

Alberternst, Stephan; Sureth, Caren

Working Paper

The effect of taxes on corporate financing decisions: Evidence from the German interest barrier

arqus Discussion Paper, No. 182

Provided in Cooperation with:

arqus - Working Group in Quantitative Tax Research

Suggested Citation: Alberternst, Stephan; Sureth, Caren (2015) : The effect of taxes on corporate financing decisions: Evidence from the German interest barrier, arqus Discussion Paper, No. 182, Arbeitskreis Quantitative Steuerlehre (arqus), Berlin

This Version is available at:

<https://hdl.handle.net/10419/106659>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



Arbeitskreis Quantitative Steuerlehre
Quantitative Research in Taxation – Discussion Papers

Stephan Alberternst / Caren Sureth

The Effect of Taxes on Corporate Financing Decisions – Evidence from the German Interest Barrier

arqus Discussion Paper No. 182

January 2015

www.arqus.info

ISSN 1861-8944

THE EFFECT OF TAXES ON CORPORATE FINANCING DECISIONS – EVIDENCE FROM THE GERMAN INTEREST BARRIER

Stephan Alberternst*
University of Paderborn

Caren Sureth †
University of Paderborn and Vienna University of Business and Economics

Abstract: The theoretical literature suggests that when taking tax effects into account, debt ought to be preferable to equity. However, there are no uniform predictions of the size of this tax benefit (tax shield) in comparison to an opposing increasing cost of debt (especially insolvency costs). The vast body of empirical studies on the impact of taxation on capital structure only provides puzzling effects. We believe the German corporate tax reform in 2008, which introduced an interest barrier as a “quasi-experiment”, is a promising opportunity to investigate the effects that arise from a reform of interest deductibility. We study capital structure adjustments empirically using financial statement data from German companies. We consider a study of German tax reform on the basis of German data of general interest because, first, similar tax reforms have been conducted in several countries. Second, the availability of single entity financial statements for German companies allow us to capture tax and capital structure details that have not been available in most prior studies. Third, the major characteristics of the German tax system can be regarded as representative for most European and the major Asian countries. All of this information enables us to contribute to solving the capital structure puzzle in a unique way. With significance at the 5% level, we find evidence that the companies that are affected by the interest barrier reduce their leverage by 3 percentage points more than companies that are not affected. We are the first to employ a detailed matching approach to the underlying rich dataset, which enables us to overcome some of the limitations of previous studies. While many prior empirical studies on capital structure have provided mixed results on capital structure reactions, we find robust evidence for the impact of tax reforms on corporations’ financing decisions.

JEL Classification: F34, H21, H24

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

Acknowledgements: We thank Harald Amberger, Kay Blaufus, Anna Feller, Katharina Finke, Annika Hegemann, Martin Jacob, Reinhold Koch, Lutz Kruschwitz, Daniela Lorenz, Jens Müller, Sönke Sievers and André Uhde, the participants of the arqus Annual Meeting in Bayreuth 2014 and the DIBT Doctoral Seminar at the Vienna University of Economics and Business in 2014 for valuable suggestions on an earlier draft. The usual disclaimer applies.

* University of Paderborn, Faculty of Business Administration and Economics, Warburger Str. 100, 33098 Paderborn, Germany. Tel.: +49-5251-60-1784, Fax: +49-5251-60-3520, email: stephan.alberternst@wiwi.upb.de, www.upb.de/taxation.

† University of Paderborn, Faculty of Business Administration and Economics, Warburger Str. 100, 33098 Paderborn, Germany. Tel.: +49-5251-60-1781, Fax: +49-5251-60-3520, email: caren.sureth@wiwi.upb.de, www.upb.de/taxation and Vienna University of Economics and Business, Vienna, Austria.

1 INTRODUCTION

Do taxes have an influence on the financing structure, particularly the debt financing, of corporations? In a series of model-theoretic analyses, *Modigliani and Miller* (1963), among others, have demonstrated that taxes have an impact on a company's debt ratio. Taking into account a constant income tax at the corporate level (corporate tax), in their model, *Modigliani and Miller* (1963) find theoretically maximal firm values for complete debt financing.¹ *Miller* (1977) extends this model with respect to a constant income tax at the shareholder level. He shows that in a so-called capital market equilibrium, capital structure always matters.² Accordingly, from an overall economic theory point of view there is an optimal capital structure. However, this optimal debt ratio cannot be determined analytically for an individual company.

The trade-off theory offers a theoretical explanation for capital structure decisions and an optimum debt ratio for individual companies.³ 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.⁴ We obtain the optimal ratio between debt and equity if the tax advantage of further debt financing (tax shield) can be perfectly offset against rising insolvency cost of further debt. Figure 1 depicts this relationship graphically.⁵ From a theoretical perspective, there is little doubt that taxes have an impact on the capital structure of companies. Nevertheless, the direction of the impact is unclear. In a series of empirical studies, however, the impact of taxes on the capital structure could not be clearly demonstrated. A strand of literature is concerned with the factors that impact the capital structure of companies. 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 will lead to an increased debt ratio.⁶ In line with this theory, further empirical studies examine the relationship between the marginal tax rate (MTR) and the financing structure of companies. *MacKie-Mason* (1990), *Givoly et al.* (1992), *Graham* (1996), *Sarkar and Zapatero* (2003) and *Stöckl and Winner* (2013) find that a higher MTR is associated with a higher debt ratio. In addition, *Graham* (2008) finds that many studies demonstrate that taxes influence financing decisions; however, this effect is not always strong.⁷ Furthermore, he concludes that more studies are needed for

¹ See *Modigliani and Miller* (1963) as the cost of debt are tax-deductible.

² See *Miller* (1977)

³ See *Fama and French* (2002).

⁴ See *Fama and French* (2002).

⁵ For figure 1 see section 3.

⁶ See *Frank and Goyal* (2009), p. 9.

⁷ See *Graham* (2008), p. 121.

a better understanding of the influence of taxes on capital structure, particularly with respect to time-series effects.⁸ By contrast, *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.

Buettner et al. (2009) indicate that a higher local tax rate is also associated with an increase in internal debt. *Buettner et al.* (2011) investigate the impact of corporate taxes on the capital structure of foreign subsidiaries of multinational firms; their results provide evidence for a positive effect of local tax rates on both internal and external debt.

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.⁹ Empirical studies in a national and international context include the works of *Givoly et al.* (1992), *Alworth and Arachi* (2001), *Cheng and Green* (2008), *Overesch and Wamser* (2010), *Lanzavecchia and Tagliavini* (2011), *Tzioumis and Klapper* (2012) and *Faccio and Xu* (2013). They find a significant but usually weak correlation between taxes and the debt ratio.

Previous research also investigates the relationship between thin capitalization rules or other interest deduction restrictions and entrepreneurial capital structure decisions. *Maßbaum and Sureth* (2009) take the Belgian, Italian and German rules as an example and investigate whether they can partially explain why corporations receive both debt and equity capital. They refer to the model of *Miller* (1977) and analytically find that the financing effects of thin capitalization rules depend significantly on the underlying tax system.¹⁰ Furthermore, *Maßbaum et al.* (2012) show theoretically that in most cases it is possible that investors are indifferent between debt and equity, taking the German interest barrier into account. *Buettner et al.* (2012) analyze empirically 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 the foreign affiliates of U.S. multinationals in 54 countries. They show that these restrictions reduce an affiliate’s debt to assets ratio on average by 1.9 percentage points. Faced with a large number of studies with mixed results on the relationship between taxes and the debt ratio, *Feld et al.* (2013) analyze 46 previous studies in a meta-analysis. They

⁸ See *Graham* (2008), p. 122.

⁹ See *Eggert and Weichenrieder* (2002), p. 532.

¹⁰ See *Maßbaum and Sureth* (2009), p. 147.

conclude that the debt-to-asset ratio rises by 2.7 percentage points if the simulated marginal tax rate increases by 10 percentage points.¹¹

In the literature, several explanations are provided for these mixed results, 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.¹² Furthermore, investigations indicate that financing decisions are often long-term decisions and companies adapt their structure only very slowly.¹³ Likewise, there is evidence that tax-induced adjustments of the debt ratio play only a minor role in financial decision-making.¹⁴

The German legislator introduced an interest barrier in the course of the corporate tax reform of 2008. Since then, the deductibility of debt expenses is limited if a certain exempted amount is exceeded and a set of other conditions is met. Against this background, it is interesting to study the emerging corporate capital structure reactions. To close the research gap and to help understand the capital structure puzzle, we investigate empirically the impact of taxes on financing decisions made after the introduction of the German interest barrier. We use the DAFNE database by Bureau van Dijk, which contains data from financial statements of over one million German companies. We concentrate our investigation on incorporated firms, i.e., the legal forms “GmbH” and “AG”, and use information drawn from the profit and loss accounts for 2004 to 2010. Finally, we obtain a sample of 6,130 companies.¹⁵ We use a “difference in difference” approach (DID) and divide the sample into a treatment group and a control group.

Prior studies by *Dreßler and Scheuering* (2012) and *Buslei and Simmler* (2012) also investigate the extent to which the introduction of the interest barrier affects the financing decisions of firms; they also use a DID. These studies, however, differ significantly from our study in the way they determine the treatment and control groups and thus in their sample selection and identification strategy. We conduct a propensity score matching to form an appropriate control group based on several company-specific metrics. Replicating the study of *Buslei and Simmler* (2012), it can be shown that their results are rather unstable. Furthermore, recalculating the results of *Buslei and Simmler* (2012) with our model specification leads to no significant results.¹⁶

¹¹ See *Feld et al.* (2013), p. 2862.

¹² See *Stöckl and Winner* (2013), p. 189.

¹³ See *Stöckl and Winner* (2013), p. 189 and *Fama and French* (2012), p. 90.

¹⁴ See *Fama and French* (2012), p. 90.

¹⁵ The study is based on companies with the legal form “GmbH” and “AG” because their disclosure requirements are higher than for partnerships. To ensure that there is no bias in the results, only corporate enterprises are included.

¹⁶ In contrast to *Buslei and Simmler* (2012), we believe that it is necessary to control also for time constant differences between the treatment and control group. See *Buslei and Simmler* (2012), p. 13. Further information is available on request.

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. Our study uses the German tax reform as a natural experiment to contribute to the solution of the capital structure puzzle. We consider a study of a German tax reform on the basis of German data 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.¹⁷ Most countries apply thin capitalization rules that limit the deductibility of interest expenses if the amount of debt exceeds a specific leverage ratio.¹⁸ This is followed by countries where the interest expenses are only deductible up to a certain fraction of the earnings before interest, taxes, depreciation and amortization (EBITDA).¹⁹ The number of countries with such thin capitalization rules has increased rapidly during the last years.²⁰ Second, 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. Third, the major characteristics of the German tax system can be regarded as representative of most European and the major Asian countries. We are convinced that our study is able to provide robust, unique, and unambiguous evidence for the capital structure effects of the restrictions of interest deductibility.

The following study is divided into seven sections. Following the introduction, we explain the German interest barrier in the second section and present our hypotheses in the third section. Section 4 presents the underlying model. Subsequently, we describe the sample in section 5 and analyze it descriptively. In section 6, we present and interpret our results and robustness checks and summarize and draw final conclusions in section 7.

2 THE GERMAN INTEREST BARRIER

2.1 LEGAL BACKGROUND

The main motivation behind the 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.²¹ The Government had recognized that revenues generated in Germany were being shifted to lower-tax countries, for example, through cross-border lending.²² To prevent this,

¹⁷ A systematization of different thin capitalization rules and an overview of the different thin capitalization rules currently in force in selected countries are given in figure 9 and table 11 of the appendix.

¹⁸ See types 3 and 9 in figure 9.

¹⁹ See type 13 figure 9.

²⁰ The number increased particularly for the types 9 and 13. See, e.g., Greece, Portugal and Poland from 2015.

²¹ See *UntStReformG* 2008 of 14.08.2007 (BGBl I 07, 1912), *Bundestag* (2007), p. 1 and *Heuermann* (2014), *EStG* § 4h Rd 12.

²² See *Bundestag* (2007), p. 1 and *Broer* (2009), p. 392.

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.²³ 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.²⁴ 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.²⁵

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.²⁶

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% than that of its parent company, the interest barrier does not apply either.²⁷

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.²⁸ For all companies within a tax group, the interest barrier is only applied on the level of the parent company.²⁹

2.2 PRIOR EMPIRICAL STUDIES

Applying a DID approach, *Dreßler and Scheuering* (2012) and *Buslei and Simmler* (2012) already conducted an empirical study on the impact of introducing the German interest barrier. These studies, however, differ significantly from our study in the way they determine the treatment and control groups. We design the treatment group based on the study by *Blaufus*

²³ EBITDA equals relevant profits plus interest expense less interest income, depreciation and amortization. See § 4h paragraph 1 sentence 2 EStG.

