.87	0.603	1,476

Source: MiDi. Descriptive statistics refer to the year 2001. Fixed Assets, Employees, and Leverage are sample means. All minority holdings are excluded, but no further restrictions are imposed. The country of the foreign investor may not always be the ultimate parent country. Subsidiaries is the number of majority holdings. Confidential information: investor countries with less than 5 observations in 2001 are excluded.

Table 2 reports summary statistics. The treatment variable T, which is analyzed in a first-step binary model (see Section 6 and the Appendix for further details), indicates that approx. 15% of all subsidiaries in the estimation sample are affected by the reform of the thin-capitalization rule. T is determined by several explanatory variables: first of all, we expect that tax-rate differentials have a positive impact on the propensity to be treated.[12] Moreover, we expect that the subsidiary's sales positively relate to the probability of being treated, because sales capture the size of a firm (e.g., Graham and Harvey, 2001). Another helpful variable to predict treatment is the binary variable loss carry-forward. The variable is one if the firm carries forward any losses, and zero otherwise. If firms are in a loss situation, the incentive to engage in tax planning is reduced (see MacKie-Mason, 1990). Therefore, we expect firms with losses to be less frequently treated by the reform of the thin-capitalization rule. Finally, we control for the tangible-to-total assets ratio of firms (tangibility). Higher tangibility may be associated with better access to external credits, because tangible assets can be used as collateral. Since a high level of external liabilities implies that the probability to be treated is low, we may expect a negative coefficient for tangibility.

6 Results

We use a binary choice model to obtain the propensity score. Corresponding first-step estimation results and also tests for the balancing property are reported in the Appendix (Tables 6 and 7). Concerning the inclusion of control variables in the binary model, we closely follow the existing literature on the capital structure choice of multinational

[12] Equation (3) motivates the inclusion of the tax-rate differential $(t_2 - t_1)$.

Table 2: Descriptive Statistics

Variable	Mean	Std. Error	Min.	Max.
Tax-Rate Differential ($t_2 - t_1$)	.050	.057	-.029	.392
ln(Sales)	10.33	1.42	c)	c)
Loss carry-forward	.333	.471	0	1
Tangibility	.363	2.16	c)	c)
Treatment (T)	.151	.358	0	1
Share of Internal Debt	.240	.228	c)	c)
Share of External Debt	.362	.277	c)	c)

Source: MiDi. 3,309 observations. c) confidential information. Treatment (T) defined as described in Section 4. Tax-rate differential defined as ($t_{\text{Germany}} - t_{\text{Foreign}}$). For further variable definitions, see the Appendix.

enterprises (see, e.g., Overesch and Wamser, 2008). Note that we implicitly control for macroeconomic factors in Germany, because all foreign investors are exposed to the same economic situation in the destination country. According to the results of the binary-choice models, a higher tax-rate differential is associated with a higher propensity to be treated, because the incentive for the German subsidiary to use internal debt finance is higher if the tax-rate difference is higher. Note that the variation in the foreign statutory tax rate is crucial to identifying an effect of the tax-rate differential. While the coefficient shows the expected sign, the effect is not statistically significant. The subsidiaries' sales relate positively to the propensity to be above the threshold level. The existence of a loss carry-forward reduces the incentives for tax-planning activities, and therefore reduces the probability of a treatment. We do not find a significant impact of the tangibility variable.

6.1 Results for External Debt

Table 3 presents the results for the change in the external-debt-to-capital ratio. Since different matching algorithms imply a trade-off between bias and efficiency, we report the results for the different procedures. As expected, standard errors are higher in the case of the nearest neighbor matching. However, the findings are robust and treatment is significantly related to the change in the share of external debt in all specifications. The findings confirm theoretical expectations: there is evidence for a positive average treatment effect on the treated. Estimates are in the range of .023 to .027, depending on the matching method. A coefficient of .027 implies that a treated subsidiary increases its external-debt-to-capital ratio by 2.7 percentage points.

