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The effect of taxes on corporate financing decisions – evidence from the German interest barrier

Abstract: The literature suggests that when taking tax effects into account, debt ought to be preferable to equity. Thus, with all else being equal, levered firms are expected to show higher firm values. However, there are no uniform predictions of the size of this tax benefit from interest deductibility nor on the effect of changes in interest deductibility. We believe that the German corporate tax reform in 2008, which introduced an interest barrier, can serve as a promising "quasi-experiment" to investigate the effects from a reform of interest deductibility. A study of this reform on the basis of German financial statement data is of general interest because, first, similar interest barriers have been introduced in several countries and proposed by the OECD to fight BEPS. Second, the major characteristics of the German tax system can be regarded as representative for most European and major Asian countries. Third, single entity financial statements for German companies allows us to capture tax and capital structure details that have not been available in most prior studies. With significance at the 5% level, we find evidence that the companies that are affected by the interest barrier reduce their leverage by 4.7 percentage points more than companies that are not affected by the interest barrier. We are the first to employ a detailed matching approach to the underlying rich dataset, which enables us to overcome several limitations of previous studies. Our results imply that capital structure reactions most likely have been underestimated in previous studies.

JEL Classification: F34, H21, H24

Keywords: Financing decisions, German tax reform, interest barrier, leverage, taxation, thin capitalization rules

1 Introduction

The cost of debt is at least partially tax-deductible in most countries, which favors debt over equity capital. This privilege, often referred to as the tax shield of debt, gives higher benefits to levered firms in comparison to corresponding unlevered or less levered firms and thus severely impacts the value of companies.[1] This bias for debt against equity in most countries' tax codes has led to intensive tax reform discussions, e.g., recently in the Brookings Institution:

> "... the effective tax rate on corporate debt is negative 6.4%, as compared to positive 35% for corporate equity, according to the Congressional Budget Office. This tax bias for debt has major negative implications for the US economy. ... Congress could limit the interest deductions of companies ..."
> (*Pozen*, 2015; for prior discussions, e.g., *U.S. Ways and Means Committee*, 2011, *Pozen*, 2013, *U.S. Senate Committee on Finance*, 2013)

Although several countries have already reformed their tax codes accordingly by restricting interest deductibility, e.g., Belgium, Germany and Italy, to avoid undesired profit shifting or excessive debt financing, it is unclear whether reforms that aim to reduce the tax privilege of debt really effectively change financing behavior. Tax politicians expect that reducing interest deductibility will make firms react such that tax shield-driven distortions across firms can be mitigated. However, empirical studies only provide puzzling results on the impact of taxes and thin capitalization rules on corporate financing decisions. We believe that the German corporate tax reform in 2008, which introduced an interest barrier, provides a promising "quasi-experiment" to investigate the effects that arise from a reduction in interest deductibility. This setting, which can be regarded as representative for many countries, enables us to disentangle the effects of interest deductibility restrictions on corporate capital structure in a unique way. Since this reform, the deductibility of debt expenses has been limited if a certain exempted amount is exceeded and a set of other conditions is met. Against this background, it is interesting to determine whether the emerging corporate capital structure reactions are in line with the rather moderate tax rate and thin capitalization sensitivity of corporate leverage that were previously found.

In contrast to many prior empirical studies, we find robust evidence for the negative impact of such thin capitalization rules on corporations' debt ratio and thus evidence of its general effectiveness. With significance at the 5% level, we find evidence that the companies that are affected by the interest barrier reduce their leverage by 4.7 percentage points more than those that are not affected. Firms with no liquidity constraint even respond with a reduction of 6.0 percentage points. This result indicates that the impact of thin capitalization rules on corporate debt financing has been underestimated so far. Our results also indicate that

[1] See *Kemsley and Nissim* (2002).

the economic size of this reform is rather limited due to the low number of affected firms. However, we show that those firms that are subject to the interest barrier respond more sensitively than what has been suggested in prior studies. Hence, if other countries that currently discuss related rules decide to introduce an interest barrier that is applicable to a broader group of firms, our results can be regarded as a lower bound of the considerable expected capital structure reactions.

We use the DAFNE database by Bureau van Dijk, which contains data from single entity financial statements of German companies. We concentrate our investigation on incorporated firms, i.e., the legal forms "GmbH" and "AG" because their disclosure requirements are higher than for partnerships and use information drawn from the profit and loss accounts from 2004 to 2010. We apply a "difference in difference" approach (DiD) and conduct detailed propensity score matching to form an appropriate control group based on several company-specific metrics to the underlying rich dataset. Therefore, we are able to overcome some of the limitations of previous studies.

In the literature, in a series of model-theoretic analyses, *Modigliani and Miller* (1963) and *Miller* (1977) have already demonstrated that taxes have an impact on a company's debt ratio. The theoretical literature suggests that when tax effects are taken into account, debt ought to be preferable to equity.

The trade-off theory offers a theoretical explanation for capital structure decisions and an optimum debt ratio for individual companies. This theory indicates that the tax benefit of the deductibility of debt costs at the company level is offset by costs, e.g., insolvency costs, that increase with an increasing level of debt (*Fama and French*, 2002). Although there are no uniform predictions of the size of this tax benefit (tax shield from interest deductibility) in comparison with an opposing increasing cost of debt (especially insolvency costs), from a theoretical perspective, there is little doubt that restricting interest deductibility will make debt financing less favorable. However, *Maßbaum and Sureth* (2009), who take the Belgian, Italian and German rules as an example, show why corporations receive both debt and equity capital. They analytically find that the financing effects of thin capitalization rules are non-uniform and depend significantly on the underlying tax system.

Surprisingly, in a series of empirical studies, the impact of taxes on the capital structure could not be clearly demonstrated. For instance, *Frank and Goyal* (2009) find, based on the studies of *Titman and Wessels* (1988) and *Harris and Raviv* (1991), that there are six core factors that influence capital structure, none of which are taxes. However, they note that due to the trade-off theory, it is likely that an increasing tax rate and thus tax shield will lead to an increased debt ratio.

Further empirical studies examine two relationships: the relationship between the marginal tax rate (MTR) and the financing structure of companies and the one between interest deductibility and financing structure.

First, *MacKie-Mason* (1990), *Givoly et al.* (1992), *Graham* (1996), *Sarkar and Zapatero* (2003) and *Stöckl and Winner* (2013) focus on tax rate effects and find that a higher MTR is associated with a higher debt ratio. In addition, *Graham* (2008) finds that although many studies demonstrate that taxes influence financing decisions, this effect is not always strong. *Buettner et al.* (2009) indicate that a higher local tax rate is also associated with an increase in internal debt. *Barclay and Smith* (1995), *Ayers et al.* (2001) and *Huang and Ritter* (2009) find evidence for a negative relationship between the MTR and the debt ratio. *Antoniou et al.* (2008) cannot identify a clear significant relation between the debt ratio and the effective tax rate (ETR) in several countries. Faced with a large number of studies with mixed results on the relationship between tax rates and the debt ratio, *Feld et al.* (2013) analyze 46 previous empirical studies in a meta-analysis. They conclude that the debt-to-asset ratio rises by 2.7 percentage points if the simulated marginal tax rate increases by 10 percentage points.

Second, *Shih* (1996) employs IRS data compiled from corporate tax returns and finds evidence that limited interest deductibility due to tax exhaustion affects leverage decisions. *Buettner et al.* (2012) empirically analyze the effects of thin capitalization rules on the capital structure of multinational firms' foreign subsidiaries located in OECD countries between 1996 and 2004. Their results indicate that thin capitalization rules effectively reduce the incentive to use internal loans for tax planning but lead to higher external debt. Similarly, *Blouin et al.* (2014) empirically investigate the impact of thin capitalization rules on the capital structure of U.S. multinationals foreign affiliates in 54 countries. They show that these restrictions reduce an affiliate's debt to assets ratio by 1.9 percentage points on average.

A variety of studies have examined the impact of taxes on the financing decisions of firms using tax reforms as a "quasi-experiment". Changes in the tax system, e.g., a change in the tax rate, are used as an exogenous shock to examine whether companies have responded as predicted by theory. Empirical studies in a national and international context include the works of *Givoly et al.* (1992), *Alworth and Arachi* (2001), *Cheng and Green* (2008), *Weichenrieder and Windischbauer* (2008), *Overesch and Wamser* (2010), *Lanzavecchia and Tagliavini* (2011), *Tzioumis and Klapper* (2012) and *Faccio and Xu* (2015). They find a significant but usually weak correlation between taxes and the debt ratio. In addition, *Schjelderup* (2015) concludes in his recent review that there is only low tax sensitivity of debts in multinational firms.

Several explanations are provided for the mixed results in many empirical studies, including differences in empirical specifications, the underlying data or the fact that the sample is restricted to a specific industry, legal form, or corporation size. Furthermore, investigations

by *Fama and French* (2012) indicate that financing decisions are often long-term decisions, and companies adapt their structure only very slowly.

Prior studies by *Dreßler and Scheuering* (2012) and *Buslei and Simmler* (2012) also aimed to investigate the extent to which the introduction of the interest barrier affects the financing decisions of German firms. These studies, however, differ significantly from our study in the way that they determine the treatment and control groups. When replicating, we find the results and its level of significance to be very sensitive to their sample selection and identification strategy. Although *Buslei and Simmler* (2012) find that, on average, the leverage of the control group is higher than that of the treatment group, we expect an opposing relation. We expect that companies are affected by the interest barrier if they have sufficiently high net interest expenses that exceed the exempted amount. Thus, rather large companies and companies with high leverage are likely to be affected. A battery of robustness checks supports the significance of our results.[2]

Considering the partially conflicting results in the prior literature, including the two studies on the German interest barrier, it is worthwhile to shed light on these issues using an enhanced sample selection and identification strategy. We consider this study of a German tax reform on the basis of German data to be of general interest because, first, many countries introduced similar interest barriers to combat the massive use of debt as a financing and profit shifting channel.[3] Most countries apply thin capitalization rules that limit the deductibility of interest expenses if the amount of debt exceeds a specific leverage ratio. Moreover, in several countries the interest expenses are only deductible up to a certain fraction of the earnings before interest, taxes, depreciation and amortization (EBITDA). The number of countries with such thin capitalization rules has increased rapidly during recent years.[4] Second, the major characteristics of the German tax system can be regarded as representative of most European and major Asian countries. Also, the interest barrier regulations recently proposed by the *OECD* (2015) and the *European Commission* (2016) to fight base erosion and profit shifting of multinational groups (BEPS) largely correspond to the German interest barrier. Third, the availability of single entity financial statements for German companies allows us to capture tax and capital structure details that have not been available in most prior studies. Fourth, in contrast to many other countries' thin capitalization rules, the German interest barrier does not distinguish between interest expenses of different origin but rather covers all types of in-

2 In contrast to *Buslei and Simmler* (2012), for example, we believe that it is necessary to also control for time constant differences between the treatment and control groups. Further information is available upon request.

3 A systematization of different thin capitalization rules and an overview of the different thin capitalization rules currently in force in selected countries are provided in Figures 7 and 8 and Table 12 in Appendices C, D, and E.

4 The number increased particularly for the types 9 and 13 described in Appendix D. See, e.g., Greece, Portugal and Poland from 2015.

terest expenses. Therefore, the introduction of the interest barrier can serve as an event that allows us to draw general conclusions on the effect of restrictions in interest deductibility on the corporate debt ratio. We are convinced that our study is able to provide robust, unique, and unambiguous evidence for the capital structure effects from the restrictions of interest deductibility.

The following study is divided into eight sections. Following the introduction, we explain the German interest barrier in Section 2 and present our hypotheses in Section 3. In Section 4, we present the underlying model. Subsequently, we describe the sample in Section 5 and analyze it descriptively. In Section 6, we present and interpret the results of our regression analysis and present robustness checks in Section 7. We summarize and present the study's conclusions in Section 8.

2 The German Interest Barrier

The main motivation behind the German Federal Government's 2008 tax reform was to increase the attractiveness of Germany as a business location and secure German tax revenue for the long term. The government had recognized that revenues generated in Germany were being shifted to lower-tax countries, for example through cross-border lending (*Broer*, 2009). To prevent this, or at least make it more difficult, it introduced the interest barrier in its 2008 corporate tax reform.

The interest barrier is regulated by German income tax law in § 4h EStG (Einkommensteuergesetz) in connection with § 8a KStG of the German corporate tax law (Körperschaftsteuergesetz). The tax-deductible interest expense of companies is limited to the amount of interest income and additionally up to 30% of EBITDA.[5] Unused EBITDA will be carried forward to the following five fiscal years. If interest expenses cannot be offset against EBITDA and an EBITDA carryforward, they can be carried forward infinitely. Nevertheless, there are some exceptions to the interest barrier.