²⁴ See § 4h paragraph 1 sentence 4 and 5 EStG.

²⁵ 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. See BuergerEntlG dated July 16, 2009 (BGBl I 09, 1959) and WachstBeschlG dated December 22, 2009 (BGBl I 09, 3950).

²⁶ See § 4h paragraph 2 lit. c in conjunction with § 4h paragraph 3 sentence 5 EStG.

²⁷ See § 4h paragraph 2 lit. c and paragraph 2 lit. c sentence 3 sqq EStG. The Growth Acceleration Act of 2009 increased the tolerated threshold from the original 1% to 2% for fiscal years ending after December 31, 2009. See WachstBeschlG 22.12.2009 (BGBl I 09, 3950).

²⁸ See *Blaufus and Lorenz* (2009), p. 505.

²⁹ 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. See *Blaufus and Lorenz* (2009), p. 505.

and Lorenz (2009), who investigated how many companies are likely to be affected by the interest barrier. In line with their study, we use more accounting details to identify the affected firms than the previous studies by *Dreßler and Scheuering* (2012) and *Buslei and Simmler* (2012). Furthermore, we conduct a propensity score matching to form an appropriate control group based on several company-specific metrics. *Buslei and Simmler* (2012) restrict their identification procedure to different intervals of net interest expenses. Moreover, our sample size differs significantly from the size used in these studies.

Dreßler and Scheuering (2012) find evidence that affected companies reduce their leverage significantly by 1.5 percentage points. *Buslei and Simmler* (2012) find evidence that companies with a net interest expense close to the amount that is exempted from the interest barrier significantly reduce their leverage by 5.3 percentage points. All companies with net interest expenses less than € 1.2 million reduce their leverage significantly by 2 percentage points. Although both studies use the same database that we do and employ a similar approach, their findings differ in the magnitude of the observed impact. The procedure to determine the treatment and control group on the basis of different net interest expenses as a single factor in the work of *Buslei and Simmler* (2012) can be put into question. Replicating their study suggests that their results may be partially driven by their identification strategy. While *Buslei and Simmler* (2012) find that, on average, the leverage of the control group is higher than the one of the treatment group,³⁰ we expect an opposing relation. We expect that for companies to be affected by the interest barrier, they need sufficiently high net interest expenses to exceed the exempted amount. Thus, rather large companies and companies with high leverage are likely to be affected. In addition, the number of companies in the treatment and control group differs, which may distort the results. Upon replicating the study of *Buslei and Simmler* (2012), it can be shown that their results are very unstable and depend significantly on the chosen intervals of net interest expense and thus the determination of the treatment and control group. This problem is also reflected in the reported coefficients.³¹ Furthermore, recalculating the results of *Buslei and Simmler* (2012) with our model specification leads to no significant results.³²

³⁰ See *Buslei and Simmler* (2012), table 1 on p. 17 and Figure 1 on p. 18.

³¹ This is, for example, the case when *Buslei and Simmler* (2012) enlarge the interval of the net interest expense of € 0.3 million. The coefficient decreases from -5.3% to -2% with only a slight decline in significance.

³² In contrast to *Buslei and Simmler* (2012), we believe that it is necessary to control also for time constant differences between the treatment and control group. See *Buslei and Simmler* (2012), p. 13. Further information is available upon request.

3 HYPOTHESES

The following study investigates empirically whether taxes have 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.³³ This relationship between the tax benefit on the one hand and rising bankruptcy and agency costs with a rising debt ratio on the other hand is summarized in the trade-off theory.³⁴ This theory suggests that the capital structure is optimal (optimal leverage) when the advantage of an additional unit of debt corresponds exactly to the costs.³⁵ The relationship between the market value of the company and the debt ratio is illustrated in figure 1. In the following,

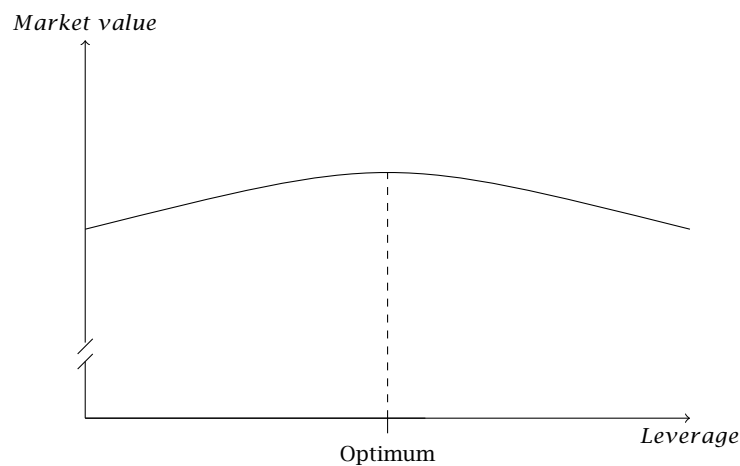


Figure 1: Trade-Off-Theory

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:

The companies that would have been affected by the interest barrier ahead of its actual introduction in the 2008 corporate tax reform reduce their debt to a greater extent than the companies that would not have been affected.

³³ See *Parrino and Weisbach* (1999), p. 39.

³⁴ See *Fama and French* (2002), p. 1.

³⁵ See *Fama and French* (2002), p. 1.

4 IDENTIFICATION STRATEGY

4.1 EMPIRICAL APPROACH

The research question is investigated by means of a “difference in difference” (DID) approach.³⁶ 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 ($TREAT = 0$).³⁷

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 0 for data before the reform and 1 for data after the reform.³⁸

The debt ratio (LEV) of the companies in the sample is defined as the ratio between debt and total assets.³⁹ The equity ratio (EQR) is defined 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:

$$\Delta LEV = LEV_t - LEV_{t-1}. \quad (1)$$

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

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

Figure 8 in appendix A depicts the expected reaction of the treatment and the control group. 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 group). Nevertheless, they are not likely to respond differently to other factors because the companies do not differ in these 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 while companies in the control group will not have such high interest expenses.

³⁶ This type of model is also known as “Interaction among dummy Variables”. See *Wooldridge* (2014), p. 195 - 202 and *Roberts and Whited* (2012), p. 38 - 47.

³⁷ In the course of study, a propensity score matching approach is used to identify a control group that is almost equivalent in terms of group size and company properties. See section 4.3.

³⁸ The exact point in time of the differentiation is described in section 4.4.

³⁹ See *Dreßler and Scheuering* (2012), p. 14.

The exogenous shock that is the introduction of the interest barrier affects only the treatment group such that we expect an adjustment of the LEV in the treatment group. All other factors, such as the impact of the financial crisis, affects both groups equally. Using the DID, we examine whether the two groups differ in their response to the 2008 corporate tax reform in regard to an adaptation of the LEV. The expected effect only occurs in firms without liquidity problems (bankruptcy costs). In terms of the direction of this effect, we expect that companies in the treatment group reduce their LEV more strongly than those in the control group.⁴⁰

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, which largely adheres to the model of *Stöckl and Winner* (2013),⁴¹ which does not focus on taxes. The control variables are presented in table 1 along with the expected reaction of the coefficients.

variable	expected reaction
SALES	+
SECURITIY	+/-
CURRENTRATIO	+
ROA	-
ZSCORE	-
NTR	+
AGE	+

Table 1: Control variables with the expected reaction

The variable *SALES* is taken as a proxy for *company size* and is defined as the logarithm of annual sales.⁴² We expect that larger firms have better access to debt capital markets. For this reason they are likely to have a 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.⁴³ 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.⁴⁴ The variable *SALES* is defined as:

$$SALES = \ln \text{ sales.} \quad (3)$$

⁴⁰ See hypothesis H1.

⁴¹ The choice of control variables in the model of *Stöckl and Winner* (2013) is based on previous empirical studies. See, e.g., *MacKie-Mason* (1990), *Rajan and Zingales* (1995), *Graham* (1999) and *Alworth and Arachi* (2001).

⁴² As in previous studies, in the present study data sales are also strongly left-skewed. Taking the logarithm of sales produces an almost normally distributed variable of sales. See *Graham* (1999), p. 168, *Bancel and Mittoo* (2004), p. 122, *Stöckl and Winner* (2013), p. 195 and *Tzioumis and Klapper* (2012), p. 12.

⁴³ See *Rajan and Zingales* (1995), p. 1422, *Graham* (1999), p. 168 and *Stöckl and Winner* (2013), p. 195.

⁴⁴ See *Graham* (1999), p. 168 and *Stöckl and Winner* (2013), p. 195.

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.⁴⁵ Conversely, investment intensity can also be seen as an indicator of depreciation or investment incentives that could impact negatively on future profits. If future income is lower, less debt interest can be invoked. This would limit the advantages of using debt.⁴⁶ According to this argument it is to be expected that a higher intensity of investment is connected with a lower debt ratio. Which of the two effects prevails cannot be predicted theoretically.⁴⁷ The variable *COLLATERAL* is defined as:

$$COLLATERAL = \frac{\text{fixed assets}}{\text{total assets}}. \quad (4)$$

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.⁴⁸ *liquidity* is represented by the *CURRENTRATIO* and is defined as:

$$CURRENTRATIO = \frac{\text{current assets}}{\text{current liabilities}}. \quad (5)$$

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.⁴⁹ The variable *ROA* serves as a proxy for *profitability* and represents the influence of the return on total assets on the financial structure of companies. The variable *ROA* is defined as:

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

We expect the variable *ROA* to have a negative influence on ΔLEV . With an increasing *probability of insolvency* the cost of debt also increases.⁵⁰ To measure the insolvency risk, we use the revised *ZSCORE* model of *Altman* (1968) because a market value for non-listed compa-

⁴⁵ See *Rajan and Zingales* (1995), p. 1455 and *Tzioumis and Klapper* (2012), p. 12.

⁴⁶ See *Stöckl and Winner* (2013), p. 196.

⁴⁷ See *Stöckl and Winner* (2013), p. 196.

⁴⁸ See *Graham* (2000), p. 1909. *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.

⁴⁹ See *Myers* (1993), p. 92, *Graham* (2000), p. 1909 and *Stöckl and Winner* (2013), p. 196.

⁵⁰ See *Graham* (1999), p. 164, *MacKie-Mason* (1990), p. 1476 and *Stöckl and Winner* (2013), p. 196.

nies is not available.⁵¹ The *ZSCORE* approach is used widely in theory and practice and is defined as follows:⁵²

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

For companies with a small *ZSCORE*, the insolvency risk is higher, and the lower boundary for a strong probability for bankruptcy is 1.23.⁵³ We expect the variable *ZSCORE* to have a negative impact on ΔLEV .⁵⁴ 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 this does not distort the investigation, we also control for the *nominal tax rate for corporations*.⁵⁵ The variable *NTR* is defined as:

$$NTR = LBT \cdot 0,035 + CTR^{56}. \quad (8)$$

The *NTR* has decreased over time, which also decreased the tax shield of debt. We hence expect a positive impact. The underlying model consists for ΔLEV as follows:

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

4.2 TREATMENT GROUP

First, we identify the companies that would potentially be affected by the interest barrier had it already existed in 2006.

⁵¹ The initial *ZSCORE* Model of *Altman* (1968) is based on listed U.S. companies. However, several studies show that the prediction ability for German and Austrian companies is also acceptable. See *Bemmann* (2005), p. 74. 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.

⁵² See *Altman* (2000), p. 25 and *Agarwal and Taffler* (2007), p. 285.

⁵³ See *Altman* (2000), p. 26.

⁵⁴ See *Stöckl and Winner* (2013), p. 196 - 197.

⁵⁵ See *Buslei and Simmler* (2012), p. 16.

⁵⁶ LBT = Local Business Tax (Gewerbesteuerhebesatz), CTR = Corporate Tax Rate (Körperschaftsteuersatz), the solidarity surcharge (Solidaritätszuschlag) is actually not included.

This study uses financial statement data from the DAFNE database, so we can only approximate the required data for the tax balance sheet.⁵⁷ The dummy variable *TREAT* is set equal to 1 for companies that meet the following conditions:⁵⁸

1. Net interest expense is greater than € 1 million.⁵⁹

$$\text{net interest expense} = \text{interest expense} - \text{interest income.} \quad (10)$$

2. Net interest expense is greater than € 1 million and the interest expenses exceed 30% of EBITDA. EBITDA is approximated as follows:⁶⁰

$$\begin{aligned} EBITDA = & \text{profit} \pm \Delta \text{ expected loss provisions} \\ & \pm \Delta \text{ accrual provisions} - \text{participation income} \\ & \pm \Delta \text{ deferred taxes} \pm \text{corporate tax} \\ & + \text{net interest expenses} + \text{depreciations.} \end{aligned} \quad (11)$$

3. The company belongs to a corporate group (participation rate greater than 50%) or there is harmful debt financing.⁶¹ Harmful debt financing occurs when the investor's stake is greater than 25% and the following applies:⁶²

$$\frac{\text{interest expenses to affiliated companies}}{\text{net interest expense}} > 10\% \quad (12)$$

⁵⁷ See *Blaufus and Lorenz* (2009).