Findings in Table 3 confirm that firms substitute external for internal debt if we consider the debt-to-capital ratios. The analysis presented in Table 4 investigates whether the positive treatment effect is still identified if we define the outcome variable as the level of external debt. To be specific, the outcome variable is calculated as the change in the natural logarithm of the liabilities to external creditors (ln(external liabilities$_{t+1}$) - ln(external liabilities$_t$)). The results show that treatment by the 2001 reform of the thin-capitalization rule is related to more external debt. Except for the nearest neighbor matching with bootstrapped standard errors, the coefficient is always significant. The ATT of .078 implies that an affected subsidiary expands its external liabilities by approx. 8%.

Table 3: Propensity Score Matching, Share of External Debt
Outcome Variable: Change in the Share of External Debt

Nearest Neighbor Matching		
Average Effect of Treatment (Std. Err.)	.027	(.010)***
(Bootstrapped Standard Errors)		(.011)**
Number of Treated Firms: 500		
Number of Control Firms: 438		
Radius Matching (radius=.1)		
Average Effect of Treatment (Std. Err.)	.023	(.006)***
(Bootstrapped Standard Errors)		(.006)***
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Radius Matching (radius=.001)		
Average Effect of Treatment (Std. Err.)	.023	(.006)***
(Bootstrapped Standard Errors)		(.007)***
Number of Treated Firms: 489		
Number of Control Firms: 2,648		
Stratification Matching		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	.026	(.006)***
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Kernel Matching (Epanechnikov kernel, bandwidth=0.06)		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	.024	(.005)***
Number of Treated Firms: 500		
Number of Control Firms: 2,809		

Coefficient (Std. Dev.). Propensity score based on probit estimation (see Appendix, Table 6). Calculations are based on the statistical software provided by Becker and Ichino (2002). Standard errors (in parentheses). (***) (**) (*) indicate significance at the (1%) (5%) (10%) level. Outcome variable: change in the share of external debt, defined as $\lambda_{t+1} - \lambda_t$, where λ is defined as external liabilities relative to total capital. The latter consists of nominal capital, capital reserves, profit reserves, and total debt.

Table 4: Propensity Score Matching, Level of External Debt
Outcome Variable: Change in the Level of External Debt

Nearest Neighbor Matching		
Average Effect of Treatment (Std. Err.)	.084	(.050)*
(Bootstrapped Standard Errors)		(.062)
Number of Treated Firms: 500		
Number of Control Firms: 438		
Radius Matching (radius=.1)		
Average Effect of Treatment (Std. Err.)	.074	(.033)**
(Bootstrapped Standard Errors)		(.031)**
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Radius Matching (radius=.001)		
Average Effect of Treatment (Std. Err.)	.078	(.035)**
(Bootstrapped Standard Errors)		(.036)**
Number of Treated Firms: 489		
Number of Control Firms: 2,648		
Stratification Matching		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	.078	(.037)**
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Kernel Matching (Epanechnikov kernel, bandwidth=0.06)		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	.076	(.029)***
Number of Treated Firms: 500		
Number of Control Firms: 2,809		

Coefficient (Std. Dev.). Propensity score based on probit estimation (see Appendix, Table 6). Calculations are based on the statistical software provided by Becker and Ichino (2002). Standard errors (in parentheses). (***) (**) (*) indicate significance at the (1%) (5%) (10%) level. Outcome variable: change in the level of external debt, defined as the change in the natural logarithm of the liabilities to external creditors, ln(external liabilities$_{t+1}$) - ln(external liabilities$_t$).

Table 5: Propensity Score Matching, Share of Internal Debt
Outcome Variable: Change in the Share of Internal Debt

Nearest Neighbor Matching		
Average Effect of Treatment (Std. Err.)	-.050	(.011)***
(Bootstrapped Standard Errors)		(.011)***
Number of Treated Firms: 500		
Number of Control Firms: 438		
Radius Matching (radius=.1)		
Average Effect of Treatment (Std. Err.)	-.043	(.008)***
(Bootstrapped Standard Errors)		(.009)***
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Radius Matching (radius=.001)		
Average Effect of Treatment (Std. Err.)	-.042	(.008)***
(Bootstrapped Standard Errors)		(.008)***
Number of Treated Firms: 489		
Number of Control Firms: 2,648		
Stratification Matching		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	-.045	(.008)***
Number of Treated Firms: 500		
Number of Control Firms: 2,725		
Kernel Matching (Epanechnikov kernel, bandwidth=0.06)		
Average Effect of Treatment (Std. Err.)		
(Bootstrapped Standard Errors)	-.043	(.007)***
Number of Treated Firms: 500		
Number of Control Firms: 2,809		