The first exception is the so-called "allowance". If the interest expense exceeds interest income by no more than € 1 million, the interest barrier does not apply.[6] Second, the "stand-alone clause" implies that the interest barrier does not apply to independent companies that are not members or are only partially members of a corporate group. Third, the "escape clause" offers shelter against the interest barrier. If a company is part of a corporate group and its equity ratio at the end of the previous reporting period is lower by no more than 1%

5 EBITDA equals relevant profits plus interest expense less interest income, depreciation and amortization.

6 The initial version of the interest barrier recognized a threshold of € 1 million. See UntStReformG 2008 dated August 14, 2007 (BGBl I 07, 1912). Since the Citizens' Relief Act of 2009 and the Growth Acceleration Act in 2009 the exemption limit was raised to € 3 million.

than that of its parent company, the interest barrier does not apply.[7] Fourth, companies classified in § 15 No. 3 KStG as a part of a "tax group" (Organschaft) are taxed as one company, so that the interest barrier rules for debt financing are not administered at the single entity level. For all companies within a tax group, the interest barrier is only applied on the level of the parent company (*Blaufus and Lorenz*, 2009).[8]
Furthermore, the German legislator reduced the corporate tax rate from 25% to 15% and introduced a flat rate withholding tax of 25%.[9] The latter can be interpreted as a decrease in taxes on interest income. In our analysis and robustness checks we control for the effects that may arise from these changes.

3 Hypotheses

Using an enhanced sample selection and identification strategy, we investigate empirically whether the introduction of an interest barrier has a significant impact on companies' financing decisions. The theory suggests that debt is favored over equity, yet it is unclear to what extent this tax advantage over the rising cost of debt comes into play (*Parrino and Weisbach*, 1999). We expect that a reduction in interest deductibility decreases the tax shield and further the optimal leverage.
In the following, we examine whether firms responded in their financing decisions (debt or equity) due to the change in the tax system by the corporate tax reform of 2008, specifically by the introduction of the interest barrier. We identify companies that would in theory have been affected by the interest barrier before the reform. Subsequently, we compare these companies' actual response to the interest barrier to a group of companies that are not affected. For this purpose, we investigate the following hypothesis:

Hypothesis H1:
Companies that met the subject-to-interest barrier criteria before the 2008 corporate tax reform reduced their debt ratio after the implementation of the reform to a greater extent than the companies that did not meet these criteria prior to the reform.

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7 The Growth Acceleration Act of 2009 increased the tolerated threshold from the original 1% to 2% for fiscal years ending after December 31, 2009.

8 If all entities in a tax group are part of an affiliated group, the interest barrier is not applied due to the "stand-alone" clause.

9 A solidarity surcharge (Solidaritätszuschlag) of 5.5%, has to be added to both the corporate and withholding taxes. Moreover, the tax base of the local business tax was broadened in the course of the 2008 tax reform. This tax base broadening impacts the tax burden of all companies in the same way. As those companies that are subject to the interest barrier and those that are not affected will experience a corresponding change in their tax burden from this base broadening, in the following, it is not necessary to account for this part of the tax reform.

Furthermore, to separate the effect of liquidity constraints from the effect of the interest deductibility restriction on the debt ratio of those companies that are subject to the interest barrier, we investigate the following hypothesis:

HYPOTHESIS H2:
Companies that met the subject-to-interest barrier criteria before the 2008 corporate tax reform reduced their debt ratio after the implementation of the reform to a greater extent if they did not face liquidity constraints.

4 IDENTIFICATION STRATEGY

4.1 EMPIRICAL APPROACH

The research question is investigated by means of a "difference in difference" (DiD) approach.[10] Under this approach, the sample is divided into a treatment group and a control group. The examined groups of companies differ only in whether they are subject to the interest barrier. All companies that are affected by the interest barrier thus belong to the treatment group ($TREAT = 1$). The remaining companies are allocated to the control group ($TREAT = 0$).
Furthermore, using a dummy variable $TIME$, the sample is divided into records before and after the 2008 reform. Here, the variable $TIME$ takes the value zero for data before the reform and one for data after the reform.
The debt ratio (LEV) of the companies in the sample is defined as the ratio between debt and total assets, and the equity ratio (EQR) is defined correspondingly as the ratio of equity to total assets. LEV and EQR do not need to sum up to one, e.g., because of provisions. We aim to investigate the change in LEV over time, which is defined as follows:

$$\Delta LEV = LEV_t - LEV_{t-1}. \tag{1}$$

The following model is applied under the DiD approach with the dependent variables ΔLEV.

$$\Delta LEV = \beta_0 + \beta_1 \cdot TIME + \beta_2 \cdot TREAT + \beta_3 \cdot (TREAT \cdot TIME) + \beta_4 \cdot controls + \epsilon. \tag{2}$$

To be able to identify the predicted post-reform reaction, a parallel trend of the depending variable of the two groups of companies prior the reform is necessary. Unfortunately, it is not possible to validate this requirement in the underlying "quasi-experiment" for a longer period of time because the relevant observations are only available in the required quality

[10] This type of model is also known as "interaction among dummy variables". See *Wooldridge* (2014), p. 195-202, and *Roberts and Whited* (2013), p. 520-531.

from 2004 onwards. To compensate for this weakness in the data, we use the DiD approach with a time dummy, enabling us to control for this shortcoming. Furthermore, we implement the propensity score matching to ensure that the treatment and control groups are similar and thus should not differ regarding the development of ΔLEV prior to the reform. This approach mitigates possible endogeneity concerns. Although, there is in general no way to statistically ensure that an endogeneity problem has been solved, our DID approach allows us to safeguard our study best against this potential problem.[11] This is true, as we employ a propensity score matching and show for a subsample that the required common trend assumption is basically fulfilled. We conduct internal validity tests, including a falsification test and robustness checks for different definitions of the control group.

In Appendix A, we depict the expected reactions of the treatment and control groups. For the period prior to the 2008 corporate tax reform we expect no different responses from the two groups. The two groups may differ with respect to the absolute LEV (difference between the LEV of the treatment and the control groups; however, due to our matching approach, the companies do not differ regarding other factors. We expect that the treatment group has a higher average absolute LEV than the control group. Companies in the treatment group must have correspondingly high interest expenses to ensure that the interest barrier applies in the first place, whereas companies in the control group will not have such high interest expenses. The exogenous shock, that is, the introduction of the interest barrier, affects only the treatment group. Using the DiD, we examine whether the two groups differ in their response to the 2008 corporate tax reform in their LEV. Furthermore, theory indicates a more pronounced reaction in firms without liquidity problems (bankruptcy costs). We expect that companies in the treatment group reduce their LEV more strongly than those in the control group.

The initial model is extended to include control variables that may also have an impact on ΔLEV and thus on financing decisions. In the following, we provide a detailed explanation of the choice of control variables.[12] The control variables are presented in Table 1 along with the expected reaction of the coefficients.

variable	expected impact on *DeltaLEV*
SALES	+
COLLATERAL	+/−
CURRENTRATIO	+
ROA	−
ZSCORE	−
NTR	+

Table 1: Control variables with the expected reaction

11 See *Roberts and Whited* (2013).

12 See, e.g., *MacKie-Mason* (1990), *Rajan and Zingales* (1995), *Graham* (1999) and *Alworth and Arachi* (2001).

The variable $SALES$ is taken as a proxy for company size and is defined as the logarithm of annual sales.[13] Prior empirical studies suggest that larger firms have better access to debt capital markets. For this reason, they are likely to have higher leverage than smaller companies. This is because larger firms are more diversified, many have uniform cash flows, and the probability that they are in financial difficulty is lower (*Rajan and Zingales*, 1995; *Graham*, 1999; *Bancel and Mittoo*; 2004; *Tzioumis and Klapper*, 2012). Furthermore, information asymmetry between lenders and borrowers is lower because information in large companies is more accessible, so the risk of default can be better assessed. The variable $SALES$ is defined as:

$$SALES = ln \text{ sales}. \tag{3}$$

Lending banks generally require collateral. Collateral may include intangible assets, buildings or land. It is to be expected that a higher intensity of investment has a positive influence on the amount of leverage and collateral (*Rajan and Zingales*, 1995; *Tzioumis and Klapper*, 2012). Conversely, the investment intensity can also be observed as an indicator of the level of depreciation allowances or tax-deductible investment incentives that could negatively impact taxable future profits. If future taxable income is lower, less debt interest can be offset for tax purposes. This would limit the advantages of using debt. According to this argument it is expected that a higher intensity of investment is connected with a lower debt ratio. Which of the two effects prevails cannot be predicted theoretically. The variable $COLLATERAL$ is defined as:

$$COLLATERAL = \frac{\text{fixed assets}}{\text{total assets}}. \tag{4}$$

Illiquid companies often have to go into greater debt to meet their financial obligations. Furthermore, the debt costs for illiquid companies are generally higher than for liquid companies as the insolvency risk is greater (*Graham*, 2000).[14] Liquidity is represented by the $CURRENTRATIO$ and is defined as:

$$CURRENTRATIO = \frac{\text{current assets}}{\text{current liabilities}}. \tag{5}$$

We expect the variable $CURRENTRATIO$ to have a positive influence on ΔLEV. Profitable companies can reinvest their profits and thus are likely not to need further debt (*Myers*, 1993; *Graham*, 2000). The variable ROA serves as a proxy for profitability and represents the

13 As in previous studies, in the present study $SALES$ data are also strongly left-skewed. Taking the logarithm of sales produces an almost normally distributed variable.

14 *Myers and Rajan* (1998) show that under certain conditions precisely the opposite effect can occur. In these cases it is more difficult for companies to generate cash and debt. These special cases are not considered in detail.

influence of the return on total assets on the financial structure of companies. The variable ROA is defined as:

$$ROA = \frac{\text{earnings before interest and taxes (EBIT)}}{\text{total assets}}. \tag{6}$$

We expect the variable ROA to have a negative influence on ΔLEV. With an increasing probability of insolvency the cost of debt also increases (*Graham*, 1999; *MacKie-Mason*, 1990). To measure the insolvency risk, we use the revised $ZSCORE$ model of *Altman* (1968) because a market value for non-listed companies is not available.[15] The $ZSCORE$ approach is used widely in theory and practice and is defined as follows:

$$\begin{aligned} ZSCORE = \quad & 0.717 \cdot \frac{\text{current assets}}{\text{total assets}} + 0.847 \cdot \frac{\text{retained earnings}}{\text{total assets}} \\ & + 3.107 \cdot \frac{\text{EBIT}}{\text{total assets}} + 0.420 \cdot \frac{\text{equity}}{\text{book value of liabilities}} \\ & + 0.998 \cdot \frac{\text{sales}}{\text{total assets}}. \end{aligned} \tag{7}$$

For companies with a small $ZSCORE$, the insolvency risk is higher, and the lower boundary for a strong probability for bankruptcy is 1.23 (*Altman*, 2013). We expect the variable $ZSCORE$ to have a negative impact on ΔLEV.

Under the 2008 corporate tax reform, the corporate tax rate of 25% was reduced to 15% in addition to the introduction of the interest barrier. To ensure that this does not distort the investigation, we also control for the nominal tax rate for corporations. The variable NTR is defined as:

$$NTR = LBT + CTR. \tag{8}$$

The nominal tax rate NTR consists of the effective local business tax rate (LBT, effektiver Gewerbesteuersatz) levied at the municipality level and the effective corporate tax rate (CTR), which includes the solidarity surcharge. The NTR has decreased over time, which also de-

[15] The initial $ZSCORE$ Model of *Altman* (1968) is based on listed U.S. companies. However, several studies show that that the prediction ability for German and Austrian companies is also acceptable. Furthermore *Agarwal and Taffler* (2007) find that the $ZSCORE$ has a clear predictive ability over a time period of 25 years and dominates more naive prediction approaches. See *Agarwal and Taffler* (2007), p. 298.

creased the tax shield of debt. Hence, we expect a positive impact.
To test hypothesis H1 the underlying model for ΔLEV is given by:

$$\begin{aligned}\Delta LEV = {} & \beta_0 + \beta_1 \cdot TIME + \beta_2 \cdot TREAT + \beta_3 \cdot TREAT \cdot TIME + \beta_4 \cdot SALES \\ & + \beta_5 \cdot COLLATERAL + \beta_6 \cdot ROA + \beta_7 \cdot CURRENTRATIO + \beta_8 \cdot ZSCORE \\ & + \beta_9 \cdot NTR + \epsilon.\end{aligned} \tag{9}$$

The investigation already includes the variable $CURRENTRATIO$ as a measure for liquidity. To investigate the influence of liquidity in more detail, we include the following dummy variable based on $CURRENTRATIO$:

$$LIQUIDITY = 1 \;\; if \; CURRENTRATIO \; < \; 1. \tag{10}$$

If $CURRENTRATIO$ is smaller than 1, the company cannot cover its current liabilities with current assets. For this reason, the dummy variable $LIQUIDITY$ can be interpreted as an indicator for liquidity constraints. Furthermore, to separate the effect of liquidity constraints on companies that are also affected by the interest barrier, we extend the basic model by a so-called three way interaction.
To test hypothesis H2 we use the following model:

$$\begin{aligned}\Delta LEV = {} & \beta_0 + \beta_1 \cdot TIME + \beta_2 \cdot TREAT + \beta_3 \cdot TREAT \cdot TIME \\ & + \beta_4 \cdot LIQUIDITY \cdot TIME + \beta_5 \cdot LIQUIDITY \cdot TREAT \\ & + \beta_6 \cdot LIQUIDITY \cdot TREAT \cdot TIME + \beta_7 \cdot controls + \epsilon.\end{aligned} \tag{11}$$

We expect a positive influence of the interaction term $LIQUIDITY \cdot TREAT \cdot TIME$ on ΔLEV because companies that are simultaneously affected by both liquidity constraints and the interest barrier are not able to reduce their debt ratio in response to the interest barrier due to their tight liquidity situation.