⁵⁸ The procedure is to identify the treatment group on the basis of the study of *Blaufus and Lorenz* (2009), p. 523.

⁵⁹ We use 1 million € as the limit for the net interest expense because the original act stipulated this amount. See section 2.1. *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. See *Buslei and Simmler* (2012), p. 12. 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.

⁶⁰ 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.

⁶¹ See *Blaufus and Lorenz* (2009), p. 523.

⁶² For the variable “interest expenses to affiliated companies” we use the procedure described in footnote 60.

4. The equity ratio of the subsidiary is more than 1% lower than the one of the parent company.⁶³ § 4h paragraph 2 lit. c sentence 3 EStG defines the equity ratio as the ratio of equity to total assets.⁶⁴
5. The company is not a subsidiary in a tax group.⁶⁵

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.⁶⁶ 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.⁶⁷ 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.⁶⁸ 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.⁶⁹ Furthermore, "matched" samples

⁶³ We set the limit on the equity ratio comparison to 1%, as this value was stipulated in the original act. See section 2.1.

⁶⁴ For the parent company the adjusted equity within the meaning of § 4h paragraph 2 sentence 5 EStG is defined as: *equity – shares in associated companies + 0.5 · special reserves with long shares*. The corrected total assets are defined within the meaning of § 4h paragraph 2 sentence 6 EStG 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. For the variables *loan to associated companies*, *special reserves with long shares* and *shares in affiliated companies* we use the same procedure as described in footnote 60. Moreover, the DAFNE database 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.

⁶⁵ 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 tax sufficient to form a tax group. See *Baatz and Weydner* (2005) p. 521.

⁶⁶ *Wacholder et al.* (1992) argues that the results are most effective in empirical studies when the groups are almost equal. See *Wacholder et al.* (1992), p. 1044.

⁶⁷ *Cosslett* (1981), pp. 54 - 56, describes three different basic ways to determine a random comparison group. See *Wacholder et al.* (1992), p. 1044.

⁶⁸ See section 4.

⁶⁹ See *Baumann* (2012), p. 108. 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. See *Baumann* (2012), p. 108.

are significantly more efficient than random samples that are independently obtained by a random process.⁷⁰

To this end, the so-called “propensity score matching” is applied, taking into account “the nearest neighbor” principle.⁷¹ 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%.⁷² 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.⁷³ In this study, therefore, total assets (TA), profit (PR) and the number of employees (NE) are included as matching variables for the size of the companies in addition to the independent variables of the model.⁷⁴ We use the logarithm of TA and 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.⁷⁵ 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.

In the matching process, we do not consider industry because only a very small number of observations in the respective industry within the caliper limit of 0.1 are available. Consequently, we would need to cluster industries. As there is no economic and empirical evidence suggesting that industry matters to our research question we abstract from industry effects.⁷⁶ The measured variables TA and PR must be interpreted as critical in that they may be distorted by accounting and tax-optimized design measures, such as sale-and-leaseback deals or sales of receivables.⁷⁷ The number of employees can also be distorted because temporary workers or outsourcing effects are not necessarily taken into account.⁷⁸ The advantage of propensity score matching is that it considers multiple dimensions.⁷⁹ This, together with the

⁷⁰ See *McKinlay* (1977), p. 726, *Wacholder et al.* (1992), pp. 1042 - 1043 and *Abadie et al.* (2004), p. 8.

⁷¹ 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).

⁷² See *Gassen and Sellhorn* (2006), p. 16.

⁷³ See *Baumann* (2012), p. 119.

⁷⁴ This is in line with the literature in section 4.3.

⁷⁵ See *Finke* (2014), p. 13.

⁷⁶ Nevertheless we consider the industry in a robustness check. See page 25.

⁷⁷ See *Baumann* (2012), p. 121 - 122.

⁷⁸ See *Baumann* (2012), p. 121.

⁷⁹ See *Dehejia and Wahba* (2002), p. 151.

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.⁸⁰

The matching is performed from the data in 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.⁸¹ 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, 2008.⁸² Transitional periods, particularly for existing financing structures, are not provided for in the act.⁸³ In Figure 2 these points in time are blue.

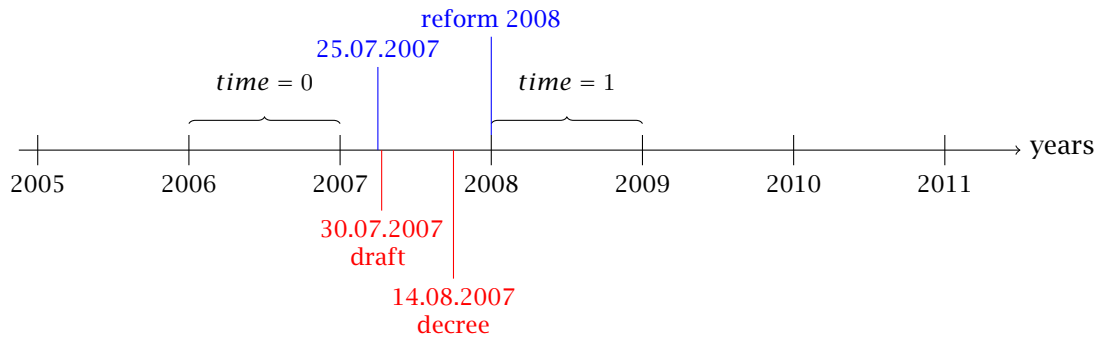


Figure 2: Overview over time

The Federal Government submitted the draft bill to the Upper House on July 30, 2007, and it passed as early as August 14, 2007.⁸⁴ In Figure 2 these data 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, in other words a period well before the corporate tax reform. For the post-reform period we use data from 2008 in the regression.

⁸⁰ See *Dehejia and Wahba* (2002), p. 151.

⁸¹ See section 4.

⁸² See section 4.

⁸³ See section 4.

⁸⁴ See *Bundestag* (2007) and *Heuermann* (2014), EStG § 4h Rd 3.

5 DATA AND DESCRIPTIVE STATISTICS

The data we use to validate the hypothesis are taken from the DAFNE database by Bureau van Dijk (BvD).⁸⁵ This unique dataset comprises actual and historical single statements of over one million German companies. The variables we use are listed in table 10 of the appendix.⁸⁶ The data were collected in August 2013.

The data we use have significant missing values and obvious false entries, which may lead to erroneous results of 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 a * in table 10 of the appendix B for the studied period, or that contain obvious erroneous data.⁸⁷ 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.⁸⁸ 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. The criterion for non-profit organizations is assumed to be the presence of the term “non-profit” in the company name.⁸⁹

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.⁹⁰ In the database, only very little information is included on the paid corporation tax, so we approximate this using the NTR and the tax paid.⁹¹ The corporate tax rate is often below the nominal corporate tax rate, which may lead to an overestimation of the affected companies because in the calculation the EBITDA is too high. The EBITDA thus calculated is deducted from corporate income taxes and thus more companies are affected.⁹²

The final sample includes a total number of 6,130 companies. Table 2 summarizes the respective steps and the extent of data losses. Approximately 950,000 companies are eliminated

⁸⁵ Bureau van Dijk Electronic Publishing GmbH, <http://www.bvdinfo.com/>.

⁸⁶ 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.

⁸⁷ For all variables without * we make assumptions for missing data and explain these as appropriate.

⁸⁸ See *Stöckl and Winner* (2013), p. 191. As these companies could greatly distort the results because they are threatened by insolvency or liquidity problems, which can be determined clearly, they are not considered further in this study.

⁸⁹ See *Blaufus and Lorenz* (2009), p. 523.

⁹⁰ 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.

⁹¹ The approximation applies the following relationship: $CTAX = \frac{tax}{NTR} \cdot (NTR - LBT \cdot 0.035)$.

⁹² This assumption is evaluated in the robustness checks. See section 6.7.

	number	sample size
complete database	1,035,986	1,035,986
Missing data for interest expense:	-949,057	86,929
Missing data for all required variables:	-80,127	6,802
US SIC = 6*** (e.g. banks)	-539	6,263
non-profit companies	-160	6,130

Table 2: Development of the sample

from the sample (approximately 92%) because the database lists no interest expense information for them.⁹³ Of the remaining 86,929 companies, approximately 89% are deleted due to incomplete records. The final sample size of 6,130 companies is approximately 6-‰ of the total number of available companies in the database. Table 3 considers the sample in more detail based on the size structure of the companies.

sales (in 1.000 €)	overall	
	count	in %
< 9,680	1,457	23.76
9,681 - 38,499	2,019	32.93
≥ 38,500	2,654	43.29
Summe	6,130	100.00

Table 3: Composition of the sample by company size⁹⁴

Approximately 43% of the companies can be classified as large corporations with an average sales of more than € 38.5 million. In addition, approximately another 33% of companies fall into the group of medium-sized corporations with average sales between € 9.6 million and € 38.5 million, while only approximately 23% are assigned to the “small corporations” group. A variety of companies in the database is more representative of small businesses with fewer disclosure requirements so that they cannot be included because of missing data for the subsequent investigation. It is expected that more medium-sized and large corporations will be affected by the interest barrier. For this reason, the companies in and the size of the sample are valued as appropriate for the subsequent investigation.

Figure 3 depicts the course of the average LEV over the entire sample over the period 2005 to 2010. The mean LEV decreases slightly over the entire period. Overall, a reduction of approximately 5.5 percentage points from 50.20% in 2005 to 44.70% in 2010 can be observed. On closer examination, it can be seen that the mean LEV falls slightly faster after 2006 and is nearly constant since 2009. Between 2007 and 2009, the mean LEV falls by 0.43% (2007), 1.15% (2008) and 1.8% (2009).⁹⁵ Because net interest expense plays a central role in

⁹³ Interest expense is a mandatory variable for the present study.

⁹⁴ Company size is measured according to § 267 HGB using the arithmetic mean of the sales from 2006 and 2008.

⁹⁵ The LEV is adjusted against missing data only for 2006 and 2008. The development in 2009 and 2010 may be due to the economic crisis of 2009 and is due to a small number of companies. The focus of the investigation is on 2006 to 2008, as described in section 4.4. A more extensive cleanup of the LEV for

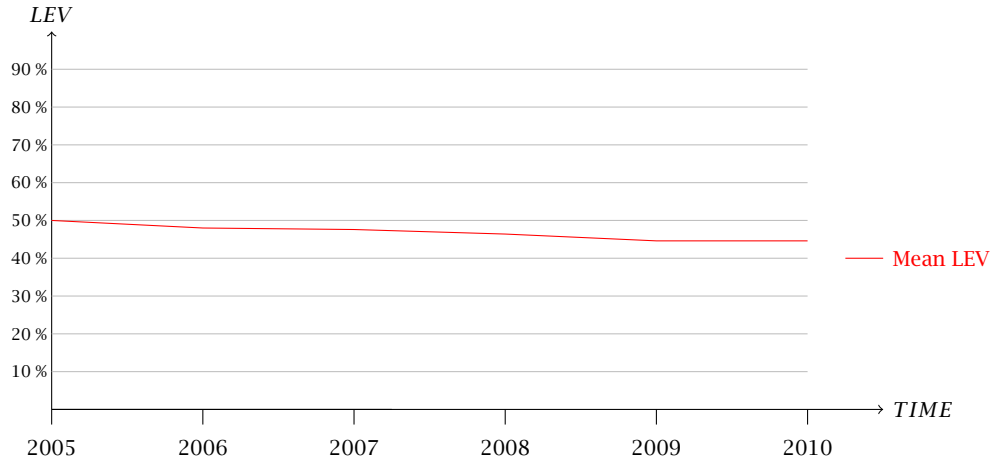


Figure 3: Mean LEV of the full sample

the present investigation, the distribution function of these variables is mapped in figure 4. We see a strong concentration around zero with a slight shift to the right. The average is € 963.71, meaning that more interest expenses exist as interest income. Skewness (*skew*) as a measure of the symmetry indicates how different a distribution is from a normal distribution. For a normally distributed variable (reference curve in figure 4) the skew is zero and the arithmetic mean, median and mode are identical. This means that for a *skew* of 56.25 in the present case, net interest expense in relation to the normal distribution has more characteristics that are larger than the arithmetic mean. Kurtosis (*kurt*) is a measure of the degree

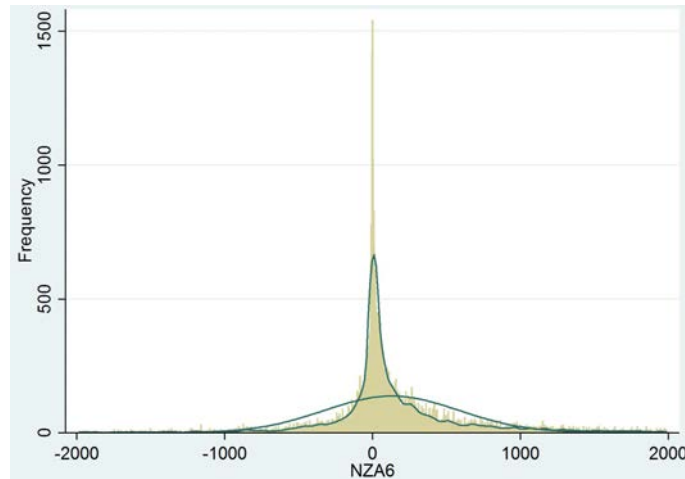


Figure 4: Distribution function of the net interest expense (in € 1.000) for the year 2006

of curvature of the distribution. A value of 3 corresponds to a normal distribution. Larger

more years is not performed because this would limit the sample size further and produce no additional information for the underlying setting.

values indicate a narrower bell compared with the normal distribution. The value of *kurt* is 3,668.23 for net interest expense in 2006. This indicates a very narrow bell curve.