Coefficient (Std. Dev.). Propensity score based on probit estimation (see Appendix, Table 6). Calculations are based on the statistical software provided by Becker and Ichino (2002). Standard errors (in parentheses). (***) (**) (*) indicate significance at the (1%) (5%) (10%) level. Outcome variable: change in the share of internal debt, defined as $\mu_{t+1} - \mu_t$, where μ is defined as internal liabilities relative to total capital. The latter consists of nominal capital, capital reserves, profit reserves, and total debt.

6.2 Results for Internal Debt

In addition to the analysis concerning the share of external debt, we examine the effectiveness of the thin-capitalization reform with respect to internal debt. Table 5 contains results where the outcome variable is defined as the change in the share of internal debt.[13] If firms are affected by the thin-capitalization reform, we expect a negative treatment effect. In other words, treated affiliates reduce their internal-debt-to-capital ratios, because interest deduction is no longer possible. A coefficient of -.05 implies that treatment by the reform of the thin-capitalization rule is associated with a 5 percentage point lower internal-debt-to-capital ratio. If we consider both the treatment effect for the change in the share of internal debt and the change in the share of external debt, we find that the affected firm can substitute external debt for approx. 55% of the reduction in its internal-debt-to-capital ratio (using the averages of the estimated ATTs in Tables 3 and 5 for this evaluation).

7 Conclusion

The empirical literature on corporate taxation and multinational companies provides extensive evidence that multinationals are mobile in various aspects and can avoid taxes (see, e.g., Devereux and Maffini, 2007). Policymakers who value adequate tax revenue, therefore, feel inclined to restrict tax-planning opportunities. In recent decades, for instance, various forms of debt-equity restrictions have been imposed in several countries. Germany

[13]The analysis confirms empirical findings of earlier research (see Buettner et al., 2008; Overesch and Wamser, 2008; Weichenrieder and Windischbauer, 2008).

and many other countries apply so-called thin-capitalization rules which limit the amount of deductible interest payments to affiliated companies.

This paper has exploited a reform of the German thin-capitalization rule in order to examine how subsidiaries of multinational firms adjust their capital structure after being affected by a stricter rule. The findings suggest that firms, to some extent, are able to substitute external for internal debt. In particular, a treated subsidiary increases its external-debt-to-capital ratio by approx. 2.5 percentage points relative to the counterfactual outcome. In terms of the stock of external borrowing, treatment is associated with approx. 8% more external debt.

Governments presumably pursue a twofold aim when introducing thin-capita-lization rules: to defend the domestic corporate tax base and to reduce discrimination against purely domestic companies (because domestic firms are not able to shift profits).[14] Concerning the first goal, the results imply that thin-capitalization restrictions aimed at avoiding adverse consequences for corporate tax revenue are not necessarily rewarding. With respect to the second goal, thin-capitalization rules may be considered as being appropriate, because excessive thin capitalization no longer provides an opportunity to shift profits. Yet, though both domestic and multinational firms are unrestricted in the use of external debt, multinational firms may also have better access to external debt finance (and interest payments to external lenders are usually deductible).

In 2004, Germany responded to the Lankhorst-Hohorst judgment of the European Court of Justice by extending the scope of application of its thin-capitalization rule to loans

[14]By contrast, some countries may strategically remove thin-capitalization restrictions to attract FDI (see Haufler and Runkel, 2008).

from resident companies (see Körner, 2004). More recently, the 2008 corporate tax reform replaced the thin-capitalization rule by a so-called earnings-stripping rule.[15] In view of the findings of this investigation, this recent reform of the rule seems to be sensible. And yet, to evaluate the medium- and long-term impact on the economy, policymakers should consider the effect of the new earnings-stripping rule on firms' cost of capital and therefore on real investment: a general non-deductibility of interest expenses is comparable to an additional tax that would risk driving productive capital, rather than tax bases, out of high-tax countries.