4.2 Treatment group

First, we identify the companies that would potentially be affected by the interest barrier had it already existed in 2006.
This study uses financial statement data, so we can only approximate the required data for the tax balance sheet (*Blaufus and Lorenz*, 2009). The dummy variable $TREAT$ is set equal to 1 for companies that meet the following conditions:

1. Net interest expense is greater than € 1 million.[16]

$$\text{net interest expense} = \text{interest expense} - \text{interest income}. \tag{12}$$

2. Net interest expense is greater than € 1 million and the interest expenses exceed 30% of EBITDA. EBITDA is approximated as follows:[17]

$$\begin{aligned} EBITDA = \text{profit} &\pm \triangle \text{ expected loss provisions} \\ &\pm \triangle \text{ accrual provisions} - \text{participation income} \\ &\pm \triangle \text{ deferred taxes} \pm \text{corporate level tax} \\ &+ \text{net interest expenses} + \text{depreciations}. \end{aligned} \tag{13}$$

3. The company belongs to a corporate group (participation rate greater than 50%) or there is harmful debt financing. Harmful debt financing occurs when the investor's stake is greater than 25% and the following applies:

$$\frac{\text{net interest expenses of affiliated companies}}{\text{net interest expenses of corporate group}} > 10\%. \tag{14}$$

4. The equity ratio of the subsidiary is more than 1% lower than the one of the parent company.[18] The equity ratio is defined as the ratio of equity to total assets.[19]

5. The company is not a subsidiary in a tax group.[20]

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16 We use € 1 million as the limit for the net interest expense because the original act stipulated this amount. *Buslei and Simmler* (2012) remove all companies from their sample whose net interest expenses are between € 0.8 million and € 1.2 million. They justify this step by arguing that this prevents a "misclassification". However, this removes valuable companies from the sample. Specifically, these companies have a special purpose due to the proximity to the allowance. For this reason, we omit this step. Unlike *Buslei and Simmler* (2012), p. 12, we do not further limit the sample, for example to a net interest expense of greater than € 2 million because we expect that companies whose net interest expense is far from the € 1 million allowance will also react.

17 See *Blaufus and Lorenz* (2009), p. 523. For the variables expected loss provisions, accrual provisions, deferred taxes, corporate income tax and participation income, we assume that if there are no entries in the database, variables are zero. This approach is consistent with the work of *Blaufus and Lorenz* (2009) and was randomly checked against individual financial statements in the Federal Gazette (Bundesanzeiger). This resulted in no deviations in the sample.

18 We set the limit on the equity ratio comparison to 1% because this value was stipulated in the original act.

19 For the parent company the adjusted equity is defined as: equity − shares in associated companies + $0.5 \cdot$ special reserves with long shares. The corrected total assets are defined as total assets − Min[loan to associated companies; liabilities]. If these data are not available we use the unadjusted equity. Goodwill cannot be considered because of missing data. Moreover, our database (DAFNE) only contains information on German companies. This means that this rule only can be checked for German parent companies and the overall result is therefore probably underestimated.

20 A tax group is assumed when the financial statement reports "profit transfer due to profit or partial profit transfer agreement" or "loss transfer due to a profit or partial profit transfer agreement" and the profit is zero. The profit must be zero because a partial profit transfer is not sufficient to form a tax group.

4.3 Control group

Companies that do not meet the criteria in section 4.2 are assigned to the control group. Consequently, a small treatment group may face a large control group. The groups may differ in specific company properties and group size. In order to avoid a bias in the results a control group with the same sample size as the treatment group is identified.[21] The control group can be derived from the total sample by a purely random selection, taking into account the criterion that they are not subject to the interest barrier.[22] The DiD approach requires that the examined groups of companies be very similar in their characteristics and only differ in the examined property. Because of this, we determine the control group in a so-called matching procedure (1:1 matching) rather than by random selection. With the 1:1 matching for each company of the treatment group, one company that is as similar as possible is identified using the predetermined companies' matching variables.[23] Furthermore, "matched" samples are significantly more efficient than random samples that are independently obtained by a random process (*McKinlay*, 1977; *Wacholder et al.*, 1992; *Abadie et al.*, 2004).

To this end, the so-called propensity score matching is applied, taking into account the nearest neighbor principle.[24] To determine companies that are as similar as possible we use a fixed caliper of 0.1, which means that the difference in the propensity score of the treatment and the control companies is less than 10%. If no such company can be found within these limits, the associated companies in the treatment group are removed from the sample.

The empirical finance literature often considers industry and size of the companies to be confounding factors. In this study, therefore, total assets, profit and the number of employees are included as matching variables for the size of the companies in addition to the independent variables of the model. We use the logarithm of total assets (TA) and the logarithm of the number of employees (NE) because the data for these variables are strongly left-skewed. Using the logarithm produces almost normally distributed variables. We also include ΔLEV as the independent variable in the matching process because *Heckman et al.* (1998) show that the computation of the propensity score should also include determinants of the outcome variable (see also *Finke*, 2014). By using ΔLEV we meet the requirement of the DiD approach that the treatment and control group may not differ with respect to the ΔLEV prior to the 2008 reform.

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21 *Wacholder et al.* (1992) argues that the results are most reliable in empirical studies when the groups are almost equal.

22 *Cosslett* (1981) describes three different basic ways to determine a random comparison group.

23 This procedure should also prevent confounding. Confounding implies that in addition to the independent variables, other, mostly non- manipulable variables may also have an impact on the dependent variable. Thanks to matching, the companies are very similar with respect to these non- manipulable variables in the DiD approach. Thus, confounding is minimized.

24 More information on propensity score matching can be found in, e.g., *Rosenbaum and Rubin* (1983), *Heckman et al.* (1998) or *Dehejia and Wahba* (2002).

In the matching process, we do not distinguish between industries because only a very small number of observations in the respective industries within the caliper limit of 0.1 are available. Consequently, we would need to cluster industries. In contrast to the impact of industry on the level of leverage, there is no economic or empirical evidence suggesting that industry matters with respect to the magnitude of changes in leverage. Hence, we abstract from industry effects. Nevertheless, we consider the industry in a robustness check.
The measured variables TA and PR (profit) must be interpreted as critical in that they may be distorted by accounting and tax-optimized design measures, such as sale-and-lease-back deals or sales of receivables. The number of employees can also be distorted because temporary workers or outsourcing effects are not necessarily taken into account. The advantage of propensity score matching is that it considers multiple dimensions. This, together with the inclusion of a caliper, can compensate for the weaknesses of individual factors. The matching method is more effective than an unspecified matching of individual characteristics (*Dehejia and Wahba*, 2002).
The matching is performed using the data of 2006, before the reform, taking into account the variables TA, PR, NE, $SALES$, $COLLATERAL$, $CURRENTRATIO$, ROA, $ZSCORE$, NTR and ΔLEV.

4.4 Time

The dummy variable $TIME$ divides the sample into a group before and a group after the exogenous shock of the 2008 corporate tax reform. The interest barrier was introduced under the 2008 corporate tax reform and applies for all companies whose year begins after July 25, 2007 and ends not after January 1, 2008. Transitional periods, particularly for existing financing structures, are not provided for in the act. In Figure 1 these points in time are blue.

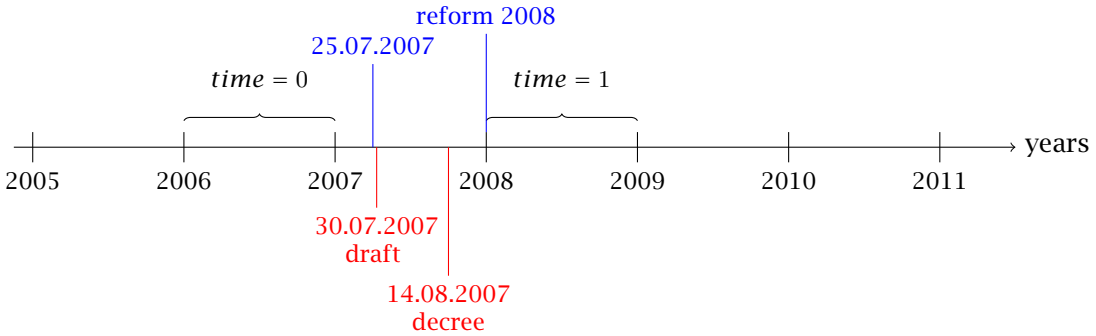

Figure 1: Overview over time

The Federal Government submitted the draft bill to the Upper House on July 30, 2007, and it passed early on August 14, 2007. In Figure 1, these dates are highlighted in red. Prior to this

the draft bill was discussed and finalized in various committees, so companies were already able to adjust their financial structures as early as 2007. In order to not distort the outcome of the investigation and to exclude an anticipatory effect of the interest barrier rules, we use data from 2006 in the regression; i.e., a period well before the corporate tax reform. For the post-reform period we use data from 2008 in the regression.

The financial crisis in the banking sector started in 2007. In the underlying research setting with the DID approach and the propensity score matching, the treatment and control groups should not be affected systematically differently by this crisis. Furthermore, the *ZSCORE* serves as a control for credit risks. Further, large companies are more likely to be affected by the interest barrier and, e.g., the empirical study by *Iyer et al.* (2014) indicates that small companies are more affected by the financial crisis than bigger companies with stronger banking relationships. Therefore, we do not expect the financial crisis to bias our investigation.

5 Data and descriptive statistics

5.1 Sample selection

The data we use to test the hypotheses are taken from the Dafne database by Bureau van Dijk (BvD).[25] This unique dataset is composed of actual and historical single financial statements of over one million German companies. The variables we use are listed in Appendix B.[26]
The data we use have significant missing values and obvious false entries, which may lead to erroneous results in the investigation. For this reason, the extracted data are first checked for completeness and plausibility. For this purpose, all records are removed from the sample that have no entries for the variables marked with an asterisk in the table in Appendix B for the studied period or that contain obvious erroneous data.[27] Furthermore, all companies with a negative equity ratio and negative profit (losses) are deleted. Equity ratios of less than 0% are possible when companies (in the short and medium term) generate losses.[28] Banks and insurance companies and non-profit organizations are also removed from the sample because they have a particular capital structure. This is to avoid further distortion of the results. To this end, all companies were removed whose US SIC code begins with 6. Non-profit

25 Bureau van Dijk Electronic Publishing GmbH, http://www.bvdinfo.com/.

26 The excerpt from the Dafne database only includes companies that between 2009 and 2012 had at least one entry for interest expense and reported subject to German GAAP.

27 For all variables without * we make assumptions for missing data and explain them and their implications.

28 These companies could bias the results because they are threatened by insolvency or liquidity problems. Thus, these companies are not considered in the following study. However, in a robustness check we control for loss-making companies.

organizations are also deleted; they are identified by the term "non-profit" in the company name (*Blaufus and Lorenz*, 2009).

In addition to the records from the DAFNE database, local business tax rates (*LBT*) are obtained from the Federal German Statistical Office for the relevant years for the companies in the dataset. The *LBT* is assigned to the registered address of the companies contained in the dataset.[29] Because the effective corporate tax rate is often below the nominal corporate tax rate, the number of affected companies may be overestimated in our study.

The final sample includes a total number of 4,994 companies. Table 2 summarizes the sample selection. Approximately 79,000 companies were eliminated from the original sample

	number	sample size
data with required variables		6,620
equity ratio ≤ 0	−3	6,617
profit < 0	−1,189	5,428
US SIC = 6*** (e.g. banks)	−389	5,039
non-profit companies	−45	4,994

Table 2: Development of the sample

(approximately 91%) because of incomplete records and missing data. Of the remaining 6,620 companies, three were deleted because of an equity ratio smaller than or equal to one, 1,189 because of negative profits, 389 because of a US SIC code starting with 6 and a further 45 because of their status as non-profit companies. The final sample size of 4,994 companies is approximately 6% of the total number of companies with the legal forms GmbH and AG in the database. Table 3 provides more details about the sample with respect to company size.[30]

sales	overall	
(in €1,000)	count	in %
< 9,680	1,139	22.80
9,681 − 38,499	1,614	32.31
≥ 38,500	2,241	44.87
sum	4,994	100.00

Table 3: Composition of the sample by company size

Approximately 45% of the companies can be classified as large corporations with average sales of more than € 38.5 million. In addition, approximately 32% of companies are medium-sized corporations with average sales between € 9.6 million and € 38.5 million, whereas only approximately 23% are assigned to the "small corporations" group. Many companies in the database are classified as small businesses with low disclosure requirements. Because of missing data for these firms, we have to exclude these firms from the sample. Because

29 See *Statistisches Bundesamt* (2007), *Statistisches Bundesamt* (2009). In the absence of information on the *LBT*, the average local business tax rate is used as an alternative.

30 In line with § 267 HGB (German Commercial Code) we classify companies by size using the arithmetic mean of the sales from 2006 and 2008.

the distribution in terms of totals assets across medium-sized and large companies in our sample is very similar to the original sample, including datasets with missing variables, we are confident that our sample is appropriate. Because mainly medium-sized and large corporations are expected to be affected by the interest barrier, we are not concerned about this loss of data. Furthermore, the structure of companies in our sample proves to be very similar to the one in the original sample in terms of profitability and leverage. For this reason, the companies in and the size of our sample are regarded as appropriate for the subsequent investigation.