Both *skew* and *kurt* confirm our expectations concerning the net interest expense in 2006, which is that most companies reported a net interest expense close to zero and due to the tax deductibility of debt interest, a larger number of companies reported a larger net interest expense.

5.1 IDENTIFICATION OF THE TREATMENT GROUP

The treatment group is determined as described in section 4.2. Table 4 shows the development of the treatment group size after each step. Most companies (approximately 90%) are not affected by the interest barrier because they do not have the required net interest expenses. In addition, another approximately 64% of the remaining companies are not subject to the interest barrier as they can use either EBITDA or the stand-alone clause. Only two companies in the present sample can use the equity clause.⁹⁶ Due to tax group membership, a further 30 companies are eliminated from the treatment group.⁹⁷ Overall, in the present study 150 companies out of the total sample were affected by the interest barrier in 2006. This corresponds to approximately 2.44%. Using propensity score matching, as described in

clause	affected companies in the full sample	treatment group	
		reduction per step	remaining companies
full sample	6,130		6,130
1. allowance	5,479	-5,479	651
2. EBITDA clause	5,894	-415	236
3. stand-alone clause	3,662	-21	182
4. escape clause	6,104	-2	180
5. tax group	5,417	-30	150

Table 4: Overview of the treatment group development for the year 2006⁹⁸

section 4.3, for all companies a corresponding company can be determined for a caliper of less than 0.1. Thus, according to the propensity score matching the treatment and the control

⁹⁶ It is important to note that only German parent companies can be considered for the equity comparison. See footnote 64. The sample includes 2,816 companies with a parent company, of which 1,314 companies have a German and 1,502 an international parent company. Only for 1,109 companies (39.38%) the necessary information for the equity comparison is available. Due to this, the escape clause might be underestimated in our analysis.

⁹⁷ With a random sample, the proxy for the tax group membership is verified on the basis of entries of profit transfer agreements in the commercial register (Amtsgericht Paderborn, for data from North Rhine-Westphalia). Occasionally, we observe that not all affiliations can be detected with the used proxy. Due to this, the results of this study could be underestimated. To use the data of the commercial register is not possible, as the University of Paderborn currently does not have access to all commercial registers in Germany.

⁹⁸ The individual steps are explained in section 4.2.

group each include 150 companies. Table 12 of the appendix shows the coefficients of the propensity score estimation. The variables TA, NI, NE, SALES, ROA, COLLATERAL and ZSCORE are significant at least at the 5% level in the regression model. In addition, the underlying R^2 is 23%.

5.2 ASSESSING MATCHING QUALITY

To obtain an appropriate investigation, it is essential that the determined control group is sufficiently similar to the treatment group regarding the chosen matching criteria. *Rosenbaum and Rubin* (1985) developed a standardized bias to assess the similarity of treatment and control group for each observable (x) of each company.⁹⁹ The standardized bias (SB) is calculated as follows:

$$SB_x = \frac{\bar{x}_{treatment} - \bar{x}_{control}}{\sqrt{\frac{\sigma_{x_{treatment}}^2 + \sigma_{x_{control}}^2}{2}}}. \quad (13)$$

The standardized bias for the treatment and control group for the unmatched and matched sample is depicted in table 5. The results illustrate that propensity score matching leads to a strong reduction in the bias between the treatment and control group. On average, the reduction is almost between 39% and 98%, which indicates a post-matching bias of less than 17% and in most cases less than 10%. 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 ZSCORE.¹⁰⁰ Thus, only the significant difference at the 10% level of ZSCORE can be observed between the two groups on the mean values. For the DID approach, the treatment and control groups must be very similar.¹⁰¹ In the underlying case, this condition is mainly satisfied. In figure 5, the standardized bias reduction is illustrated graphically by points before and crosses after matching. This figure demonstrates the strong standardized bias reduction due to the propensity score matching. The results suggest that the propensity score matching works well in assigning sufficient similar control companies to the treatment companies. figure 6 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,

⁹⁹ See *Finke* (2014), p. 18.

¹⁰⁰ 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.

¹⁰¹ See section 4.

Variable		Mean		%bias	%reduction bias	t-test	
		Treated	Control			t	p> t
TA (ln)	Unmatched	11.782	9.6121	140.7		14.57	0.000
	Matched	11.782	11.937	-9.4	93.3	-0.88	0.381
NI	Unmatched	11,812	4,792.2	9.9		1.45	0.147
	Matched	11,812	13,850	-2.9	-71.0	-0.23	0.817
NE (ln)	Unmatched	4.908	4.4678	26.3		3.42	0.001
	Matched	4.908	5.1748	-15.9	39.4	-1.26	0.207
SALES (ln)	Unmatched	10.944	10.094	53.1		6.15	0.000
	Matched	10.944	11.218	-17.1	67.8	-1.36	0.174
ROA	Unmatched	.03928	.10903	-48.5		-5.54	0.000
	Matched	.03928	.03352	4.0	91.8	0.43	0.665
COLLATERAL	Unmatched	.60729	.34764	88.9		11.84	0.000
	Matched	.60729	.61201	-1.6	98.2	-0.14	0.893
NTR	Unmatched	39	38.722	14.3		1.71	0.088
	Matched	39	39.137	-7.0	50.8	-0.60	0.551
ZSCORE	Unmatched	1.2836	4.4702	-5.3		-0.46	0.644
	Matched	1.2836	1.6823	-0.7	87.5	-1.75	0.082
CURRENTRATIO	Unmatched	58.345	61.96	-0.3		-0.03	0.975
	Matched	58.345	24.881	3.1	-825.7	0.59	0.554
ΔLEV	Unmatched	-.00464	-.0187	16.1		1.62	0.106
	Matched	-.00464	-.01121	7.5	53.3	0.63	0.529

Notes: This table compares the means of all matching criteria between the treatment and a control group which was determined via propensity score matching. The first line for each criteria indicates the mean of the unmatched and the line below for the matched sample. The two columns in the middle indicates the bias between the two subsamples and the absolute 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 and the year 2006.

Source: own calculation.

Table 5: Assessment of Matching Quality

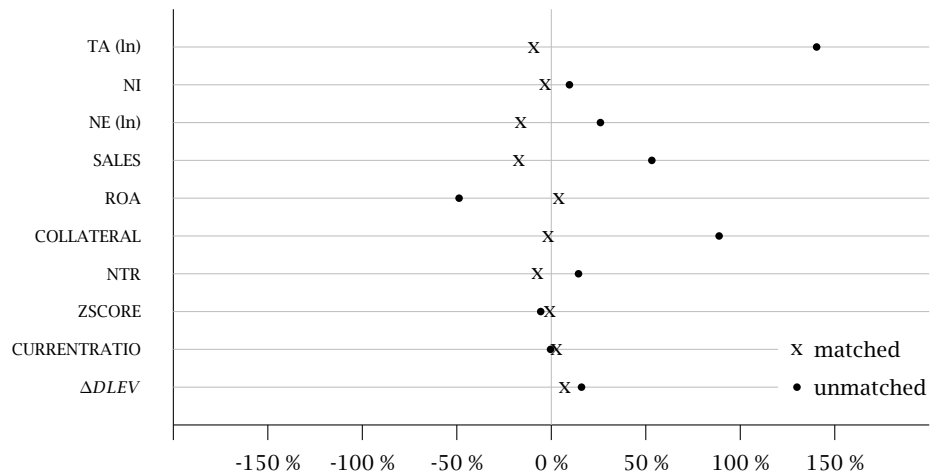


Figure 5: Standardized % bias across covariates

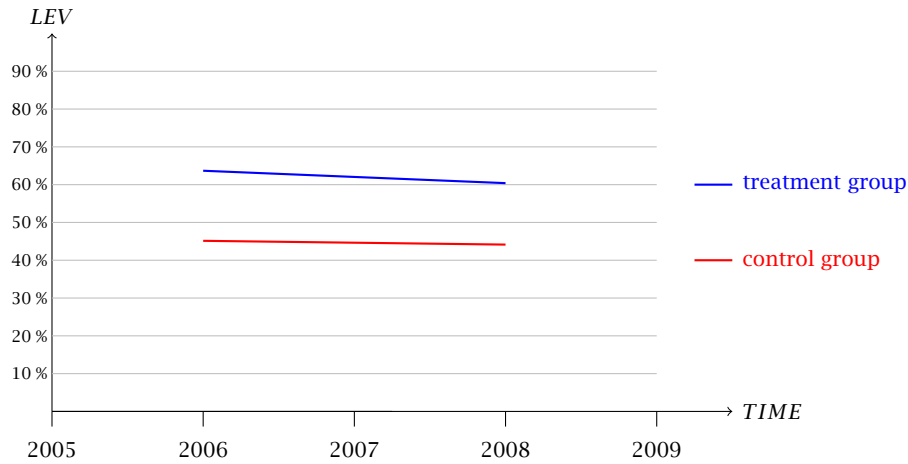


Figure 6: Mean LEV of the treatment and control groups

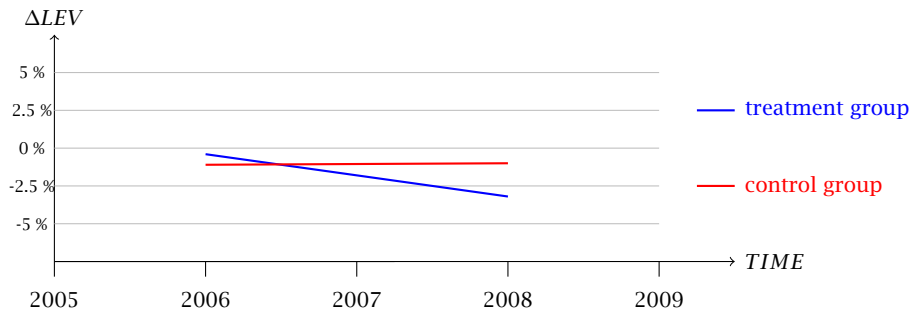


Figure 7: Mean ΔLEV of the treatment and control groups

the mean LEV of the treatment group falls from 63.67% (2006) to 60.38% (2008), by a total of 3.29 percentage points. During the same period, however, the mean LEV of the control group falls from 45.14% (2006) to 44.14%, a slight reduction by 1 percentage point. As expected, the LEV of the treatment group is a mean of 18.53 percentage points higher than the LEV of the control group in 2006. In figure 7 the development of the mean of ΔLEV is depicted. ΔLEV of the treatment group increases from -0.4% (2006) to -3.28% (2008) by a total of 2.88 percentage points. By contrast, the mean ΔLEV value of the control group is nearly constant with -1.1% (2006) and -1% (2008). From a purely descriptive perspective, these two figures indicate that hypothesis H1 cannot be rejected. The structure of the “matched” sample for the treatment and control groups is shown in table 6. The expectation that more large companies are affected by the interest barrier cannot be refuted descriptively, as it concerns approximately 60% large, 29% medium and only 9% of small corporations. In addition, no huge differences between the treatment and control groups can be observed.

sales (in 1.000 €)	“matched”		treatment group		control group	
	count	in %	count	in %	count	in %
< 9,680	33	11.00	14	9.33	19	12.66
9,681 - 38,499	86	28.66	48	32.00	38	25.33
≥ 38,500	181	60.33	88	58.66	93	62.00
sum	300	100.00	150	100.00	150	100.00

Table 6: Sample composition for the full, the “matched” sample and the treatment and control groups

6 RESULTS AND ROBUSTNESS CHECKS

We estimate various regression models for equation (9). The results are shown in table 7. The complete model is shown in model (8) and only with none or one control variable in model (1) to (7). We focus on the interaction term $TREAT \cdot TIME$ to figure out to what extent 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. First, the results of model (8) are considered. 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 stronger than those that are not affected. In other words, the companies in the treatment group reduced their LEV by 3 percentage points more than the companies in the control group. This indicates that hypothesis H1 for ΔLEV (8) cannot be rejected.¹⁰²

The variable $TREAT$ is not significant and cannot be interpreted. The variable $TIME$ is significant on the 5% level and has a negative coefficient of -3.6%.¹⁰³ This means that the time has a negative effect of 3.6% on ΔLEV . In the following, the control variables are considered and compared with the expected sign of the respective coefficient. The variable $SALES$, a proxy for the size of the company, has a positive coefficient and is high significant at the 1% level. Consequently, the expectation that larger companies use more debt to finance themselves can be supported. Furthermore, we use $ZSCORE$ as an indicator of the probability of insolvency. The coefficient of $ZSCORE$ is also highly significant and negative at the 1% level. A negative sign is in line with the expectation that for companies with a high risk of insolvency it is more difficult or costly to incur debt. The NTR is significant at the 5% level and negative.¹⁰⁴ With the corporate tax reform 2008 the corporate tax rate of 25% was reduced to 15%. As a consequence, the attractiveness of the tax shield was reduced. The result of the coefficient is in line with our expectation that companies use less debt because of the reduced

¹⁰² See section 4.