The central insight of this analysis is that any policy that urges multinationals to report income locally rather than shifting it to low-tax countries requires careful consideration. As to future research, additional work is needed to understand the role of internal debt which is not related to profit shifting. This is probably a significant share and must not be affected by thin-capitalization rules. Moreover, to develop a deeper understanding of substitution possibilities in a dynamic context, future research should aim at testing how costly it is for companies to adjust their capital structure.

Appendix

The estimation of the average treatment effect relies on two assumptions. First, the balancing property has to hold. This assumption is testable. Results are displayed in Table 7. Second, unconfoundedness given the pre-treatment characteristics X and given the

[15] Under the new interest barrier (Zinsschranke), interest deductions are limited to 30% of earnings (EBITDA). The new interest barrier rule includes several exceptions and additional requirements (escape clause, single business exception, exemption limit; see, e.g., Müller-Duttiné and Scheunemann, 2007).

propensity score $p(X)$ has to be satisfied. The unconfoundedness assumption refers to the assignment to the treatment. Rosenbaum and Rubin (1983) formulate Lemma 1 and Lemma 2, where $p(X)$ is the propensity score, T the treatment and X is the vector of pre-treatment characteristics:

Lemma 1 (Balancing Property): $$T \perp X \mid p(X).$$

Lemma 2 (Unconfoundedness): $$Y_1, Y_0 \perp T \mid X.$$
$$Y_1, Y_0 \perp T \mid p(X).$$

Table 6: Probability of Treatment

	Probit	Logit
Tax-Rate Difference	.016 (.584)	.048 (1.02)
ln(Sales)	.040 (.020)**	.074 (.036)**
Loss carry-forward	-.163 (.059)***	-.302 (.110)***
Tangibility	-.029 (.044)	-.063 (.094)
Sector 2	-.521 (.417)	-.907 (.779)
Sector 3	-.082 (.228)	-.145 (.388)
Sector 4	-.376 (.156)**	-.677 (.265)**
Sector 5	-.502 (.217)**	-.927 (.393)**
Sector 6	-.598 (.267)**	-1.11 (.503)**
Sector 7	-.171 (.157)	-.308 (.267)
Sector 8	-.359 (.327)	-.647 (.598)
Sector 9	-.637 (.208)***	-1.17 (.386)***
Sector 10	-.572 (.192)***	-1.05 (.346)***
Sector 11	-.699 (.274)**	-1.28 (.531)**
Sector 12	-.789 (.516)	-1.45 (1.06)
Europe	-.553 (.262)**	-.962 (.426)**
America	-.679 (.275)**	-1.19 (.453)***
Asia	-.452 (.283)	-.766 (.466)*
Observations	3,309	3,309
Log-likelihood	-1,372.92	-1,372.71
Pseudo R-sq	.023	.023

Source: MiDi. Considered are only majority-owned affiliates. Robust standard errors (in parentheses). (***) (**) (*) indicate significance at the (1%) (5%) (10%) level. Sector dummies are defined according to Table 8. Dependent variable: Treatment (T). Regarding the regional dummies, 'Rest of the World' is the reference group.

Table 7: Balancing Property

Variable	Mean (Treated)	Mean (Control)	Bias in %	Bias reduction in %	t-value	p-value
Tax-Rate Diff.	.052	.050	2.9	9.1	.46	.645
ln(Sales)	10.519	10.597	-5.6	65.0	-.92	.359
Loss carry-f.	.28	.288	-1.7	87.1	-.28	.779
Tangibility	.292	.289	.1	97.0	.14	.888
Sector 2	.004	.012	-11.7	-497.0	-1.42	.156
Sector 3	.03	.032	-1.3	83.1	-.18	.855
Sector 4	.42	.402	3.6	47.5	.58	.563
Sector 5	.026	.018	4.6	19.6	.86	.389
Sector 6	.012	.016	-3.2	51.8	-.54	.591
Sector 7	.378	.374	.9	95.9	.13	.896
Sector 8	.008	.012	-4.3	-218.5	-.64	.525
Sector 9	.028	.034	-2.9	81.1	-.55	.585
Sector 10	.042	.052	-4.4	59.9	-.75	.456
Sector 11	.01	.008	1.6	82.9	.33	.738
Sector 12	.002	0	3.4	33.0	1.00	.318
Europe	.778	.776	.5	46.0	.08	.940
America	.13	.134	-1.1	88.7	-.19	.852
Asia	.076	.07	2.4	72.1	.36	.716