Figure 2 depicts the development of the average LEV of our sample from 2005 to 2010. The mean LEV decreases slightly over the entire period. Overall, a reduction of approximately 5.59 percentage points from 50.06% in 2005 to 44.47% in 2010 can be observed. On closer examination, it can be observed that the mean LEV falls slightly faster after 2007 and is nearly constant since 2009. Between 2007 and 2009, the mean LEV falls by 0.36% (2007), 1.14% (2008) and 1.79% (2009).[31]

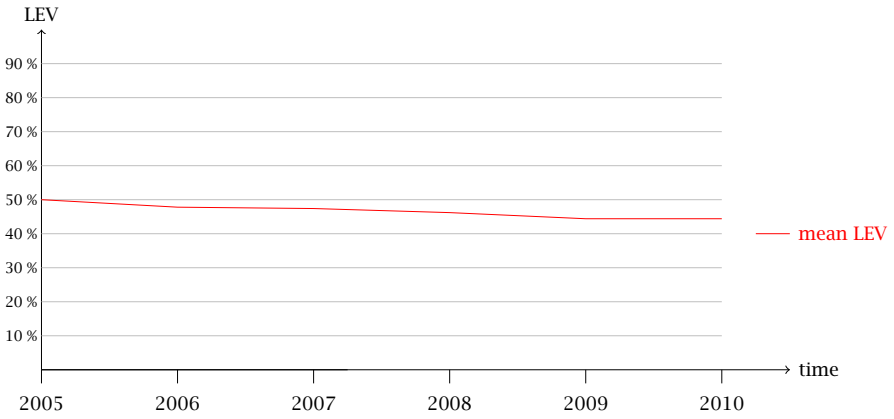

Figure 2: Mean LEV of our sample

We expect that on average, those companies that are subject to the interest barrier reduce their LEV more strongly than the unaffected companies. Because sufficiently high net interest expense (*NIE*) is necessary to trigger the application of the interest barrier, the distribution function of this variable is mapped in Figure 3. We see a strong concentration around zero *NIE*, with a slight skew to the right. The average *NIE* is € 1,078.48, meaning that interest expenses exceed interest income.

In contrast to a normally distributed variable, the skewness is not equal to zero, and the arithmetic mean, median and mode are not identical. Here, a skewness of 50.01 indicates that the majority of companies report *NIE* that is larger than the arithmetic mean. In 2006,

[31] The LEV is adjusted against missing data only for 2006 and 2008. A more extensive cleanup of the LEV for more years is not performed because this would limit the sample size further and produce no additional information for the underlying setting.

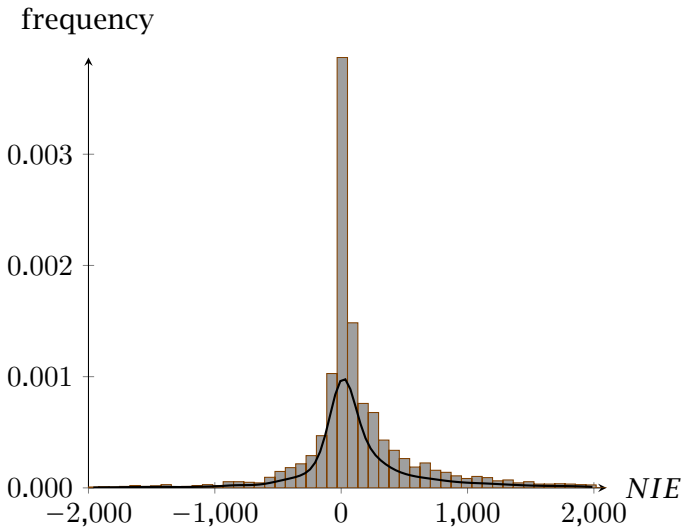

Figure 3: Distribution function with density line of the net interest expense (*NIE* in € 1,000) for the year 2006

most companies reported a net interest expense that was significantly higher than zero, often even higher than € 1 million, i.e., those companies were likely to be subject to the interest barrier.

5.2 Identification of the treatment group

The treatment group is determined as described in section 4.2. Table 4 displays the development of the treatment group size after each step. Most companies in the sample (approximately 90%) are not affected by the interest barrier because they do not have the required net interest expenses. In addition, another approximately 80% of the remaining companies are not subject to the interest barrier because of the exemption rules. They can either refer to sufficient EBITDA or the stand-alone clause. One company can remain unaffected by the interest barrier due to the equity clause.[32] Due to tax group membership, 19 companies have to be eliminated from the treatment group.[33] Overall, 104 companies out of the total sample met the interest barrier criteria in 2006. This corresponds to approximately 2.08%.
Using propensity score matching, as described in section 4.3, for each company of the treatment group, a corresponding company can be determined for a caliper of less than 0.1. Thus,

[32] It is important to note that only German parent companies can be considered for the equity comparison for the equity clause. The sample includes 4,159 companies with a parent company, of which 1,923 companies have a German and 2,236 an international parent company. Only for 914 companies (47.52% of German parent companies) the necessary information for the equity comparison available. Due to this limitation in the data, the escape clause might be underestimated in our analysis.

[33] With a random sample, the proxy for the tax group membership relies on the entries of profit transfer agreements in the commercial register (local court at the authors' university). Spot-check inspections clarified that not all subsidiaries can be identified by this approach. Hence, the effects on LEV could be underestimated.

clause	affected companies in the full sample	treatment group reduction per step	treatment group remaining companies
full sample	4,994		4,994
1. allowance	4,474	−4,474	520
2. EBITDA clause	4,834	−360	160
3. stand-alone clause	2,846	−36	124
4. escape clause	4,733	−1	123
5. tax group	4,582	−19	104

Table 4: Overview of the treatment group development for the year 2006

after the propensity score matching the treatment and control groups, each group includes 104 companies. Appendix F shows the coefficients of the propensity score estimation. The variables TA, NI, NE, ROA, $COLLATERAL$ and $ZSCORE$ are significant at least at the 5% level in the regression model. In addition, the underlying R^2 is 23%.

5.3 Assessing matching quality

It is essential that the determined control group is sufficiently similar to the treatment group in the chosen matching criteria. *Rosenbaum and Rubin* (1985) developed a standardized bias to assess the similarity of the treatment and control groups for each observable (x) of each company (*Finke*, 2014). The standardized bias (SB) is calculated as follows:

$$SB_x = \frac{\bar{x}_{treatment} - \bar{x}_{control}}{\sqrt{\frac{\sigma^2_{x_{treatment}} + \sigma^2_{x_{control}}}{2}}} \tag{15}$$

and is depicted in Table 5 for the unmatched and matched samples. The results illustrate that propensity score matching leads to a strong reduction in the bias between the treatment and control groups. On average, the reduction is almost between 36% and 92%, which indicates a post-matching bias of less than 25% and in most cases less than 15%. Only the bias for $CURRENTRATIO$ could not be alleviated by the matching process. Moreover, a t-test for equality is performed to examine the differences between the means of the treatment group and the control group. The null hypothesis of the t-test that the treatment group's mean is not significantly different than that of the control group cannot be rejected for all variables, except for the NE.[34] Thus, only the significant difference at the 10% level of NE can be observed between the two groups on the mean values.

In Figure 4, the standardized bias reduction is illustrated graphically by points before and

[34] We also conducted a Wilcoxon matched-pairs signed-ranks test to test for equality because the Shapiro-Wilk normality test shows that all variables are not normally distributed. The Wilcoxon matched-pairs signed-ranks test confirms the results of the t-test with the exception of $CURRENTRATIO$. This indicates that the group means for $ZSCORE$ and $CURRENTRATIO$ are not equal.

variable		mean treat	mean control	%bias	%reduction |bias|	t	p>|t|
TA	unmatched	11.862	9.6168	142.2		12.44	0.000
	matched	11.862	12.077	− 13.6	90.4	−1.03	0.303
NI	unmatched	16,752	5,757	13.3		1.71	0.087
	matched	16,752	13,027	4.5	66.1	0.37	0.712
NE	unmatched	5.1076	4.4387	40.0		4.35	0.000
	matched	5.1076	5.5343	− 25.5	36.2	− 1.76	0.080
SALES	unmatched	11.191	10.151	64.4		6.28	0.000
	matched	11.191	11.490	− 18.5	71.3	− 1.19	0.236
ROA	unmatched	0.0438	0.1186	− 52.6		− 5.64	0.000
	matched	0.0438	0.0655	− 15.3	71.0	− 1.27	0.205
COLLATERAL	unmatched	0.5865	0.3302	89.8		10.05	0.000
	matched	0.5865	0.5472	13.8	84.7	0.95	0.342
NTR	unmatched	40.278	40.063	11.1		1.10	0.270
	matched	40.278	40.262	0.9	91.9	0.60	0.950
ZSCORE	unmatched	1.7581	4.9892	− 4.9		− 0.35	0.723
	matched	1.7581	1.2442	0.8	84.1	0.50	0.615
CURRENTRATIO	unmatched	81.214	70.731	0.9		0.07	0.945
	matched	81.214	138.55	− 4.7	− 447.0	− 0.37	0.715
ΔLEV	unmatched	− 0.0069	− 0.0214	16.2		1.40	0.163
	matched	− 0.0069	0.0005	− 8.3	48.6	− 0.63	0.532

Notes: This table compares the means of all matching criteria of the treatment with those of the control group, which was determined via propensity score matching. The first row for each criteria shows the mean of the unmatched and the row below for the matched sample. The two columns in the middle display the bias between the two subsamples and the reduction in the bias due to matching. The two columns on the right show the result of a t-test if the mean values between the treatment and the control group are statistically equal. The results are based on the nearest neighbor matching with a caliper of 0.1 for the year 2006.
Source: own calculation.

Table 5: Assessment of matching quality

crosses after matching. This figure demonstrates the strong standardized bias reduction by the propensity score matching.

A further possibility to access the quality of the matching is interpreting the $Pseudo - R^2$ from the probit estimation of the conditional treatment probability (propensity score) on all matching variables before and after the matching. Table 6 illustrates that the matching variables do not longer explain if a company is part of the treatment group. The explanatory power in terms of the $Pseudo - R^2$ is reduced by the propensity score matching from 0.217 to 0.025. The observables are also jointly insignificant ($p > \chi^2 = 0.999$). In the mean, the bias between the unmatched and the matched sample across all matching criteria is reduced from 43.5% to 10.6%. All of these results suggest that the propensity score matching functions well in assigning sufficiently similar control companies to the treatment companies.

Because of missing data, we can only validate the parallel trend of the dependent variable ΔLEV of the two groups prior to the reform for a subsample and the years 2005 and 2006. The required data to calculate ΔLEV are available for 80 companies of the treatment and 82 companies of the control group. The results of a t-test for the mean values of ΔLEV of the two groups is depicted in Appendix G. The hypothesis that the mean values are not

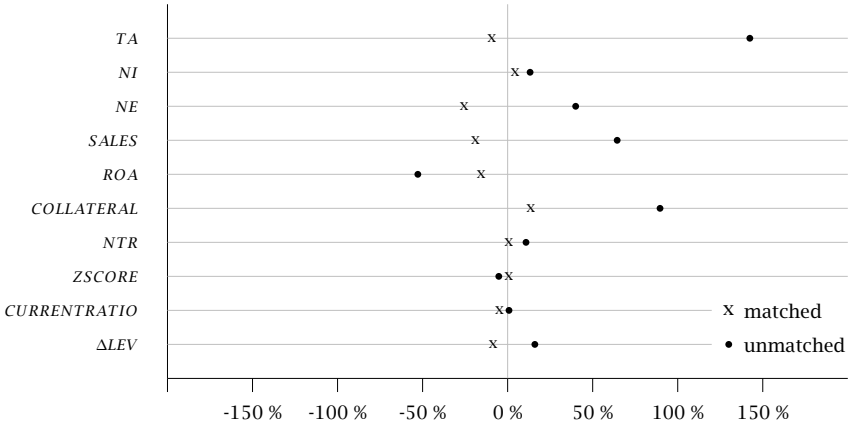

Figure 4: Standardized % bias across covariates

	$Pseudo - R^2$	$p > \chi^2$	mean %bias	median %bias
unmatched	0.217	0.000	43.5	28.1
matched	0.025	0.696	10.6	11.0

Notes: The table shows that after matching the matching criteria no longer provide joint explanatory power for being affected by the interest barrier.
Source: own calculation.

Table 6: Joint insignificance of observables after matching

equal cannot be rejected. These results indicate that the requirement of a parallel trend for the dependent variable in a DiD is fulfilled for the subsample. Overall, the results of this t-test, the propensity score matching and the chosen research design strongly indicate that the requirements for the DiD approach are fulfilled.

In Figure 5, the development of the mean of ΔLEV is depicted. ΔLEV of the treatment group changes from -0.69% (2006) to -3.51% (2008) by a total of 2.82 percentage points. By contrast, the mean ΔLEV of the control group is positive with 0.05% (2006) and 1.84% (2008).[35] From a purely descriptive perspective, this result highlights that the treatment group reacts systematically different than the control group. These descriptions already provide a first indication that hypothesis H1 cannot be rejected.