¹⁰³ The coefficient $TIME$ must interpreted with care due to a correlation between NTR and $TIME$ of -0.8663 (Spearman). See page 25.

¹⁰⁴ The coefficient NTR must be interpreted with care due to a correlation between NTR and $TIME$ of -0.8663 (Spearman). See page 25.

	(1) ΔLEV	(2) ΔLEV	(3) ΔLEV	(4) ΔLEV	(5) ΔLEV	(6) ΔLEV	(7) ΔLEV	(8) ΔLEV
TIME	0.001 (0.011)	0.001 (0.011)	0.001 (0.011)	0.001 (0.011)	0.001 (0.011)	0.003 (0.011)	-0.028 (0.022)	-0.036* (0.022)
TREAT	0.007 (0.011)	0.007 (0.011)	0.007 (0.011)	0.007 (0.011)	0.007 (0.011)	0.002 (0.011)	0.006 (0.011)	0.003 (0.011)
$TREAT \cdot TIME(-)$	-0.029* (0.015)	-0.029* (0.015)	-0.029* (0.015)	-0.029* (0.015)	-0.029* (0.015)	-0.030** (0.015)	-0.029* (0.015)	-0.030** (0.015)
SALES		0.002 (0.002)						0.008*** (0.002)
COLLATERAL			0.016 (0.013)					-0.002 (0.014)
ROA				-0.001 (0.033)				-0.024 (0.032)
CURRENTRATIO					0.000 (0.000)			-0.000 (0.000)
ZSCORE						-0.010*** (0.002)		-0.013*** (0.002)
NTR							-0.003 (0.002)	-0.004** (0.002)
Constant	-0.011 (0.008)	-0.031 (0.025)	-0.021* (0.011)	-0.011 (0.008)	-0.011 (0.008)	0.006 (0.008)	0.103 (0.077)	0.078 (0.077)
Observations	600	600	600	600	600	600	600	600
adjusted R-squared	0.013	0.014	0.016	0.013	0.013	0.058	0.017	0.081
F statistic	2.663	2.163	2.412	1.994	1.994	9.189	2.561	5.790

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 asterisks (***/ ** / *) indicate the significance at the 1% / 5% / 10% level.

Source: DAFNE database, 2006 and 2008, own calculations.

Table 7: Results of the regression

value of the tax shield. This result is also an indicator for taxes having in general an impact on corporate financing decisions. For all other control variables, i.e., *SECURTIY*, *ROA* and *CURRENTRATIO*, we cannot draw any conclusions because the respective coefficients are not significant. The regression equation has an adj. R-squared of 0.081, which corresponds to similar studies.

Models (1) to (7) in table 7 confirm the previously presented results of the model (8). There are no differences in the signs and only minimal changes in the magnitude of the coefficients. All coefficients are significant, except *TIME*. The coefficient *TIME* is unchanged in models (1) to (6). If we include *NTR* in models (7) and (8), the sign and magnitude of the coefficient of *TIME* change, but only the coefficient in model (8) is significant. The coefficient of *TIME* must be interpreted cautiously due to a correlation between *NTR* and *TIME* of -0.8663 (Spearman). However, especially the interaction term *TREAT* · *TIME* with -2.9% and -3.0% is nearly constant. We find a significance level close to the 5% level with a p-value of 5.5%. This level does not change across all models.

In the correlation matrix according to Spearman in table 13 in appendix F, a significant correlation of -0.5982 between the variables *ZSCORE* and *COLLATERAL* and of 0.5035 between *ZSCORE* and *SALES* can be observed. These correlations can be explained by the fact that *COLLATERAL* is indirectly and *SALES* directly included in *ZSCORE*.¹⁰⁵ Additionally, a significant correlation of -0.8663 between *NTR* and *TIME* can be identified. This result can be explained as 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. We use the variance inflation factor (VIF) to test for multicollinearity. Basically, a smaller VIF indicates less concerns with respect to multicollinearity.¹⁰⁶ 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 10 is chosen.¹⁰⁷ The results of the VIF-test are displayed in table 8. The complete model (8) includes VIFs smaller than nine. Except for *NTR* and *TIME*, all VIFs are smaller than three and are thus distant from 10. For this reason, we are not worried about multicollinearity.

In the following section, we test the robustness of the results against different influences beginning with the Citizens' Relief Act. Furthermore, we test for credit ratings, liquidity constraints, different reporting dates, different matching approaches, a simplified calculation for the EBITDA and industry as an additional matching criterion.

¹⁰⁵ See equation 4 and 7.

¹⁰⁶ See Wooldridge (2014), p. 86.

¹⁰⁷ See Wooldridge (2014), p. 86.

Variable	VIF
TIME	8.78
NTR	7.80
$TIME \cdot TREAT$	3.01
TREAT	2.02
ZSCORE	1.34
SALES	1.32
COLLATERAL	1.30
ROA	1.03
CURRENTRATIO	1.01
Mean VIF	3.07

Table 8: Results of the VIF-test

6.1 CITIZENS' RELIEF ACT

The legislature raised the exemption limit to € 3 million with the Citizens' Relief Act and the Growth Acceleration Act in 2009.¹⁰⁸ Additionally, the limit for the escape clause was increased by 1 percentage point to 2% by the Growth Acceleration Act in 2009.¹⁰⁹ To test our results against the possible anticipation effects of this reform, we identify the treatment group for the threshold of € 3 million and the escape clause with the 2%-limit and estimate the regression equation (9) again. All other parameters remain unchanged.

The results of the calculation are shown in table 14 of the appendix G. The sample size with 260 and 65 treated companies in total is less than half the size of the initial sample. The coefficient of $TREAT \cdot TIME$ is with -4.1% by 1.1 percentage points greater than in the initial regression and significant on the 5% level. Due to the greater magnitude and significant results, we conclude that the regression is robust against anticipation effects of the Citizens' Relief Act and the Growth Acceleration Act in 2009. In other words, those companies that have higher net interest expenses and cannot use the escape clause (2%-limit), react more sensitively to the tax reform and reduce their LEV by addition 4.1 percentage points in comparison to the companies in the control group.

6.2 CREDIT RATINGS

The costs of and the access to a loan often depends on the credit ratings by banks or rating agencies that are commonly used in order to control for risk.¹¹⁰ 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.¹¹¹ To control for the influence of credit ratings,

¹⁰⁸ See BuergerEntlG dated July 16, 2009 (BGBl I 09, 1959), p. 2 and WachstBeschlG dated December 22, 2009 (BGBl I 09, 3950), p. 43.

¹⁰⁹ See WachstBeschlG dated December 22, 2009 (BGBl I 09, 3950), p. 17.

¹¹⁰ See Koch and Prassel (2012), pp. 8 - 9.

¹¹¹ See Koch and Prassel (2012), p. 9.

we include the following two risk measures developed by *Koch and Prassel* (2012), which are approximated by measures determined on the basis of published accounting data.

$$RISK1 = \sqrt[3]{\frac{\text{interest paid}}{\text{non current liabilities} + \text{loans}}}. \quad (14)$$

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

In their study, *Koch and Prassel* (2012) 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.¹¹² 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 due to this reduces the attractiveness of debt. It is not possible to conjecture a uniform, either positive or negative influence. This effect depends on the initial level of the risk measure before the reform and their development over time. Both directions are conceivable.

In table 15 of the appendix H, 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 while 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.¹¹³ 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 at the 10% level, but the p-values are just below the 5% 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.

6.3 LIQUIDITY

The investigation already includes the variable $CURRENTRATIO$ as a measure for liquidity. The results in table 7 imply that $CURRENTRATIO$ is not significant and also has no economic impact because the coefficient is almost zero. To investigate the influence of liquidity in more detail, we include the following dummy variable based on $CURRENTRATIO$:

$$LIQUIDITY = 1 \text{ if } CURRENTRATIO < 1. \quad (15)$$

¹¹² See *Koch and Prassel* (2012), p. 15.

¹¹³ See *Koch and Prassel* (2012), p. 12.

If CURRENTRATIO is smaller than 1, the company cannot cover its obligations by 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. We obtain the following model:

$$\begin{aligned}\Delta LEV = & \beta_0 + \beta_1 \cdot TREAT + \beta_2 \cdot TIME + \beta_3 \cdot (TIME \cdot TREAT) \\ & + \beta_4 \cdot (TREAT \cdot LIQUIDITY) + \beta_5 \cdot (TIME \cdot LIQUIDITY) \\ & + \beta_6 \cdot (TIME \cdot TREAT \cdot LIQUIDITY) + \beta_7 \cdot controls + \epsilon.\end{aligned}\tag{16}$$

We expect a positive influence of the interaction term ($TIME \cdot TREAT \cdot LIQUIDITY$) on ΔLEV because companies that are affected by liquidity constraints and the interest barrier are not able to reduce their debt ratio due to liquidity constraints. We believe that liquidity constraints overcome the adaption reactions of companies on the interest barrier.

The results are shown in table 16 of the appendix. In column (2), the dummy variable LIQUIDITY is included and is not significant. In this model, *LIQUIDITY* has no impact on all other coefficients, including the interaction term $TREAT \cdot TIME$. Thus, we do not find evidence for a general influence of the variable *LIQUIDITY* on ΔLEV . In column (3), the results of the regression including the three way interaction are depicted. The interaction term $TIME \cdot TREAT \cdot LIQUIDITY$ is significant on the 5% level with 7.1%, meaning that companies with liquidity constraints which are also affected by the interest barrier increase their LEV by 7.1 percentage points. This is in line with our expectations, including the three way interaction that liquidity has also an effect on $TREAT \cdot TIME$. The coefficient of $TREAT \cdot TIME$ is with -5.0% significant on the 1% level and this is 2 percentage points higher than in the initial investigation. All other coefficients are almost unchanged. We believe that the effect from the liquidity constraints dominates the reaction of the interest barrier.

6.4 DIFFERENT REPORTING DATES

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.¹¹⁴ In table 17 of the appendix J, it is obvious that the results are still stable. The sample with 560 observations is 40 items smaller. The interaction term $TREAT \cdot TIME$ is still significant at the 5% level. The coefficient is with -3.3%, a 0.2 percentage point larger than in the initial investigation. No important changes for the other control variables can be observed.

¹¹⁴ See the underlying assumptions in section 5.

6.5 MATCHING

The propensity score matching is very important to identify similar companies to the treated companies. To test the robustness of the results, we calculate the regressions with a propensity score matching with 1 to 5 neighbors with replacement and without any propensity score matching.

6.5.1 1 TO 5 NEAREST NEIGHBOR MATCHING

The appendix K in table 18 depicts the results of the calculation 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 150 and the control group 519 companies, which results in 1,338 observations.¹¹⁵ The interaction term $TREAT \cdot TIME$ is still on the 5% level significant and with -2.8% only 0.2 percentage points smaller in comparison to the initial model. The adj. R^2 drops down to 1.6 %.

6.5.2 WITHOUT MATCHING

The regression results without a matching are shown of the appendix L in table 19. The treatment group includes still 150 and the control group 5,980 companies, which leads to 12,260 observations. The results for the interaction Term $TREAT \cdot TIME$ remain unchanged at the 5% significance level with -3.0%. The adj. R^2 also decreases to 1.3%. In sum, these two calculations indicate that the results are robust against different matching approaches. The content of the declaration of regressions (adj. R^2) decreases with an increasing sample size.