Source: MiDi. 3,309 observations, 500 treated observations, 2,809 untreated observations. The balancing property is tested by using the software *pstest* provided by Leuven and Sianesi (2003).

Table 8: Variable Definitions

Internal-debt ratio (μ)	*Definition:*	Liabilities to shareholders/affiliated enterprises linked with the party required to report through participating interests divided by total capital consisting of nominal capital, capital reserves, profit reserves, and total debt.
	Source:	MiDi
External-debt ratio (λ)	*Definition:*	Borrowing from external creditors divided by total capital consisting of nominal capital, capital reserves, profit reserves, and total debt.
	Source:	MiDi
Sales	*Definition:*	Affiliate-specific sales.
	Source:	MiDi
Loss carry-forward	*Definition:*	Binary variable. If a firm carries forward any losses, the dummy variable is 1.
	Source:	MiDi
Tangibility	*Definition:*	Ratio of fixed assets to balance-sheet total.
	Source:	MiDi
Tax-Rate Differential	*Definition:*	Difference in statutory tax rates between Germany and investors' home countries ($t_{\text{Germany}} - t_{\text{Foreign}}$).
	Source:	Statutory tax rates are taken from the International Bureau of Fiscal Documentation (IBFD) and from tax surveys provided by Ernst&Young, PricewaterhouseCoopers (PwC), and KPMG. Tax rates take into account restrictions on interest deductibility.
Sector Definition		Sectors are defined according to the following classification: Agriculture (Sector 1); Mining (Sector 2); Metal Working Industry (Sector 3); Manufacturing (Sector 4); Electricity and Water Supply, Sewage Disposal, Telecommunication, Transport and Post (Sector 5); Construction (Sector 6); Retail and Wholesale Trade (Sector 7); Hotels and Restaurants (Sector 8); Other Services (Sector 9); Financial Intermediation and Financial Services (Sector 10); Computer, Research and Development (Sector 11); Government, Social Security, Social Care, Private Households, and Nonprofit Organizations (Sector 12).

References

Auerbach, A.J. (2002). Taxation and corporate financial policy. In: A. Auerbach and M. Feldstein (eds.), Handbook of Public Economics, Vol. 3. Amsterdam, 1251-1292.

Becker, S.O. and A. Ichino (2002). Estimation of average treatment effects based on propensity scores, *The Stata Journal* 2, 358-377.

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

Buettner, T. and G. Wamser (2007). Intercompany loans and profit shifting – evidence from company-level data, CESifo Working Paper No. 1959, Munich.

Buettner, T., M. Overesch, U. Schreiber, and G. Wamser (2008). The impact of thin-capitalization rules on multinationals' financing and investment decisions, Bundesbank Discussion Paper, 03/2008, Frankfurt.

Dehejia, R.H. and S. Wahba (2002). Propensity score-matching methods for nonexperimental causal studies, *The Review of Economics and Statistics* 84, 151-161.

Desai, M.A., C.F. Foley, and J.R. Hines (2004a). A multinational perspective on capital structure choice and internal capital markets, *The Journal of Finance* 59, 2451-2487.

Desai, M.A., C.F. Foley, and J.R. Hines (2004b). The costs of shared ownership: evidence from international joint ventures, *Journal of Financial Economics* 73, 323-374.

Devereux, M.P. and G. Maffini (2007). 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 Series, WP 07/02.

Dourado, A.P. and R. de la Feria (2008). Thin capitalization rules in the context of the CCCTB, Oxford University Centre for Business Taxation Working Paper Series, WP 08/04.