The structure of the matched sample for the treatment and control groups is shown in Table 7. The expectation that more large companies are affected by the interest barrier cannot be refuted descriptively because we find that approximately 65% large, 29% medium and only 6% of small corporations are subject to the interest barrier. In addition, no huge differences in size structure between the treatment and control groups can be observed.

35 For corresponding data regarding *LEV* see Appendix H.

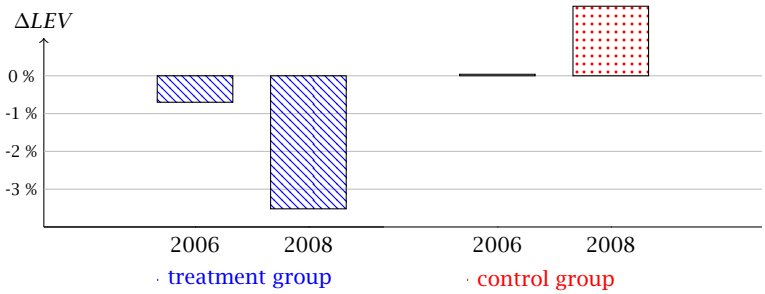

Figure 5: Mean ΔLEV of the treatment and control groups

sales (in €1,000)	matched count	matched in %	treatment group count	treatment group in %	control group count	control group in %
< 9,680	15	7.21	6	5.76	9	8.65
9,681 – 38,499	47	22.59	30	28.84	17	16.34
≥ 38,500	146	70.19	68	65.38	78	75.00
sum	208	100.00	104	100.00	104	100.00

Table 7: Sample composition for the full, the matched sample and the treatment and control groups

6 Results

We estimate various regression models for equation (9) to test hypothesis H1. The results are shown in Table 8 in columns (1) to (8). We focus on the interaction term $TREAT \cdot TIME$ to determine the extent to which companies in the treatment group, i.e., those companies that are subject to the interest barrier, adjust their leverage when they experience the tax reform 2008. In model (8), the variable $TREAT \cdot TIME$ has a negative coefficient and is significant at the 5% level. A negative coefficient implies that the companies that are affected by the interest barrier reduce their LEV more strongly than those that are not affected. In other words, the companies in the treatment group reduced their LEV by 4.7% percentage points more than the companies in the control group. This indicates that hypothesis H1 for ΔLEV cannot be rejected. However, we find considerably higher adjustments in leverage than previous studies (*Shih*, 1996, also *Blouin et al.*, 2014), which indicates that hitherto this effect has most likely been underestimated.

The NTR is not significant at the 10% level but at the 15% level and has a negative coefficient.[36] With the corporate tax reform of 2008, the corporate tax rate of 25% was reduced to 15%. As a consequence, the benefit from the tax shield decreased. The sign of the coefficient is consistent with our expectation that companies use less debt because of the reduced tax shield. For all other control variables, i.e., $COLLATERAL$, ROA and $CURRENTRATIO$, we cannot draw any conclusions from our regression because the respective coefficients are

[36] The coefficient NTR must be interpreted with care due to a correlation between NTR and $TIME$ of -0.8663 (Spearman). See appendix K for further details.

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV	(9) ΔLEV	(10) ΔLEV
TIME	0.018	0.018	0.018	0.018	0.018	0.019	− 0.016	− 0.017	− 0.021	− 0.012
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.028)	(0.028)	(0.028)	(0.029)
TREAT	− 0.007	− 0.006	− 0.006	− 0.007	− 0.007	− 0.007	− 0.007	− 0.005	− 0.007	− 0.001
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.016)
$TREAT \cdot TIME(-)$	− 0.046**	− 0.046**	− 0.046**	− 0.046**	− 0.046**	− 0.047**	− 0.046**	− 0.047**	− 0.045**	− 0.060***
	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.022)
SALES		0.003						0.003	0.003	0.003
		(0.003)						(0.003)	(0.003)	(0.003)
COLLATERAL			− 0.027*					− 0.022	− 0.033*	− 0.032*
			(0.016)					(0.018)	(0.019)	(0.019)
ROA				0.009				− 0.002	− 0.002	− 0.003
				(0.037)				(0.038)	(0.038)	(0.038)
CURRENTRATIO					0.000			0.000	0.000	0.000
					(0.000)			(0.000)	(0.000)	(0.000)
ZSCORE						− 0.001		− 0.001	− 0.001	− 0.001
						(0.001)		(0.001)	(0.001)	(0.001)
NTR							− 0.003	− 0.003	− 0.004	− 0.004
							(0.002)	(0.002)	(0.002)	(0.002)
$LIQUIDITY$									0.017	0.028
									(0.012)	(0.023)
$LIQUIDITY \cdot TIME$										− 0.028
										(0.031)
$LIQUIDITY \cdot TREAT$										− 0.019
										(0.030)
$LIQUIDITY \cdot TREAT \cdot TIME$										0.053
										(0.042)
Constant	0.001	− 0.038	0.015	− 0.000	0.000	0.001	0.128	0.118	0.133	0.122
	(0.009)	(0.031)	(0.013)	(0.010)	(0.009)	(0.009)	(0.095)	(0.100)	(0.101)	(0.101)
observations	416	416	416	416	416	416	416	416	416	416
adjusted R- squared	0.040	0.044	0.047	0.040	0.040	0.042	0.045	0.056	0.061	0.065
F statistic	5.771	4.773	5.071	4.332	4.320	4.539	4.793	2.683	2.629	2.148

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiary and cannot use the EBITDA, stand-alone or equity clause. The control group consists of companies that are as similar as possible, which were determined using a propensity score matching and are not subject to the interest barrier. The measure $LIQUIDITY$ is a dummy variable with the value 1 if $CURRENTRATIO < 1$. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: DAFNE database, 2006 and 2008, own calculations.

Table 8: Results of the regression for hypothesis H1 and H2

not significant. The regression equation has an adjusted R^2 of 0.065, which corresponds to related studies.

Models (1) to (7) in Table 8 confirm the previously presented results of model (8). There are no differences in the signs and only minimal changes in the magnitude of the coefficients, except *TIME*. The coefficient *TIME* is unchanged in models (1) to (6). If we include *NTR* in models (7) and (8), the sign of the coefficient of *TIME* changes, but is still insignificant. However, the interaction term $TREAT \cdot TIME$ with -4.6% and -4.7% is nearly constant. We find a significance level close to the 1% level with a p-value of 1.2%. This level is robust across all models.

We estimate various regression models for equation (11) to test hypothesis H2. The results are shown in Table 8 in columns (9) and (10). We find no significant impact of the dummy variable *LIQUIDITY* and, moreover, *LIQUIDITY* has no impact on the interaction term $TREAT \cdot TIME$. Only the coefficient *COLLATERAL* is significant at the 10% level with a slightly increased negative magnitude. Thus, we do not find evidence for a general influence of the variable *LIQUIDITY* on ΔLEV. We display the results of the regression including the three- way interaction in Table 8. The interaction term $LIQUIDITY \cdot TREAT \cdot TIME$ is not significant with a coefficient of 5.3%. A p-value of 0.2 indicates that companies with liquidity constraints that are simultaneously affected by the interest barrier increase their LEV by 5.3 percentage points. This result is consistent with our expectations. The coefficient of $TREAT \cdot TIME$ with -6.0% is significant at the 1% level, which is 1.3 percentage points larger than in the initial investigation. All other coefficients remain almost unchanged. We believe that the effect of the liquidity constraints dominates the response to the interest barrier.

We use the variance inflation factor (VIF) to test for multicollinearity. Basically, a smaller VIF indicates less concern with respect to multicollinearity. If the VIF exceeds a certain critical cut-off level, the results are no longer interpretable. A general cut-off value for VIF has not been defined in the literature until now and depends on the underlying model. Sometimes, the value ten is chosen (*Wooldridge*, 2014). The results of the VIF-test are displayed in Table 9. The complete model (8) includes VIFs smaller than ten. Except for *NTR* and *TIME*, all VIFs are equal or smaller than three and are thus distant from ten. For this reason, we are not concerned about multicollinearity.

7 Robustness checks

In the following, we report a battery of robustness checks. We test our results for the impact of losses. Furthermore, we test for changes due to credit ratings, liquidity constraints, different reporting dates, different matching approaches, a simplified calculation for the *EBITDA* and industry as an additional matching criterion.

variable	VIF
$TIME$	9.34
NTR	8.31
$TREAT \cdot TIME$	3.01
$TREAT$	2.02
$SALES$	1.32
$COLLATERAL$	1.27
$ZSCORE$	1.04
ROA	1.04
$CURRENTRATIO$	1.01
mean VIF	3.15

Table 9: Results of the VIF-test

So far, companies with losses are excluded to avoid biased results because of liquidity constraints. In this robustness check we test the influence of losses. All remains equal except for the fact that companies with losses are not excluded from our sample. The results of the calculation are shown in Appendix I. The treatment group has 181 companies, which is much larger than in the initial investigation. The coefficient of $TREAT \cdot TIME$ with 0.02 percentage points is statistically not significant. Furthermore we include a dummy variable $LOSSES$, which is 1 if the net income is smaller than zero. The coefficient of $LOSSES$ with 5 percentage points is significant on the 1% level. We find evidence that losses have a positive influence on ΔLEV, which highlights the robustness of our results based on the original sample selection excluding loss-making firms. Unreported calculations indicate that the matching quality is weaker. We also calculated the regression without matching, including companies with losses. The results are shown in the table in Appendix O. The coefficient of $TREAT \cdot TIME$ with -3.2 percentage points is significant on the 5% level. This result is consistent with our initial investigation. In addition, including the dummy variable $LOSSES$ hardly changes the results. Furthermore, unreported results for the initial calculation indicate that the results remain unchanged if we exclude additional companies with losses in the year 2007. The treatment group is then further reduced by eight companies.

The costs of and access to a loan often depend on the credit ratings by banks or rating agencies, which are commonly used to control for credit risk. In general, credit ratings are not published on a regular basis and are often only available for listed companies and thus only for a small subsample of our dataset. To control for the influence of credit ratings, we include the following two risk measures developed by *Koch and Prassel* (2011), which are approximated by measures determined on the basis of published accounting data.

$$RISK1 = \sqrt[3]{\frac{\text{interest paid}}{\text{non current liabilities + loans}}}.$$

$$RISK2 = \frac{\text{intangible fixed assets}}{\text{fixed assets}}. \tag{16}$$

In their study, *Koch and Prassel* (2011) show that both of the accounting-based measures are significantly negatively correlated with the credit rating variable, meaning that higher values for these risk measures come with a weaker credit rating. We expect a negative influence of the two risk measures on ΔLEV, meaning that a higher value of risk raises the cost of debt and thus reduces the attractiveness of debt. It is not possible to conjecture a uniform influence, either positive or negative. This effect depends on the initial level of the risk measure before the reform and their development over time. Both directions are conceivable. In Appendix L, the results of the additional estimation of the regression, including the two risk measures $RISK1$ and $RISK2$, are shown. There, the columns (1) to (3) are based on the full sample whereas columns (4) to (6) refer to a restricted sample where we excluded values greater than one for $RISK1$. We consider these risk values as abnormal. The results of $TREAT \cdot TIME$ are almost identical to our previous findings in both samples. In the full sample, the significance is still at the 5% level and in the restricted sample, including $RISK1$ at the 1% level and including $RISK2$ at the 5% level. However, the p-value is just below the 1% level. The measures $RISK1$ and $RISK2$ are not significant in both samples and cannot be interpreted. If we include these two risk measures in the regression model, the results are only marginally affected. In sum, we find that our results for $TREAT \cdot TIME$ are robust against these measures for credit ratings.

In the initial investigation, all reporting dates for the years 2006 and 2008 are included. To test the results against different possible anticipation effects due to different reaction periods, all financial statements with a reporting date that differs from December 31 are excluded. In the table of Appendix M, it is obvious that the results are still robust. The sample with 384 observations is smaller by 32 items. The interaction term $TREAT \cdot TIME$ is significant at the 1% level. The coefficient is -6.2%, 1.5 percentage points larger than in the initial investigation.

The propensity score matching is very important in regard to identifying companies that are similar to the treated companies. To test the robustness of the results, we calculate the regressions using a propensity score matching with 1 to 5 neighbors with replacement and without any propensity score matching. In Appendix N, we provide the results of the regression for the treatment and control group after the propensity score matching with 1 to 5 neighbors and with replacement. Only the matching options are adapted; all other assumptions remain unchanged. The treatment group still includes 104 companies and the control group includes 417 companies, which results in 1,042 observations.[37] The interaction term $TREAT \cdot TIME$ is still significant at the 5% level, and with a value of -3.3%, is only

[37] The difference to the expected 520 companies in the control group is because 1 to 5 neighbors matching is only possible with replacement. See *Leuven and Sianesi* (2003). Companies that are included twice or more in the control group are only taken into account once in the regression.

1.4 percentage points smaller in comparison to the initial model. The regression results without a matching are shown in Appendix O. The treatment group still consists of 104 companies and the control group 4,890 companies, which leads to 9,988 observations. The results for the interaction term $TREAT \cdot TIME$ remain unchanged at the 5% significance level with a value of -3.3%. In sum, these two calculations indicate that the results are robust against different matching approaches.