6.6 FALSIFICATION TEST - “PLACEBO REFORM”

We also examine whether potential treated and untreated companies had also a different development of their LEV in the period 2005 to 2006.¹¹⁶ The chosen new time window is much earlier than the German corporate tax reform 2008 and can be regarded as a placebo reform in 2006. As a robustness test, we made the same regression analysis for the time window 2005 to 2006. The results are shown in table 20 of the appendix M. As expected, the interaction term $TREAT \cdot TIME$ is neither statistically and nor economically significant. This result implies that the investigated companies do not differ in their behavior and all

¹¹⁵ The difference to the expected 750 companies in the control group is because 1 to 5 neighbors matching is only possible with replacement. See *Leuven and Sianesi* (2003), p. 5. Companies that are included twice or more in the control group are taken into account only once in the regression.

¹¹⁶ We do not use the period 2004 to 2006 because the data for 2004 are not available in the necessary quality.

companies react in the same way. A real reform suggests that the treated companies react differently to the control group as obvious in our investigation.

6.7 SIMPLIFIED EBITDA

The underlying definition of EBITDA in equation (11) contains a number of assumptions, especially regarding the corporate tax.¹¹⁷ To test the robustness of the model against these assumptions, we use the following simplified definition of EBITDA:

$$simp_EBITDA = profit + net\ interest\ expenses + depreciations. \quad (17)$$

As a consequence, we receive a little smaller treatment group with 142 companies. We conduct the same regression analysis with this simplified EBITDA. The results are displayed in table 21 of the appendix N. The interaction term $TREAT \cdot TIME$ is with -4.6% highly significant at the 1% level. Using the simplified EBITDA leads to more significant results with a coefficient that is 1.6% higher 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 overestimation of the effects due to this inaccuracy. However, this test underlines the robustness of our previous calculations.

6.8 INDUSTRY

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 9, the distribution of the companies across different industries is shown, classified by the first digit of the US SIC code. It can be seen that the distribution for the ten different industries is not equal. The industries 1, 2, 8 and 10 have fewer than 64 companies in the complete sample and fewer than 3 companies in the treatment group. Consequently, a matching with a caliper of 0.1 is not possible on a required quality level for these industries.¹¹⁸ Hence, we do not consider this industry in the following. For all other industries we matched an almost similar company to the treated companies using the propensity score matching with the additional requirement that the company must have the same industry classification. All other assumptions remain unchanged. The results are shown in table 22 of the appendix O. The treatment group contains 133 companies. It is smaller than the original treatment group because not all industries could be considered and not for all companies a

¹¹⁷ See footnote 91.

¹¹⁸ The industry 8 is not represented in the sample, because all companies of this industry are excluded due to special properties regarding their LEV. See page 5.

No.	Industry	Total sample	Treatment group
1.	Agriculture, Forestry, Fishing	64	3
2.	Mining	52	0
3.	Construction	767	43
4.	Manufacturing	2252	37
5.	Transportation, Communications, Electric, Gas and Sanitary Services	1069	30
6.	Wholesale Trade	938	22
7.	Retail Trade	243	3
8.	Finance, Insurance and Real Estate	0	0
9.	Services	742	12
10.	Public Administration	2	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 9: Distribution of the sample to industries (US SIC code)

match could be identified with a caliper of 0.1. 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 table 22 of the interaction term $TREAT \cdot TIME$ is still -2.9% and not statistically significant at any reported level. However, with a p-value of 11.2% it is close to the 10% significance level. One reason for the lower level of significance is possibly the relatively lower quality of the matching process. Nevertheless, our results are also stable if we consider industry as an additional matching criterion because the coefficient is unchanged and almost statistically significant on the 10% level.

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.

7 CONCLUSION

With a “difference in difference approach”, we investigate whether taxes have an impact on the financial structure of companies. The theoretical literature suggests that taking tax effects into account debt should be preferred against equity. Against the backdrop of Germany’s 2008 corporate tax reform, this relationship is empirically examined in the context of a quasi-experiment.

The so-called interest barrier was introduced under the 2008 corporate tax reform and 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. In this study we identify the companies that would potentially have been affected by the interest barrier before the 2008 reform and compare them with respect to a change in their debt ratio to a

control group. We use the DAFNE database by Bureau van Dijk with a sample size of 6,130 companies.

Of these, 150 companies were fictitiously affected in 2006 by the interest barrier. Using a propensity score matching for these 150 companies, we identify similar 150 unaffected companies. With a significance at the 5% level it is shown that the companies that are affected by the interest barrier reduce their debt ratio by 3 percentage points more than companies that are not affected. Furthermore, robustness checks indicate that affected companies without liquidity constraints reduce their debt ratio more by 4.9 percentage points. The results are also stable against various risk measures, a threshold of € 3 million, different reporting dates, different matching approaches and a simplified EBITDA. This provides unambiguous evidence for our prediction that taxes have an impact on firms' financing decisions. Our results are in line with the results of the meta study of *Feld et al.* (2013), who scrutinize the mixed results of 46 previous studies of the influence of taxes on financing decisions. Moreover, our findings are in line with those of *Blouin et al.* (2014) who examine the impact of thin capitalization rules that limit the tax deductibility of interest on the capital structure of the foreign affiliates of U.S. multinationals.

In principle, we can confirm the results of the studies of *Buslei and Simmler* (2012) and *Dreßler and Scheuering* (2012). While we can show that the results of *Buslei and Simmler* (2012) are highly dependent on the identification strategy and the model specification, our results prove to be robust against a whole set of variations and robustness checks. However, there are differences in the magnitude of the coefficients. The reaction of the leverage that we find is not as enormous at 3 percentage points as that found by *Buslei and Simmler* (2012) with 5.3 percentage points, but it is higher than the result of *Dreßler and Scheuering* (2012) with 1.53 percentage points. Moreover, we believe that we use a more complete and well-specified model and that we identify the affected companies in a more appropriate way. Furthermore, the control group is determined using a propensity score matching method, thereby skewing of results can be avoided. 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 capital structure effects of taxes.

Our empirical results imply that the equity of those German companies that are affected by the interest barrier has been strengthened. That said, from an empirical perspective, it is still unclear whether the interest barrier effectively prevents profit shifting into low-tax countries. This question arises especially due to the large number of exemptions with respect to the application of this rule. This issue should be subject to future research.

REFERENCES

- Abadie, Alberto; Drukker, David; Herr, Jane Leber and Imbens, Guido W. (2004) "Implementing Matching Estimators for Average Treatment Effects in Stata", *The Stata Journal*, 4 (3), 290-311.
- Agarwal, Vineet and Taffler, Richard J. (2007) "Twenty-five years of the Taffler z-score model: does it really have prediction ability?", *Accounting and Business Research*, 37 (4), 285-300.
- Altman, Edward I. (1968) "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy", *The Journal of Finance*, 23 (4), 589-609.
- (2000) "Predicting financial distress of companies: Revisiting the Z-Score and Zeta Models", *Stern School of Business Working Paper, New York University*.
- Alworth, Julian and Arachi, Giampaolo (2001) "The Effect of Taxes on Corporate Financing Decisions: Evidence from a Panel of Italian Firms", *International Tax and Public Finance*, 8, 353-376.
- Antoniou, Antonios; Yilmaz, Guney and Paudyal, Krishna (2008) "The Determinants of Capital Structure: Capital Market-Oriented versus Bank-Oriented Institutions", *Journal of Financial and Quantitative Analysis*, 43 (1), 59-92.
- Ayers, Benjamin C.; Cloyd, Bryan C. and Robinson, John R. (2001) "The Influence of Income Taxes on the Use of Inside and Outside Debt By Small Businesses", *National Tax Journal*, 54 (1), 27-55.
- Baatz, Eva and Weydner, Anselm (2005) "6. Kapitel: Hauptversammlung", in: Dirk Jannot and Jürgen Frodermann (eds.), *Handbuch der Europäischen Aktiengesellschaft - Societas Europaea*, C.F.Müller Wirtschaftsrecht, 204-236, Müller, Heidelberg.
- Bancel, Franck and Mittoo, Usha R. (2004) "Cross-Country Determinants of Capital Structure Choice: A Survey of European Firms", *Financial Management*, 33 (4), 103-132.
- Barclay, Michael J. and Smith, Clifford W. (1995) "The Priority Structure of Corporate Liabilities", *The Journal of Finance*, 50 (3), 899-916.
- Baumann, Rico (2012) *Leverage Buyout: Eine empirische Untersuchung der finanziellen Charakteristika, Vermögenseffekte und brancheninternen Effekte*, Dissertation EBS Universität für Wirtschaft und Recht and Gabler Verlag, Wiesbaden and Oestrich-Winkel.
- Bemmann, Martin (2005) "Verbesserung der Vergleichbarkeit von Schätzgüteregebnissen von Insolvenzprognosestudien", *Dresden Discussion Paper in Economics, Technische Universität Dresden*, (08/05).

- Blaufus, Kay and Lorenz, Daniela (2009) "Wem droht die Zinsschranke? Eine empirische Untersuchung zur Identifikation der Einflussfaktoren", *Zeitschrift für Betriebswirtschaft*, 79 (4), 503–526.
- Blouin, Jennifer; Huizinga, Harry; Laeven, Luc and Nicodème, Gaëtan (2014) "Thin Capitalization Rules and Multinational Firm Capital Structure", *CESIFO Working Paper No. 4695*.
- Broer, Michael (2009) "Ziele, Wirkungsweise und Steueraufkommen der neuen Zinsschranke", *Schmollers Jahrbuch - Journal of Applied Social Science Studies*, 129 (3), 391–413.
- Buettner, Thiess; Overesch, Michael; Schreiber, Ulrich and Wamser, Georg (2009) "Taxation and capital structure choice—Evidence from a panel of German multinationals", *Economics Letters*, 105 (3), 309–311.
- (2011) "Corporation taxes and the debt policy of multinational firms", *Zeitschrift für Betriebswirtschaft*, 81 (12), 1325–1339.
- (2012) "The impact of thin-capitalization rules on the capital structure of multinational firms", *Journal of Public Economics*, 96 (11-12), 930–938.
- Bundestag, Deutscher (2007) "Entwurf eines Unternehmenssteuerreformgesetzes 2008", *Bundesanzeiger*, Drucksache 220/07, vom 30.03.2007.
- Buslei, Hermann and Simmler, Martin (2012) "The Impact of Introducing an Interest Barrier: Evidence from the German Corporation Tax Reform 2008", *Deutsches Institut für Wirtschaftsforschung*, DIW Discussion Paper 1215.
- Cheng, Yue and Green, Christopher J. (2008) "Taxes and Capital Structure: A Study of European Companies", *Manchester School*, 76 (Supplement 1), 85–115.
- Cosslett, Stephen R. (1981) "Efficient Estimation of Discrete-Choice Models", in: Charles F. Manski and Daniel L. McFadden (eds.), *Structural Analysis of Discrete Data and Econometric Applications*, 51–111, The MIT Press, Cambridge.
- Dehejia, Rajeev H. and Wahba, Sadek (2002) "Propensity Score-Matching Methods for Nonexperimental Causal Studies", *The Review of Economics and Statistics*, 84 (1), 151–161.
- Deloitte (2014) "Deloitte International Tax Source", www.dits.deloitte.de (assessed 17.01.2015).
- Dreßler, Daniel and Scheuering, Uwe (2012) "Empirical Evaluation of Interest Barrier Effects", *Zentrum für europäische Wirtschaftsforschung*, Discussion Paper No. 12-146.