Fama, E.F. (1978). The effects of a firm's financing and investment decisions on the welfare of its security holders, *American Economic Review* 68, 272-284.

Gopalan, R., V. Nanda, and A. Seru (2007). Affiliated firms and financial support: evidence from Indian business groups, *Journal of Financial Economics* 86, 759-795.

Graham, J.R. (2000). How big are the tax benefits of debt? *The Journal of Finance* 55, 1901-1941.

Graham, J.R. (2003). Taxes and corporate finance: a review, *The Review of Financial Studies* 16, 1075-1129.

Graham, J.R. and C.R. Harvey (2001). The theory and practice of corporate finance: evidence from the field, *Journal of Financial Economics* 60, 187-243.

Haufler, A. and M. Runkel (2008). Multinationals' capital structures, thin capitalization rules, and corporate tax competition. Paper presented at the 2008 meeting of the European Tax Policy Forum, London.

Heckman, J.J. (2005). The scientific model of causality, *Sociological Methodology* 35, 1-97.

Heckman, J.J. (2008). Econometric causality, *International Statistical Review* 76, 1-27.

Jensen, M. and W. Meckling (1976). Theory of the firm: managerial behavior, agency costs, and ownership structure, *Journal of Financial Economics* 7, 305-360.

Kemsley, D. and D. Nissim (2002). Valuation of the debt tax shield, *The Journal of Finance* 57, 2045-2073.

Körner, A. (2004). The new German thin capitalization rules: tax planning; incompatibility with European law, *Intertax* 32(8/9), 401-415.

Kraus, A. and R.H. Litzenberger (1973). A state-preference model of optimal financial leverage, *Journal of Finance* 28, 911-922.

Leuven, E. and B. Sianesi (2003). PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing, version 3.0.0., http://ideas.repec.org/c/boc/bocode/s432001.html.

Lipponer, A. (2007). Microdatabase Direct Investment – MiDi. A brief guide, Bundesbank Discussion Paper, Frankfurt.

MacKie-Mason, J. (1990). Do taxes affect corporate financing decisions? *The Journal of Finance* 45, 1471-1493.

Mintz, J. and A.J. Weichenrieder (2005). Taxation and the financial structure of German outbound FDI, CESifo Working Paper No. 1612, Munich.

Modigliani, F. and M. Miller (1958). The cost of capital, corporation finance, and the theory of investment, *American Economic Review* 48, 261-297.

Modigliani, F. and M. Miller (1963). Corporate income taxes and the cost of capital: a correction, *American Economic Review* 53, 443-453.

Morgan, S.L. and D.J. Harding (2006). Matching estimators of causal effects: prospects and pitfalls in theory and practice, *Sociological Methods & Research* 35, 3-60.

Müller-Duttiné, T. and M.P. Scheunemann (2007). New German tax rules on financing expenses, *Intertax* 35, 518-525.

Myers S.C. (1977). Determinants of corporate borrowing, *Journal of Financial Economics* 3, 799-819.

Myers, S.C. (2001). Capital structure, *Journal of Economic Perspectives* 15, 81-102.

Overesch, M. and G. Wamser (2008). Corporate tax planning and thin-capitalization rules: evidence from a quasi-experiment, forthcoming in *Applied Economics*.

Ramb, F. and A.J. Weichenrieder (2005). Taxes and the financial structure of German inward FDI, *Review of World Economics* 141, 670-692.

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.

Rosenbaum, P.R. and D.B. Rubin (1984). Reducing bias in observational studies using subclassification on the propensity score, *Journal of the American Statistical Association* 79, 516-524.

Ruf, M. (2008). Using mergers and acquisitions for implementing tax induced debt finance, Working Paper, University of Mannheim.

Scott, J.H. (1976). A theory of optimal capital structure, *Bell Journal of Economics* 7, 33-54.

Weichenrieder, A.J. and J. Mintz (2008). What determines the use of holding companies and ownership chains? Oxford University Centre for Business Taxation Working Paper Series, WP 08/03.