Assuming a placebo reform in 2006, we also examine whether potentially treated and untreated companies also differ in the development of their LEV in the period 2005 to 2006.[38] The chosen new time window is much earlier than the German corporate tax reform in 2008 and can be regarded as a placebo reform in 2006. The results of this robustness test are shown in Appendix P. As expected, the interaction term $TREAT \cdot TIME$ is neither statistically nor economically significant. This result implies that the investigated companies do not differ in their behavior, and all companies react in the same way.[39]

The underlying definition of $EBITDA$ in equation (13) contains a number of assumptions, especially regarding the corporate tax. To test the robustness of the model against these assumptions, we use the following simplified definition of $EBITDA$:

$$SIMP\_EBITDA = \text{profit} + \text{net interest expenses} + \text{depreciations}. \tag{17}$$

As a consequence, we obtain a slightly smaller treatment group with 97 companies. We repeat our regression analysis for this simplified EBITDA. Our results are displayed in Appendix Q. The interaction term $TREAT \cdot TIME$ is -3.8% and is significant at the 5% level. Using the simplified EBITDA leads to results with a coefficient that is 1.1% smaller than in the initial model. We believe that the calculation of the detailed $EBITDA$ is more appropriate and that the results of the simplified EBITDA lead to an underestimation of the effects due to this inaccuracy. However, this test underlines the robustness of our previous calculations.

As discussed previously, we see no economic and empirical evidence suggesting that industry matters to our research question. Nevertheless, we implement the industry as a matching criterion to test the results against possible influences of different industries. In Table 10, the distribution of the companies across different industries is shown and is classified by the first digit of the US SIC code. It can be observed that the distribution for the ten different industries is not equal. Industries 1, 2, 8 and 10 have at most 48 companies in the complete sample and not more than one company in the treatment group. Consequently, a matching

38 We do not use the period 2004 to 2006 because the data for 2004 are not available in the necessary quality.

39 This result makes us confident that we do not need to be concerned about endogeneity. See *Roberts and Whited* (2013) p. 529.

with a caliper of 0.1 is not possible at a required quality level for these industries.[40] Hence, we do not consider this industry in the following. For all other industries, we are able to find a matching company using the propensity score matching with the additional requirement of the identical industry classification. All other assumptions remain unchanged. The results

no.	industry	total sample	treatment group
1.	agriculture, forestry, fishing	42	1
2.	mining	48	0
3.	construction	620	24
4.	manufacturing	1,863	29
5.	transportation, communications, electric, gas and sanitary services	869	22
6.	wholesale trade	831	16
7.	retail trade	202	2
8.	finance, insurance and real estate	0	0
9.	services	517	10
10.	public administration	1	0

Notes: This table shows the regression result of the propensity score matching. Only data of the year 2006 are considered.
Source: own calculation.

Table 10: Distribution of the sample across industries (US SIC code)

are shown in Appendix R. The treatment group contains 93 companies. It is smaller than the original treatment group because not all industries could be considered and a match with a caliper of 0.1 could not be identified for all companies. The matching quality is lower than in the initial investigation because the number of possible matches in each industry is much smaller than in the complete sample. The coefficient in the table of Appendix R of the interaction term $TREAT \cdot TIME$ is -3.0% and is statistically significant at the 10% level. This indicates that the results are also stable if we consider industry as an additional matching criterion.

To summarize, our robustness tests show that the results of the initial regression are very stable. Furthermore, the effect of the interest barrier on the capital structure becomes even stronger under certain conditions, which supports the impression that the response to changes in interest deductibility have been underestimated in prior studies.

8 Conclusions

With a difference in difference approach, we investigate whether the introduction of an interest deductibility restriction, as is being discussed in many countries, influences the financial structure of companies. The theoretical literature suggests that taking the tax effects into account debt should be preferred against equity and thus levered firms are expected to show

[40] The industry 8 is not represented in the sample because all companies of this industry are excluded due to special properties regarding their LEV.

higher firm values. However, prior empirical research provides only mixed results on the impact of taxes on corporate leverage and only moderate response to thin capitalizations rules.

We use the introduction of the so- called interest barrier in Germany as a "quasi-experiment" and employ an improved identification strategy to examine potential responses in corporate leverage empirically. The interest barrier prohibits, under certain conditions, the tax deductibility of interest. Accordingly, it is expected that companies that are affected by the interest barrier reduce their debt ratio.

We use the DAFNE database by Bureau van Dijk with a sample size of 4,994 companies. Using a propensity score matching with a significance level of 5%, we find that companies affected by the interest barrier reduce their debt ratio by 4.7 percentage points more than companies that are not affected. Furthermore, we find that affected companies without liquidity constraints reduce their debt ratio even more, i.e., by 6 percentage points. This result indicates that the impact of thin capitalization rules on corporate leverage have most likely been underestimated thus far. In contrast to prior studies our results are also stable against a battery of robustness checks and variations in the model specification, such as various risk measures, different reporting dates, different matching approaches and a simplified EBITDA that serves as an interest barrier threshold. Thus, our study provides unambiguous evidence for our prediction that the introduction of an interest barrier uniformly lowers firms' propensity to use debt financing.

We are the first to employ a detailed matching approach to the underlying rich dataset, which enables us to overcome several limitations of previous studies. We believe that our more complete and well-specified model and identification strategy for the treatment and control groups using a propensity score matching method avoids skewed results. In contrast to previous studies, we obtain a very clear, unambiguous and stable result, meaning that our results contribute strongly toward a better understanding of the effectiveness of interest deductibility restrictions.

Our empirical results imply that the equity of those German companies that are affected by the interest barrier has been strengthened. Thus, one political objective of the reform seems to be achieved. However, the number of affected firms is rather limited due to several exemptions in the German tax code. As a consequence the economic relevance of this tax reform in Germany is rather small. However, if other countries that are currently discussing related rules decide to introduce an interest barrier that is applicable to a broader group of firms, our results can serve as a lower bound of the expected capital structure reactions. Furthermore, if the OECD BEPS action plan succeeds in limiting undesired excessive cross-country debt financing in multinational entities a newly introduced national interest barrier can be expected to generate even more profound adjustments in corporate leverage. Nevertheless, from an

empirical perspective, the relationship between cross-country intrafirm debt financing and the introduction of an interest barrier still needs to be scrutinized in future research.

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Appendix

A Expected response

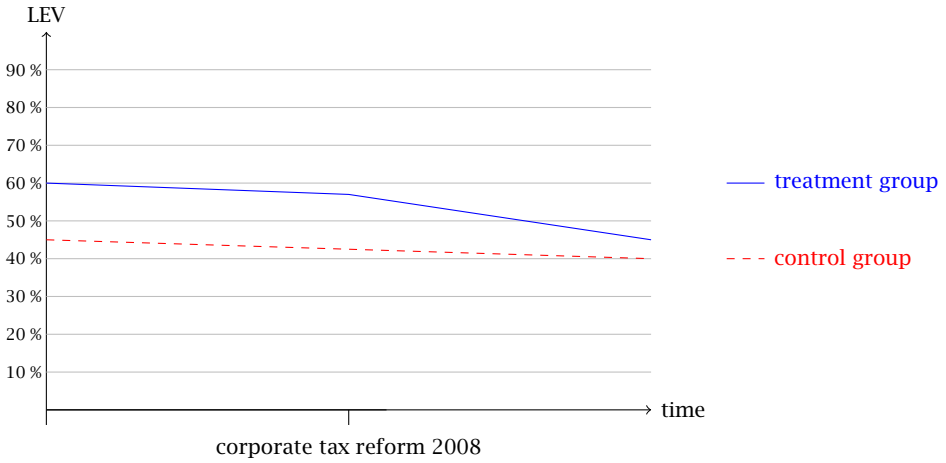


Figure 6: Expected response of the treatment group and the control group

B List of data directly exported from the DAFNE database

Variable name	Label
General information:	
Name of the company	NAME
BvD ID number	BVD
National parent company - name	NPC_NAME
National parent company - BvD ID number	NPC_BVD
Global parent company - Name	GPC_NAME
Global parent company - BvD ID number	GPC_BVD
US SIC - Code	USSIC
US SIC - description	USSIC_NAME
Legal form	LF
Type of financial statement	ABA
Balance sheet date	BSD
Interest of affiliated companies	IFAC
Number of employees*	NE
Number of subsidiaries	NOS
Postcode	PC
City	C
Date of birth	DOB
Balance sheet items:	
Equity*	E
Total assets*	TA
Profit	PR
Financial and investment income	FIE
Profit / loss before tax*	PLBT
Intangible assets*	IA
Fixed assets*	FA
Current assets*	CA
Current liabilities*	CL
Liabilities*	L
Liabilities with remaining maturity up to 1 year	L1
Liabilities with remaining maturity between 1-5 years	L15
Liabilities with remaining maturity more than 5 years	L5
Liabilities to shareholders	LTS
Provisions*	P
Provisions for impending losses	PFIL
Provisions for expenses	PFE
Deferred taxes	DT
Shares in affiliated companies	SAC

Variable name	Label
Extraordinary items with an equity portion	EIEP
Loan to associated companies	LTAC
Financial assets	FA
Intangible assets	IA
Loan liabilities	LL
Information from the income statement:	
Net interest expenses*	NIE
Interest expense*	IE
Interest income*	II
Tax	TAX
Taxes on income and earnings	TOIAE
Sales*	SALES
Corporate tax	CTAX
Depreciation*	AFA
Operating profit*	OP
Income from investments	IFI
Transfer of profits due to a profit or partial profit transfer agreement	TGA
Transfer of losses due to a profit or partial profit transfer agreement	TLA

Notes: * The data we use have significant missing values and obvious false entries, which may lead to erroneous results of the investigation. For this purpose, all records are removed from the sample that have no entries for the variables marked.

Table 11: Overview of the data exported from the Dafne database

C Thin capitalization rules in selected countries

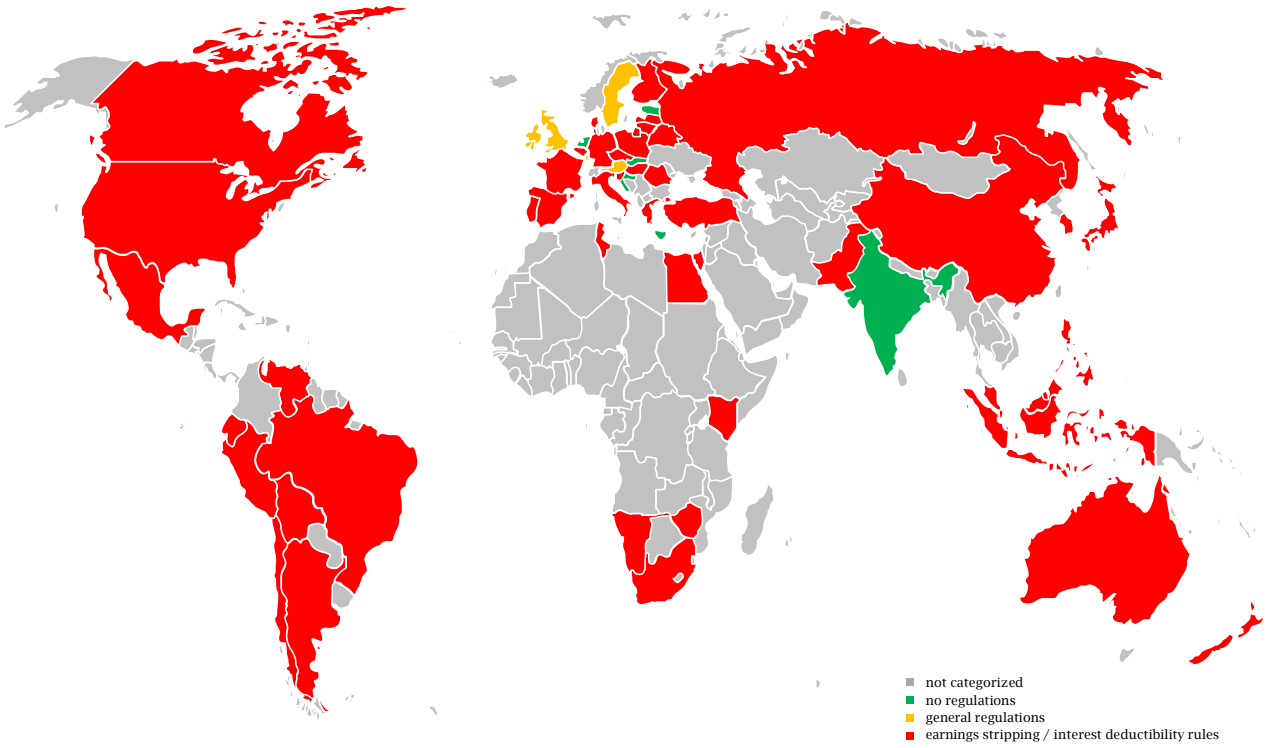
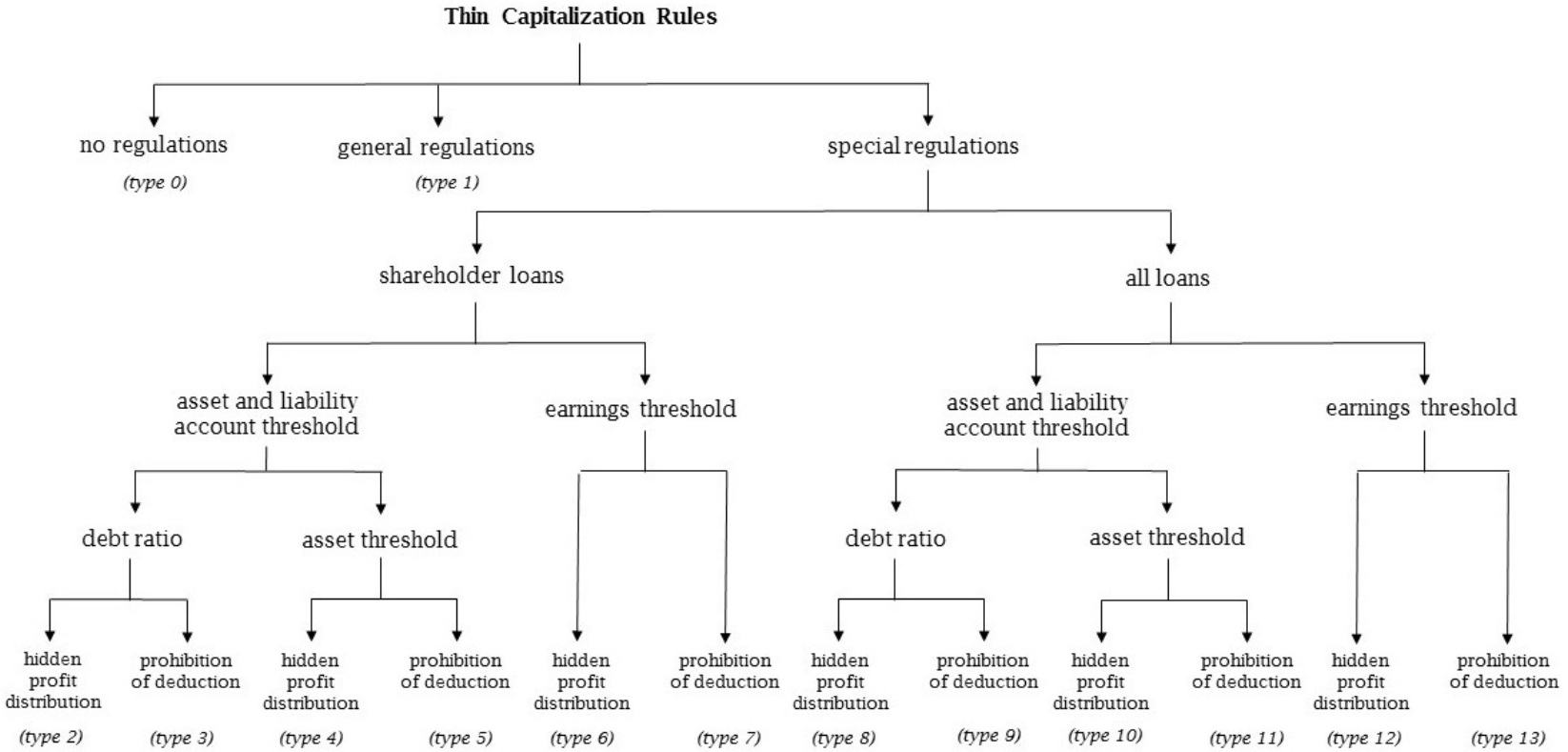