- Eggert, Wolfgang and Weichenrieder, Alfons J. (2002) "Steuerreform und Unternehmensfinanzierung: Tax Reform and Corporate Finance", *Jahrbücher für Nationalökonomie und Statistik*, 5 (222), 531-555.
- Faccio, Mara and Xu, Jin (2013) "Taxes and Capital Structure", *Social Science Research Network*, SSRN Working Paper 1781158.
- Fama, Eugene F. and French, Kenneth R. (2002) "Testing Trade-Off and Pecking Order Predictions About Dividends and Debt", *The Review of Financial Studies*, 15 (1), 1-33.
- (2012) "Capital Structure Choices", *Critical Finance Review*, 1 (1), 59-101.
- Feld, Lars P.; Heckemeyer, Jost H. and Overesch, Michael (2013) "Capital structure choice and company taxation: A meta-study", *Journal of Banking & Finance*, 37 (8), 2850-2866.
- Finke, Katharina (2014) "What is the scale of tax avoidance? Evidence from a Propensity Score Matching Approach", *Centre for European Economic Research*, Working Paper.
- Frank, Murray Z. and Goyal, Vidhan K. (2009) "Capital Structure Decisions: Which Factors Are Reliably Important?", *Financial Management*, 38 (1), 1-37.
- Gassen, Joachim and Sellhorn, Thorsten (2006) "Applying IFRS in Germany – Determinants and Consequences", *Betriebswirtschaftliche Forschung und Praxis*, 58 (4), 365-386.
- Givoly, Dan; Hayn, Carla; Ofer, Aharon R. and Sarig, Oded (1992) "Taxes and Capital Structure: Evidence from Firms Response to the Tax Reform Act of 1986", *The Review of Financial Studies*, 5 (2), 331-355.
- Graham, John R. (1996) "Debt and the marginal tax rate", *Journal of Financial Economics*, 41 (1), 41-73.
- (1999) "Do personal taxes affect corporate financing decisions?", *Journal of Public Economics*, 73 (2), 147-185.
- (2000) "How Big are the Tax Benefits of Debt?", *Journal of Finance*, 55 (5), 1901-1941.
- (2008) "Taxes and Corporate Finance", in: Bjørn Espen Eckbo (ed.), *Handbook of Empirical Corporate Finance - Volume 2*, 59-133, Elsevier, Amsterdam.
- Harris, Milton and Raviv, Artur (1991) "The Theory of Capital Structure", *The Journal of Finance*, 46 (1), 297-355.
- Heckman, James J.; Ichimura, Hidehiko and Todd, Petra (1998) "Matching As An Econometric Evaluation Estimator", *Review of Economic Studies*, 65 (2), 261-294.

- Heuermann, Bernd (2014) “EStG § 4h Betriebsausgabenabzug für Zinsaufwendungen (Zinsschranke)”, in: Bernd Heuermann and Peter Brandis (eds.), *Blümich - Einkommensteuergesetz, Körperschaftsteuergesetz, Gewerbesteuergesetz (Kommentar)*, Franz Vahlen, München.
- Huang, Rongbing and Ritter, Jay R. (2009) “Testing Theories of Capital Structure and Estimating the Speed of Adjustment”, *Journal of Financial and Quantitative Analysis*, 44 (2), 237-271.
- Koch, Reinhold and Prassel, Jens (2012) “Impact of fiscal loss compensation on company risk-taking”, unpublished working paper.
- Lanzavecchia, Alberto and Tagliavini, Giulio (2011) “Lesson Learned by the New Italian Law on Limited Tax Shield on Debt: Much Ado about Nothing”, *Intertax*, 39 (5/6), 343-352.
- Leuven, Edwin and Sianesi, Barbara (2003) “PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing”, *StataCorp. 2013. Stata 13 Base Reference Manual. College Station, TX: Stata Press.*, Version 1.2.3.
- MacKie-Mason, Jeffrey K. (1990) “Do Taxes Affect Corporate Financing Decisions?”, *Journal of Finance*, 45 (5), 1471-1493.
- Maßbaum, Alexandra (2011) *Der Einfluss von Thin Capitalization Rules auf unternehmerische Kapitalstrukturentscheidungen: Dissertation Universität Paderborn*, 1edition, Gabler Verlag, Wiesbaden.
- Maßbaum, Alexandra; Klotzkowski, Tasja and Sureth, Caren (2012) “Der Einfluss der Zinsschranke auf unternehmerische Kapitalstrukturentscheidungen”, *Zeitschrift für Betriebswirtschaft*, 82 (12), 1389-1425.
- Maßbaum, Alexandra and Sureth, Caren (2009) “Thin Capitalization Rules and Entrepreneurial Capital Structure Decisions”, *Business Research*, 1 (4), 1-23.
- McKinlay, Sonja M. (1977) “Pair-Matching - A Reappraisal of a Popular Technique”, *Biometrics*, 33 (4), 725-735.
- Miller, Merton H. (1977) “Debt and taxes”, *The Journal of Finance*, 32 (2), 261-275.
- Modigliani, Franco and Miller, Merton (1963) “Corporate Income Taxes and the Cost of Capital: A Correction”, *American Economic Review*, 53 (3), 433-443.
- Myers, Stewart C. (1993) “Still Searching for Optimal Capital Structure”, *Journal of Applied Corporate Finance*, 6 (1), 4-14.

- Myers, Stewart C. and Rajan, Raghuram G. (1998) "The Paradox of Liquidity", *The Quarterly Journal of Economics*, 113 (3), 733-771.
- Overesch, Michael and Wamser, Georg (2010) "Corporate tax planning and thin-capitalization rules: evidence from a quasi-experiment", *Applied Economics*, 42 (5), 563-573.
- Parrino, Robert and Weisbach, Michael S. (1999) "Measuring investment distortions arising from stockholder-bondholder conflicts", *Journal of Financial Economics*, 53 (1), 3-42.
- Rajan, Raghuram G. and Zingales, Luigi (1995) "What Do We Know about Capital Structure? Some Evidence from International Data", *The Journal of Finance*, 50 (5), 1421-1460.
- Roberts, Michael R. and Whited, Toni M. (2012) "Endogeneity in Empirical Corporate Finance", *Simon School Working Paper*, (FR 11-29).
- Rosenbaum, Paul R. and Rubin, Donald B. (1983) "The Central Role of the Propensity Score in Observational Studies for Causal Effects", *Biometrika*, 70 (1), 41-55.
- (1985) "Constructing a Control Group Using Multivariate Matched Sampling Methods That Incorporate the Propensity Score", *The American Statistician*, 39 (1), 33-38.
- Sarkar, Sudipto and Zapatero, Fernando (2003) "The trade-off model with mean reverting earnings: Theory and empirical tests", *The Economic Journal*, 113 (490), 834-860.
- Statistisches Bundesamt (2007) "Hebesätze der Realsteuern", https://www.destatis.de/GPStatistik/receive/NWHeft_heft_00009187;jsessionid=776B80E69010730BCF1F6458E6684975 (assessed 17.01.2015).
- (2009) "Hebesätze der Realsteuern", https://www.destatis.de/GPStatistik/receive/NWHeft_heft_00009197;jsessionid=776B80E69010730BCF1F6458E6684975 (assessed 17.01.2015).
- Stöckl, Matthias and Winner, Hannes (2013) "Körperschaftbesteuerung und Unternehmensverschuldung: Evidenz aus einem Europäischen Firmenpanel", *Jahrbücher für Nationalökonomie und Statistik*, 233 (2), 188-205.
- Titman, Sheridan and Wessels, Roberto (1988) "The Determinants of Capital Structure Choice", *The Journal of Finance*, 43 (1), 1-19.
- Tzioumis, Konstantinos and Klapper, Leora F. (2012) "Taxation and Capital Structure: Evidence from a Transition Economy", *Finanzarchiv*, 68 (2), 165-190.
- Wacholder, Sholom; Silverman, Debra T.; McLaughlin, Joseph K. and Mandel, Jack S. (1992) "Selection of Controls in Case-Control Studies: III. Design Options", *American Journal of Epidemiology*, 135 (9), 1042-1050.

Wooldridge, Jeffrey M. (2014) *Introduction to Econometrics: Europe, Middle East, and African Edition*, Cengage Learning EMEA, Hampshire and United Kingdom.

APPENDIX

A EXPECTED RESPONSE

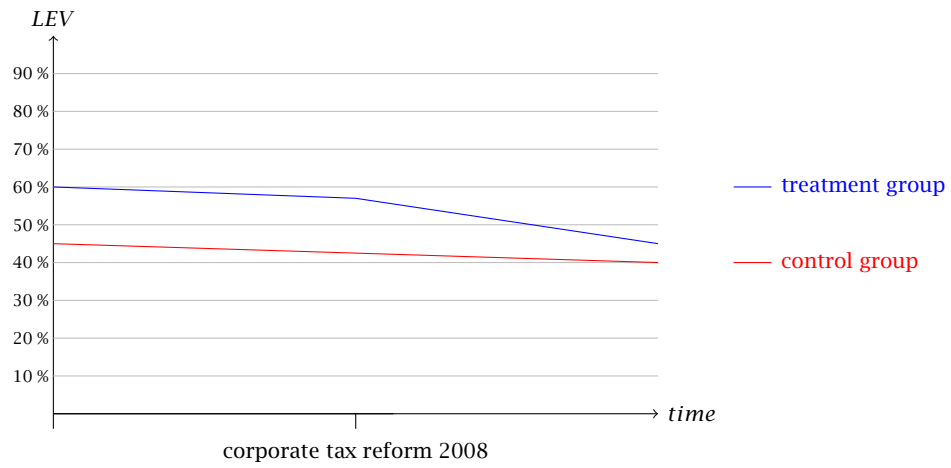


Figure 8: Expected response of the treatment group and the control group

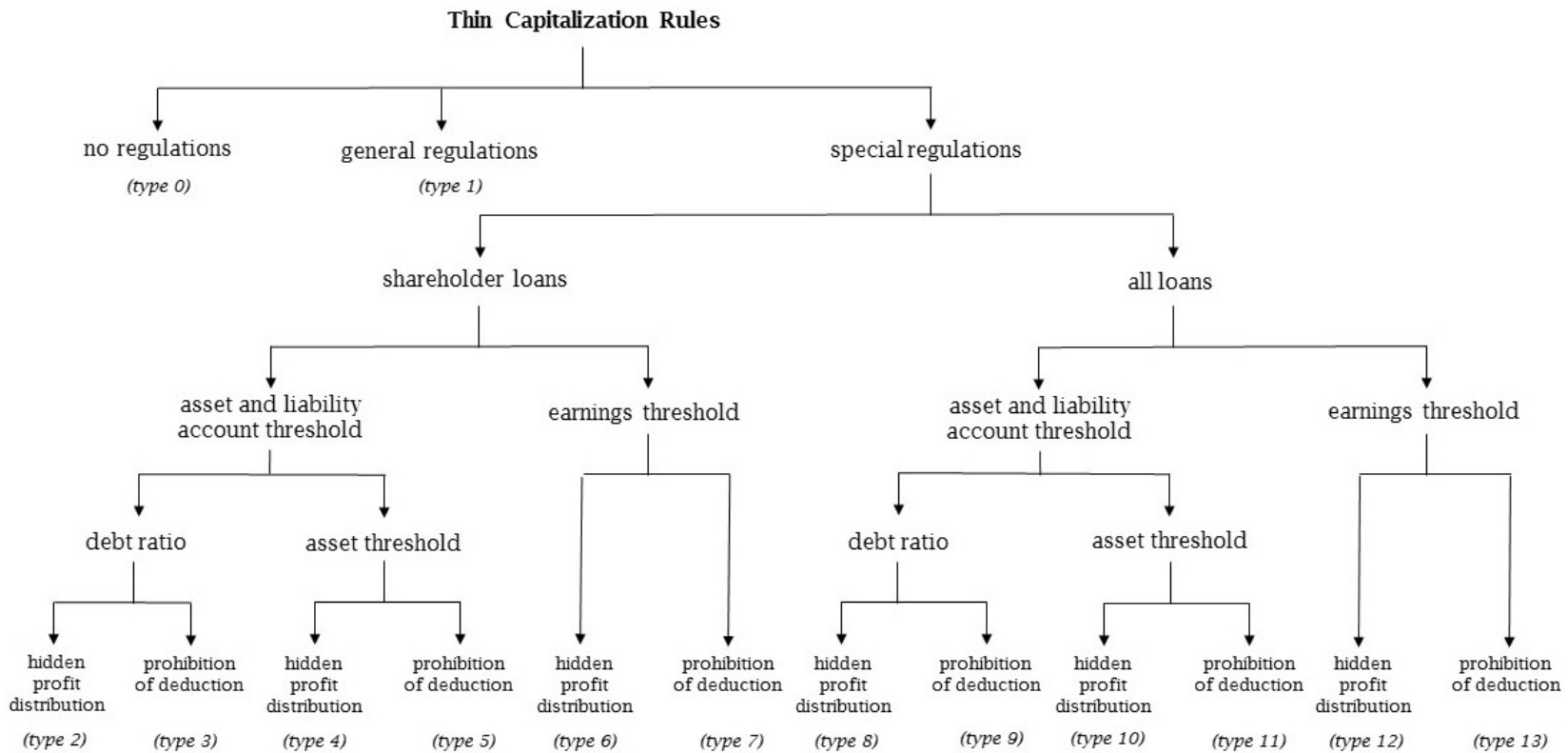
B LIST OF VARIABLES

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*	S
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

Table 10: Overview of the data exported from the DAFNE database

C 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 9: Systematization of thin capitalization rules.