Weichenrieder, A.J. and H. Windischbauer (2008). Thin-capitalization rules and company responses – experience from German legislation, *mimeo*, Johann Wolfgang Goethe University, Frankfurt.

Ifo Working Papers

No. 61 Carstensen, K., J. Hagen, O. Hossfeld and A.S. Neaves, Money Demand Stability and Inflation Prediction in the Four Largest EMU Countries, August 2008.

No. 60 Lahiri, K. and X. Sheng, Measuring Forecast Uncertainty by Disagreement: The Missing Link, August 2008.

No. 59 Overesch, M. and G. Wamser, Who Cares about Corporate Taxation? Asymmetric Tax Effects on Outbound FDI, April 2008.

No. 58 Eicher, T.S: and T. Strobel, Germany's Continued Productivity Slump: An Industry Analysis, March 2008.

No. 57 Robinzonov, N. and K. Wohlrabe, Freedom of Choice in Macroeconomic Forecasting: An Illustration with German Industrial Production and Linear Models, March 2008.

No. 56 Grundig, B., Why is the share of women willing to work in East Germany larger than in West Germany? A logit model of extensive labour supply decision, February 2008.

No. 55 Henzel, S., Learning Trend Inflation – Can Signal Extraction Explain Survey Forecasts?, February 2008.

No. 54 Sinn, H.-W., Das grüne Paradoxon: Warum man das Angebot bei der Klimapolitik nicht vergessen darf, Januar 2008.

No. 53 Schwerdt, G. and J. Turunen, Changes in Human Capital: Implications for Productivity Growth in the Euro Area, December 2007.

No. 52 Berlemann, M. und G. Vogt, Kurzfristige Wachstumseffekte von Naturkatastrophen – Eine empirische Analyse der Flutkatastrophe vom August 2002 in Sachsen, November 2007.

No. 51 Huck, S. and G.K. Lünser, Group Reputations – An Experimental Foray, November 2007.

No. 50 Meier, V. and G. Schütz, The Economics of Tracking and Non-Tracking, October 2007.

No. 49 Buettner, T. and A. Ebertz, Quality of Life in the Regions – Results for German Counties, September 2007.

No. 48 Mayr, J. and D. Ulbricht, VAR Model Averaging for Multi-Step Forecasting, August 2007.

No. 47 Becker, S.O. and K. Wohlrabe, Micro Data at the Ifo Institute for Economic Research – The "Ifo Business Survey", Usage and Access, August 2007.

No. 46 Hülsewig, O., J. Mayr and S. Sorbe, Assessing the Forecast Properties of the CESifo World Economic Climate Indicator: Evidence for the Euro Area, May 2007.

No. 45 Buettner, T., Reform der Gemeindefinanzen, April 2007.

No. 44 Abberger, K., S.O. Becker, B. Hofmann und K. Wohlrabe, Mikrodaten im ifo Institut – Bestand, Verwendung und Zugang, März 2007.

No. 43 Jäckle, R., Health and Wages. Panel data estimates considering selection and endogeneity, March 2007.

No. 42 Mayr, J. and D. Ulbricht, Log versus Level in VAR Forecasting: 16 Million Empirical Answers – Expect the Unexpected, February 2007.

No. 41 Oberndorfer, U., D. Ulbricht and J. Ketterer, Lost in Transmission? Stock Market Impacts of the 2006 European Gas Crisis, February 2007.

No. 40 Abberger, K., Forecasting Quarter-on-Quarter Changes of German GDP with Monthly Business Tendency Survey Results, January 2007.

No. 39 Batchelor, R., Forecaster Behaviour and Bias in Macroeconomic Forecasts, January 2007.

No. 38 Sülzle, K., Innovation and Adoption of Electronic Business Technologies, December 2006.

No. 37 Overesch, M. and G. Wamser, German Inbound Investment, Corporate Tax Planning, and Thin-Capitalization Rules – A Difference-in-Differences Approach, December 2006.

No. 36 Kempkes, G. and C. Pohl, The Efficiency of German Universities – Some Evidence from Non-Parametric and Parametric Methods, October 2006.