Figure 7: Map of various thin capitalization rules in selected countries

D Systematization of thin capitalization rules



Notes: If debts exceed a certain debt ratio (harmful debt to equity ratio) interest deduction restrictions apply. The earnings threshold indicates that the interest expenses are only tax-deductible up to a certain amount of earnings, e.g., EBITDA. If the harmful debt ratio or the earnings threshold are exceeded, excess interest expenses are non tax-deductible (prohibition of deduction) or are reclassified as dividend payments (hidden profit distribution).
Source: Maßbaum (2011), p. 21.

Figure 8: Systematization of thin capitalization rules.

E Classification of various thin capitalization rules

type	short description	countries
type 0	no regulations	Croatia[1], Cyprus, Estonia, India, Malta, Netherlands, Slovakia
type 1	general regulations	United Kingdom[2], Ireland[3], Luxembourg[4], Austria[5], Sweden
type 2	shareholder loans debt ratio hidden profit distribution	Belgium, Slovenia
type 3	shareholder loans debt ratio prohibition of deduction	Denmark, Canada, France, Lithuania, Poland, USA
type 7	shareholder loans earnings threshold prohibition of deduction	USA, France
type 9	all loans debt ratio prohibition of deduction	Belgium, Brazil, Bulgaria, Canada, Czech Republic, China, Hungary, Latvia, Romania, Russia
type 11	all loans asset threshold prohibition of deduction	Denmark
type 13	all loans earnings threshold prohibition of deduction	Denmark, Finland, Germany, Greece, Italy, Portugal, Poland (from 2015), Spain

Notes: If debts exceed a certain debt ratio (harmful debt to equity ratio) interest deduction restrictions apply. The earnings threshold indicates that the interest expenses are only tax-deductible up to a certain amount of earnings, e.g., EBITDA. If the harmful debt ratio or the earnings threshold are exceeded, the excess interest expenses are non tax-deductible (prohibition of deduction) or are reclassified as dividend payments (hidden profit distribution). [1]Debt provided by foreign shareholders with shares > 25% lead to non tax-deductible interest expenses if the debt exceeds the shareholders' equity by a factor of four. [2]"Arms-Length-Principle." [3]Interest paid by a non-trading company to a non-resident non-treaty parent company that owns at least 75% of the Irish subsidiary is generally reclassified as a dividend (hidden profit distribution). [4]In practice, the tax administration applies a debt to equity ratio of 85:15 to the holding of participations. [5]There are no specific thin capitalization rules, but in accordance with case law, interest may be reclassified as a dividend (hidden profit distribution) in certain situations. The tax authorities usually accept a debt to equity ratio of 4:1 in tax audits, although this is not considered a safe harbor. Further detailed information of characteristics of thin capitalization rules at year-end 2004 with an inventory border for selected countries is available in *Blouin et al.* (2014), p. 34.
Source: Maßbaum (2011), p. 21 and *Deloitte* (2014).

Table 12: Classification of various thin capitalization rules in selected countries

F Results of the propensity score matching

	treatment group
TA	0.376
	(0.048)***
NI	−0.000
	(0.000)**
NE	−0.072
	(0.037)**
$SALES$	−0.052
	(0.049)
ROA	−1.236
	(0.432)***
$COLLATERAL$	0.538
	(0.188)***
NTR	−0.021
	(0.024)
$ZSCORE$	−0.024
	(0.011)**
$CURRENTRATIO$	−0.000
	(0.000)
ΔLEV	0.072
	(0.516)
Constant	−4.348
	(0.989)***
N	4,994
pseudo R^2	0.216

Notes: This table shows the regression results of the propensity score matching. Only data from 2006 are considered.
Source: own calculations.

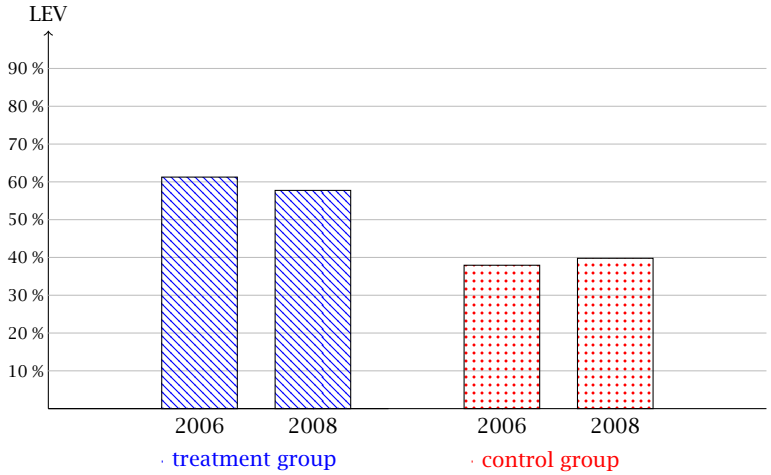
Table 13: Results of the propensity score matching

G Results of the t-test for the parallel trend assumption

		mean		std. err.			t-test	
		treated	control	treated	control	diff	t	p>|t|
full	ΔLEV 2005							
sample	ΔLEV 2006	−0.0069	−0.0005	0.0695	0.0993	−0.0064	−0.63	0.532
	n	104	104					
sub	ΔLEV 2005	0.0057	−0.0059	0.0627	0.0734	0.0116	1.09	0.277
sample	ΔLEV 2006	−0.0020	−0.0090	0.0742	0.0924	−0.0030	0.53	0.596
	n	80	82					

Table 14: Results of the t-test for the parallel trend assumption

H Mean LEV



Notes: This figure compares the development of the means of the LEV of the treatment and the corresponding control group. Between 2006 and 2008, the important points in time in this investigation, the mean LEV of the treatment group falls from 61.26% (2006) to 57.75% (2008), by a total of 3.51 percentage points. During the same period, however, the mean LEV of the control group rises from 37.94% (2006) to 39,78%, a slight increase by 1.84 percentage points. As expected, the LEV of the treatment group is a mean of 23.32 percentage points higher than the LEV of the control group in 2006.

Figure 9: Mean LEV of the treatment and control groups

I Robustness check, losses

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV	(9) ΔLEV
TIME	−0.024**	−0.024**	−0.024**	−0.023**	−0.024**	−0.022*	−0.050*	−0.065**	−0.066***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.026)	(0.026)	(0.025)
TREAT	−0.015	−0.015	−0.015	−0.016	−0.015	−0.018	−0.015	−0.021*	−0.028**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
TREAT · TIME (−)	−0.000	−0.000	−0.000	−0.001	0.000	−0.002	−0.000	−0.001	0.002
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.016)	(0.016)
SALES		0.001						0.006**	0.005**
		(0.002)						(0.003)	(0.003)
COLLATERAL			0.001					−0.029*	−0.026
			(0.015)					(0.016)	(0.016)
ROA				−0.067*				−0.048	−0.003
				(0.040)				(0.040)	(0.041)
CURRENTRATIO					0.000			0.000	0.000
					(0.000)			(0.000)	(0.000)
ZSCORE						−0.010***		−0.013***	−0.013***
						(0.002)		(0.002)	(0.002)
NTR							−0.002	−0.004*	−0.004*
							(0.002)	(0.002)	(0.002)
LOSSES									0.050***
									(0.010)
Constant	0.019**	0.002	0.019	0.023***	0.019**	0.039***	0.119	0.166*	0.147*
	(0.008)	(0.028)	(0.012)	(0.009)	(0.008)	(0.009)	(0.088)	(0.090)	(0.089)
Observations	724	724	724	724	724	724	724	724	724
adjusted R^2	0.016	0.016	0.016	0.019	0.016	0.048	0.017	0.066	0.095
F statistic	3.802	2.946	2.848	3.547	3.006	9.104	3.173	5.636	7.519

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause (1% limit). The control group consists of companies that are as similar as possible. They were determined using propensity score matching and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 15: Results of the regression, robustness check losses

J Robustness check, losses without matching

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV	(9) ΔLEV
TIME	0.010***	0.009***	0.009***	0.009***	0.010***	0.010***	0.004	0.001	−0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
TREAT	0.023**	0.018**	0.017*	0.015*	0.023**	0.023**	0.023**	0.007	−0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
TREAT · *TIME* (−)	−0.034***	−0.033***	−0.033***	−0.033***	−0.034***	−0.034***	−0.034***	−0.032**	−0.031**
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
SALES		0.004***						0.004***	0.005***
		(0.001)						(0.001)	(0.001)
COLLATERAL			0.024***					0.014***	0.014***
			(0.004)					(0.004)	(0.004)
ROA				−0.108***				−0.104***	−0.074***
				(0.007)				(0.007)	(0.008)
CURRENTRATIO					0.000			0.000	0.000
					(0.000)			(0.000)	(0.000)
ZSCORE						−0.000**		−0.000**	−0.000**
						(0.000)		(0.000)	(0.000)
NTR							−0.001	−0.001	−0.001
							(0.001)	(0.001)	(0.001)
LOSSES									0.051***
									(0.004)
Constant	−0.018***	−0.060***	−0.026***	−0.007***	−0.018***	−0.018***	0.005	−0.025	−0.035
	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)	(0.002)	(0.023)	(0.023)	(0.023)
Observations	12,034	12,034	12,034	12,034	12,034	12,034	12,034	12,034	12,034
adjusted R^2	0.002	0.005	0.005	0.019	0.002	0.002	0.002	0.024	0.038
F statistic	7.672	15.95	13.64	59.66	5.938	7.125	6.019	33.36	47.79

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause (1% limit). The control group consists of companies that are as similar as possible. They were determined using propensity score matching and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 16: Results of the regression, robustness check losses without matching

K Correlation matrix

	ΔLEV	$TIME$	$TREAT$	TIME · TREAT	$SALES$	$COLLATERAL$	ROA	$CURRENTRATIO$	$ZSCORE$	NTR
ΔLEV	1.0000									
$TIME$	− 0.0246	1.0000								
$TREAT$	− 0.1069*	0.0000	1.0000							
$TREAT \cdot TIME$	− 0.1385*	0.5792*	0.5764*	1.0000						
$SALES$	0.0705	0.0025	− 0.1323*	− 0.0804	1.0000					
$COLLATERAL$	− 0.0634	− 0.0187	0.0865	0.0381	− 0.5155*	1.0000				
ROA	− 0.0151	− 0.0296	− 0.0674	− 0.0160	0.1125*	− 0.1183*	1.0000			
$CURRENTRATIO$	− 0.0764	− 0.0253	− 0.1562*	− 0.0986*	0.2889*	− 0.4993*	0.0315	1.0000		
$ZSCORE$	− 0.0938	0.0132	− 0.2188*	− 0.1155*	0.4765*	− 0.6503*	0.2499*	0.5277*	1.0000	
NTR	− 0.0052	− 0.8663*	0.0021	− 0.4990*	0.0271	0.0223	− 0.0067	− 0.0257	− 0.0672	1.0000

Notes: A significant correlation of -0.6503 between the variables $ZSCORE$ and $COLLATERAL$, of 0.4765 between $ZSCORE$ and $SALES$ and of 0.5277 between $ZSCORE$ and $CURRENTRATIO$ can be observed. These correlations can be explained by $COLLATERAL$ and $CURRENTRATIO$ being indirectly and $SALES$ directly included in $ZSCORE$ (eqs. (4) and (7)). Additionally, a significant correlation of -0.8663 between NTR and $TIME$ can be identified. This result can be explained by the corporate tax rate being cut by 10 percentage points from 25% to 15% in the corporate tax reform 2008 for all companies. While the NTR decreases over time, the $TIME$ variable increases from zero prior the reform to one after the reform.

Table 17: Correlation matrix (Spearman)

L Robustness check, credit ratings

	(1) ΔLEV complete	(2) ΔLEV complete	(3) ΔLEV complete	(4) ΔLEV restricted	(5) ΔLEV restricted	(6) ΔLEV restricted
TIME	−0.017	−0.016	−0.017	−0.019	−0.019	−0.019
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)
TREAT	−0.005	−0.009	−0.005	−0.009	−0.000	−0.009
	(0.013)	(0.014)	(0.013)	(0.014)	(0.015)	(0.014)
TREAT · *TIME* (−)	−0.047**	−0.045**	−0.047**	−0.047**	−0.049***	−0.047**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
SALES	0.003	0.003	0.003	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
COLLATERAL	−0.022	−0.024	−0.023	−0.020	−0.009	−0.022
	(0.018)	(0.018)	(0.019)	(0.018)	(0.020)	(0.019)
ROA	−0.002	−0.014	−0.003	−0.012	−0.010	−0.014
	(0.038)	(0.040)	(0.038)	(0.052)	(0.052)	(0.053)
CURRENTRATIO	0.000	−0.000	0.000	−0.001*	−0.001	−0.001*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
ZSCORE	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
NTR	−0.003	−0.003	−0.003	−0.004	−0.004	−0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
*RISK*1		0.015			−0.051	
		(0.016)			(0.040)	
*RISK*2			−0.013			−0.013
			(0.038)			(0.038)
Constant	0.118	0.110	0.121	0.129	0.144	0.132
	(0.100)	(0.101)	(0.101)	(0.102)	(0.103)	(0.103)
observations	416	416	416	404	404	404
F statistic	0.056	0.058	0.056	0.063	0.067	0.064
adjusted R^2	2.683	2.501	2.421	2.962	2.837	2.672

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause (1% limit). The control group consists of companies that are as similar as possible. They, were determined using propensity score matching and are not subject to the interest barrier. The regression results are tested for robustness against the risk measures *RISK*1 and RIKS2. The Columns (1) to (3) are based on the full sample while the columns (4) to (6) are based on a restricted sample with excluded values greater than one for *RISK*1 as abnormal values (*Koch and Prassel* (2011), p. 12.). Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 18: Results of the regression, robustness check for *RISK*1 and *RISK*2

M Robustness check, various reporting dates

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.040***	0.040***	0.040***	0.041***	0.040***	0.041***	0.018	0.005
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.030)	(0.029)
TREAT	0.022	0.026*	0.022	0.022*	0.020	0.019	0.021	0.024*
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
TREAT · TIME (–)	−0.064***	−0.064***	−0.064***	−0.065***	−0.062***	−0.065***	−0.064***	−0.062***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)
SALES		0.006**						0.012***
		(0.003)						(0.003)
COLLATERAL			0.011					0.011
			(0.017)					(0.019)
ROA				0.047				0.076*
				(0.042)				(0.041)
CURRENTRATIO					0.000*			0.000**
					(0.000)			(0.000)
ZSCORE						−0.006***		−0.010***
						(0.002)		(0.002)
NTR							−0.002	−0.003
							(0.003)	(0.002)
Constant	−0.029***	−0.102***	−0.036***	−0.032***	−0.029***	−0.015	0.055	−0.028
	(0.009)	(0.034)	(0.014)	(0.010)	(0.009)	(0.010)	(0.102)	(0.102)
observations	384	384	384	384	384	384	384	384
adjusted R^2	0.035	0.047	0.036	0.038	0.044	0.057	0.037	0.113
F statistic	4.588	4.718	3.546	3.764	4.403	5.679	3.610	5.279

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 3 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause (2% limit). The control group consists of companies that are as similar as possible. They were determined using propensity score matching and are not subject to the interest barrier. The regression results are tested for robustness against the liquidity measure *LIQUIDITY*. The measure *LIQUIDITY* is a dummy variable with the value 1 if *CURRENTRATIO* < 1 . Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 19: Results of the regression, robustness check for various reporting dates

N Robustness check, 1 to 5 nearest neighbor matching

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.003	0.003	0.003	0.003	0.003	0.005	−0.025	−0.039**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.019)	(0.019)
TREAT	−0.004	−0.004	−0.004	−0.005	−0.004	−0.006	−0.004	−0.006
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
TREAT · TIME (−)	−0.031*	−0.031*	−0.031*	−0.031*	−0.031*	−0.033**	−0.031*	−0.033**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
SALES		0.004**						0.005***
		(0.002)						(0.002)
COLLATERAL			−0.006					−0.013
			(0.012)					(0.012)
ROA				−0.034				−0.042
				(0.033)				(0.033)
CURRENTRATIO					−0.000			−0.000
					(0.000)			(0.000)
ZSCORE						−0.004***		−0.005***
						(0.001)		(0.001)
NTR							−0.003	−0.004**
							(0.002)	(0.002)
Constant	−0.003	−0.045**	0.000	−0.001	−0.003	0.007	0.103	0.125*
	(0.005)	(0.021)	(0.008)	(0.005)	(0.005)	(0.005)	(0.065)	(0.067)
observations	1,042	1,042	1,042	1,042	1,042	1,042	1,042	1,042
adjusted R^2	0.010	0.014	0.010	0.011	0.010	0.028	0.012	0.043
F statistic	3.341	3.641	2.562	2.778	2.506	7.593	3.171	5.131

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 3 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause (2% limit). The control group consists of companies that are as similar as possible, which were determined using a propensity score matching (1 to 5 nearest neighbor) and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 20: Results of the regression, robustness check for propensity score matching with 1 to 5 nearest neighbors

O Robustness check, without matching

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.006**	0.005**	0.006**	0.006**	0.006**	0.006**	−0.001	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.007)
TREAT	0.014	0.009	0.009	0.008	0.014	0.014	0.015	0.001
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
TREAT · TIME (−)	−0.034**	−0.033**	−0.034**	−0.034**	−0.034**	−0.034**	−0.034**	−0.033**
	(0.017)	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.016)
SALES		0.005***						0.005***
		(0.001)						(0.001)
COLLATERAL			0.020***					0.011**
			(0.005)					(0.005)
ROA				−0.082***				−0.076***
				(0.009)				(0.009)
CURRENTRATIO					0.000			−0.000
					(0.000)			(0.000)
ZSCORE						−0.000**		−0.000**
						(0.000)		(0.000)
NTR							−0.001	−0.001
							(0.001)	(0.001)
Constant	−0.021***	−0.075***	−0.028***	−0.012***	−0.021***	−0.021***	0.006	−0.035
	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)	(0.002)	(0.024)	(0.025)
observations	9,988	9,988	9,988	9,988	9,988	9,988	9,988	9,988
adjusted R^2	0.001	0.007	0.003	0.009	0.001	0.001	0.001	0.016
F statistic	3.047	16.36	6.801	23.63	2.293	3.395	2.607	17.67

Notes: The treatment group consists of companies subject to the interest barrier. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause. The control group consists of all other companies in the sample which are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2006 and 2008, own calculations.

Table 21: Results of the regression, robustness check without matching

P Robustness check, falsification test placebo reform

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.009
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
TREAT	0.002	0.003	0.002	0.002	0.002	0.002	0.002	0.002
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
TREAT · *TIME* (–)	−0.009	−0.009	−0.009	−0.009	−0.009	−0.009	−0.009	−0.009
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
SALES		0.003						0.005**
		(0.002)						(0.003)
COLLATERAL			0.000					−0.004
			(0.016)					(0.024)
ROA				−0.050				−0.068
				(0.043)				(0.045)
CURRENTRATIO					0.000			0.000
					(0.000)			(0.000)
ZSCORE						−0.002		−0.004
						(0.003)		(0.004)
NTR							0.001	−0.000
							(0.002)	(0.002)
Constant	−0.011	−0.047*	−0.011	−0.010	−0.011	−0.008	−0.050	−0.043
	(0.008)	(0.026)	(0.014)	(0.008)	(0.008)	(0.009)	(0.091)	(0.093)
observations	436	436	436	436	436	436	436	436
adjusted R^2	0.001	0.006	0.001	0.005	0.001	0.002	0.002	0.015
F statistic	0.190	0.679	0.142	0.488	0.155	0.228	0.188	0.745

Notes: The treatment group consists of companies subject to a potential interest barrier in 2005. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the EBITDA, stand-alone or equity clause. The control group consists of companies that are as similar as possible, which were determined using a propensity score matching and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2005 and 2006, own calculations.

Table 22: Results of the regression, robustness check placebo reform 2006

Q Robustness check, simplified EBITDA

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	−0.009	−0.009	−0.009	−0.009	−0.009	−0.008	−0.041	−0.041
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.027)	(0.028)
TREAT	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.002
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
TREAT · *TIME* (−)	−0.036**	−0.036**	−0.036**	−0.036**	−0.037**	−0.038**	−0.036**	−0.038**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)
SALES		−0.001						0.001
		(0.002)						(0.003)
COLLATERAL			0.022					0.021
			(0.015)					(0.016)
ROA				−0.009				−0.005
				(0.035)				(0.035)
CURRENTRATIO					−0.001			−0.000
					(0.001)			(0.001)
ZSCORE						−0.001		−0.001
						(0.001)		(0.001)
NTR							−0.003	−0.003
							(0.002)	(0.002)
Constant	−0.005	0.007	−0.017	−0.004	−0.004	−0.004	0.119	0.100
	(0.009)	(0.028)	(0.012)	(0.009)	(0.009)	(0.009)	(0.094)	(0.098)
observations	388	388	388	388	388	388	388	388
adjusted R^2	0.045	0.045	0.050	0.045	0.046	0.048	0.049	0.058
F statistic	6.028	4.563	5.073	4.528	4.656	4.869	4.969	2.606

Notes: The treatment group consists of companies subject to a potential interest barrier in 2005. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the simplified EBITDA, stand-alone or equity clause. The control group consists of companies that are as similar as possible, which were determined using a propensity score matching and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2005 and 2006, own calculations.

Table 23: Results of the regression, robustness check simplified EBITDA

R Robustness check, various industries

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.004	0.003	0.004	0.004	0.003	0.005	−0.035	−0.051**
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.026)	(0.025)
TREAT	0.003	0.004	0.003	0.003	0.001	0.004	0.003	0.005
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
TREAT · *TIME* (−)	−0.031*	−0.031*	−0.031*	−0.031*	−0.029*	−0.033*	−0.031*	−0.030*
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
SALES		0.006**						0.012***
		(0.003)						(0.003)
COLLATERAL			0.009					0.013
			(0.015)					(0.016)
ROA				−0.033				−0.023
				(0.035)				(0.035)
CURRENTRATIO					0.000**			0.000**
					(0.000)			(0.000)
ZSCORE						−0.006***		−0.009***
						(0.002)		(0.002)
NTR							−0.004*	−0.005**
							(0.002)	(0.002)
Constant	−0.011	−0.079**	−0.017	−0.010	−0.011	−0.003	0.135	0.074
	(0.009)	(0.031)	(0.012)	(0.009)	(0.009)	(0.009)	(0.087)	(0.087)
observations	372	372	372	372	372	372	372	372
adjusted R^2	0.019	0.033	0.020	0.021	0.033	0.037	0.027	0.102
F statistic	2.372	3.103	1.877	1.996	3.138	3.557	2.507	4.588

Notes: The treatment group consists of companies subject to a potential interest barrier in 2005. These companies have a net interest expense greater than € 1 million, do not belong to a tax group as subsidiaries and cannot use the simplified EBITDA, stand-alone or equity clause. The control group consists of companies that are as similar as possible, which were determined using a propensity score matching and are not subject to the interest barrier. Robust standard errors on firm level are reported in parentheses. The asterisks (*** / ** / *) indicate the significance at the 1% / 5% / 10% level.
Source: Dafne database, 2005 and 2006, own calculations.

Table 24: Results of the regression, robustness check of various industries