D OVERVIEW 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). ¹Debt 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." ³Interest 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). ⁴In practice, the tax administration applies a debt to equity ratio of 85:15 to the holding of participations. ⁵There 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 11: Overview of various thin capitalization rules in selected countries

E RESULTS OF THE PROPENSITY SCORE MATCHING

	Treatmentgroup
TA (ln)	0.430 (0.042)***
NI	-0.000 (0.000)**
NE (ln)	-0.111 (0.031)***
SALES	-0.070 (0.043)
ROA	-0.921 (0.348)***
COLLATERAL	0.426 (0.162)***
NTR	-0.014 (0.021)
ZSCORE	-0.036 (0.010)***
CURRENTRATIO	-0.000 (0.000)
ΔLEV	0.024 (0.427)
Constant	-4.787 (0.837)***
N	6,130
Pseudo R^2	0.230

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

Source: own calculations.

Table 12: Results of the propensity score matching

F CORRELATION MATRIX

	ΔLEV	TIME	TREAT	TIME · TREAT	SALES	COLLATERAL	ROA	CURRENTRATIO	ZSCORE	NTR
ΔLEV	1.0000									
TIME	-0.0904*	1.0000								
TREAT	-0.0142	0.0000	1.0000							
TIME · TREAT	-0.0781	0.5774*	0.5774*	1.0000						
SALES	0.0439	-0.0020	-0.0899*	-0.0594	1.0000					
COLLATERAL	-0.0119	-0.0318	0.0457	0.0131	-0.4354*	1.0000				
ROA	-0.0315	-0.0066	-0.0295	-0.0169	0.1572*	-0.1178*	1.0000			
CURRENTRATIO	-0.0858*	0.0184	-0.1750*	-0.0928*	0.1098*	-0.4255*	-0.0302	1.0000		
ZSCORE	-0.1095*	0.0310	-0.2611*	-0.1320*	0.5035*	-0.5982*	0.1448*	0.3899*	1.0000	
NTR	0.0545	-0.8663*	-0.0269	-0.5156*	0.0878*	0.0153	-0.0436	-0.0317	-0.0449	1.0000

Table 13: Correlation matrix (Spearman)

G ROBUSTNESS CHECK, CITIZENS' RELIEF ACT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔLEV	ΔLEV	ΔLEV	ΔLEV	ΔLEV	ΔLEV	ΔLEV	ΔLEV
TIME	0.012 (0.014)	0.012 (0.014)	0.012 (0.014)	0.012 (0.014)	0.011 (0.014)	0.011 (0.014)	-0.036 (0.029)	-0.052* (0.028)
TREAT	0.017 (0.014)	0.018 (0.014)	0.017 (0.014)	0.017 (0.014)	0.017 (0.014)	0.014 (0.014)	0.017 (0.014)	0.016 (0.014)
$TREAT \cdot TIME (-)$	-0.042** (0.020)	-0.042** (0.020)	-0.042** (0.019)	-0.042** (0.020)	-0.042** (0.020)	-0.042** (0.019)	-0.042** (0.019)	-0.041** (0.019)
SALES		0.001 (0.003)						0.007** (0.003)
COLLATERAL			0.027 (0.017)					0.010 (0.019)
ROA				-0.019 (0.038)				-0.036 (0.039)
CURRENTRATIO					0.000 (0.001)			0.000 (0.001)
ZSCORE						-0.006*** (0.002)		-0.008*** (0.002)
NTR							-0.005* (0.002)	-0.006** (0.002)
Constant	-0.017* (0.010)	-0.031 (0.033)	-0.034** (0.014)	-0.016 (0.010)	-0.017* (0.010)	-0.006 (0.010)	0.169* (0.098)	0.154 (0.100)
Observations	260	260	260	260	260	260	260	260
adjusted R-squared	0.022	0.023	0.032	0.023	0.023	0.054	0.036	0.095
F statistic	1.925	1.494	2.080	1.504	1.512	3.618	2.367	2.903

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 asterisks (***) / (**) / (*) indicate the significance at the 1% / 5% / 10% level.

Source: DAFNE database, 2006 and 2008, own calculations.

Table 14: Robustness check, results of the regression

H ROBUSTNESS CHECK, CREDIT RATINGS

	(1) Δ LEV complete	(2) Δ LEV complete	(3) Δ LEV complete	(4) Δ LEV restricted	(5) Δ LEV restricted	(6) Δ LEV restricted
TIME	-0.036* (0.022)	-0.036 (0.022)	-0.034 (0.022)	-0.032 (0.023)	-0.032 (0.023)	-0.030 (0.023)
TREAT	0.003 (0.011)	0.002 (0.011)	0.003 (0.011)	0.002 (0.011)	0.002 (0.011)	0.002 (0.011)
<i>TREAT · TIME</i>	-0.030** (0.015)	-0.030** (0.015)	-0.030** (0.015)	-0.031* (0.016)	-0.030* (0.016)	-0.031* (0.016)
SALES	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.003)	0.008*** (0.003)	0.008*** (0.003)
COLLATERAL	-0.002 (0.014)	-0.003 (0.014)	0.003 (0.015)	-0.001 (0.015)	-0.001 (0.016)	0.005 (0.015)
ROA	-0.024 (0.032)	-0.027 (0.033)	-0.020 (0.033)	-0.017 (0.042)	-0.017 (0.042)	-0.009 (0.042)
CURRENTRATIO	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
ZSCORE	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)	-0.014*** (0.002)
NTR	-0.004** (0.002)	-0.004** (0.002)	-0.004** (0.002)	-0.003* (0.002)	-0.003* (0.002)	-0.003 (0.002)
RISK1		0.004 (0.010)			0.002 (0.018)	
RISK2			0.040 (0.029)			0.043 (0.030)
Constant	0.078 (0.077)	0.074 (0.078)	0.067 (0.077)	0.064 (0.083)	0.063 (0.084)	0.051 (0.083)
Observations	600	600	600	564	564	564
F statistic	0.081	0.081	0.084	0.081	0.081	0.084
adjusted R-squared	5.790	5.218	5.404	5.427	4.877	5.099

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 risk measures RISK1 and RISK2. 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 RISK1 as abnormal values (see *Koch and Prassel* (2012), p. 12.). 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 for RISK1 and RISK2

I ROBUSTNESS CHECK, LIQUIDITY

	(1) Δ LEV	(2) Δ LEV	(3) Δ LEV
TIME	-0.036* (0.022)	-0.036* (0.022)	-0.029 (0.022)
TREAT	0.003 (0.011)	0.003 (0.011)	0.009 (0.013)
<i>TREAT · TIME</i>	-0.030** (0.015)	-0.030** (0.015)	-0.050*** (0.018)
SALES	0.008*** (0.002)	0.008*** (0.002)	0.008*** (0.002)
COLLATERAL	-0.002 (0.014)	-0.002 (0.015)	-0.002 (0.015)
ROA	-0.024 (0.032)	-0.024 (0.032)	-0.024 (0.032)
CURRENTRATIO	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
ZSCORE	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)
NTR	-0.004** (0.002)	-0.004** (0.002)	-0.004** (0.002)
LIQUIDITY		-0.000 (0.009)	0.009 (0.018)
<i>LIQUIDITY · TIME</i>			-0.037 (0.025)
<i>LIQUIDITY · TREAT</i>			-0.019 (0.023)
<i>LIQUIDITY · TREAT · TIME</i>			0.071** (0.033)
Constant	0.078 (0.077)	0.078 (0.077)	0.077 (0.077)
Observations	600	600	600
F statistic	0.081	0.081	0.090
adjusted R-squared	5.790	5.202	4.440

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. 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 for LIQUIDITY

J ROBUSTNESS CHECK, VARIOUS REPORTING DATES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	0.007 (0.012)	0.007 (0.012)	0.007 (0.012)	0.007 (0.012)	0.007 (0.012)	0.008 (0.012)	-0.018 (0.024)	-0.031 (0.025)
TREAT	-0.004 (0.012)	-0.004 (0.012)	-0.004 (0.012)	-0.005 (0.012)	-0.004 (0.012)	-0.005 (0.012)	-0.005 (0.012)	-0.004 (0.012)
<i>TREAT · TIME (-)</i>	-0.034** (0.017)	-0.033** (0.016)	-0.034** (0.017)	-0.034** (0.017)	-0.034** (0.017)	-0.035** (0.017)	-0.034** (0.017)	-0.033** (0.016)
SALES		0.006** (0.002)						0.008*** (0.003)
COLLATERAL			0.009 (0.015)					0.026 (0.016)
ROA				0.020 (0.034)				0.011 (0.035)
CURRENTRATIO					0.000 (0.000)			0.000 (0.000)
ZSCORE						-0.000 (0.000)		-0.000 (0.000)
NTR							-0.002 (0.002)	-0.004* (0.002)
Constant	-0.001 (0.008)	-0.066** (0.027)	-0.006 (0.012)	-0.001 (0.008)	-0.001 (0.008)	-0.000 (0.008)	0.097 (0.084)	0.043 (0.086)
Observations	560	560	560	560	560	560	560	560
adjusted R-squared	0.022	0.033	0.022	0.022	0.022	0.023	0.024	0.045
F statistic	4.137	4.791	3.187	3.187	3.139	3.280	3.445	2.871

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. The asterisks (***) / ** / *) indicate the significance at the 1% / 5% / 10% level.

Source: DAFNE database, 2006 and 2008, own calculations.

Table 17: Results of the regression, robustness check for various reporting dates

K ROBUSTNESS CHECK, 1 TO 5 NEAREST NEIGHBOR MATCHING

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	0.000 (0.007)	-0.000 (0.007)	0.000 (0.007)	0.000 (0.007)	0.000 (0.007)	0.001 (0.007)	-0.018 (0.017)	-0.025 (0.017)
TREAT	0.007 (0.010)	0.008 (0.010)	0.006 (0.010)	0.007 (0.010)	0.007 (0.010)	0.006 (0.010)	0.007 (0.010)	0.006 (0.010)
<i>TREAT · TIME (-)</i>	-0.028** (0.014)	-0.028** (0.014)	-0.028** (0.014)	-0.029** (0.014)	-0.028** (0.014)	-0.029** (0.014)	-0.028** (0.014)	-0.028** (0.014)
SALES		0.004** (0.002)						0.005*** (0.002)
COLLATERAL			0.012 (0.010)					0.018* (0.011)
ROA				-0.032 (0.026)				-0.044* (0.026)
CURRENTRATIO					0.000 (0.000)			0.000 (0.000)
ZSCORE						-0.000 (0.000)		-0.000 (0.000)
NTR							-0.002 (0.002)	-0.003 (0.002)
Constant	-0.011** (0.005)	-0.056*** (0.018)	-0.018** (0.008)	-0.010** (0.005)	-0.011** (0.005)	-0.011** (0.005)	0.059 (0.060)	0.020 (0.062)
Observations	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338
adjusted R-squared	0.005	0.009	0.006	0.006	0.005	0.006	0.006	0.016
F statistic	2.062	3.163	1.860	1.945	1.546	1.905	1.895	2.464

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.

Source: DAFNE database, 2006 and 2008, own calculations.

Table 18: Results of the regression, robustness check for propensity score matching with 1 to 5 nearest neighbors

L ROBUSTNESS CHECK, WITHOUT MATCHING

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.001 (0.006)	-0.001 (0.006)
TREAT	0.014 (0.010)	0.010 (0.010)	0.009 (0.010)	0.010 (0.010)	0.014 (0.010)	0.014 (0.010)	0.014 (0.010)	0.002 (0.010)
<i>TREAT · TIME (-)</i>	-0.031** (0.014)	-0.031** (0.014)	-0.031** (0.014)	-0.032** (0.014)	-0.031** (0.014)	-0.031** (0.014)	-0.031** (0.014)	-0.030** (0.014)
SALES		0.005*** (0.001)						0.005*** (0.001)
COLLATERAL			0.020*** (0.004)					0.014*** (0.004)
ROA				-0.056*** (0.007)				-0.051*** (0.007)
CURRENTRATIO					0.000 (0.000)			-0.000 (0.000)
ZSCORE						-0.000** (0.000)		-0.000** (0.000)
NTR							-0.000 (0.001)	-0.000 (0.001)
Constant	-0.019*** (0.002)	-0.073*** (0.007)	-0.026*** (0.002)	-0.013*** (0.002)	-0.019*** (0.002)	-0.019*** (0.002)	-0.011 (0.021)	-0.058*** (0.022)
Observations	12,260	12,260	12,260	12,260	12,260	12,260	12,260	12,260
adjusted R-squared	0.001	0.006	0.003	0.005	0.001	0.001	0.001	0.013
F statistic	2.205	19.60	7.779	16.89	1.663	2.906	1.692	17.60

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.

Source: DAFNE database, 2006 and 2008, own calculations.

Table 19: Results of the regression, robustness check without matching

M ROBUSTNESS CHECK, FALSIFICATION TEST “PLACEBO REFORM”

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	-0.013 (0.011)	-0.013 (0.011)	-0.013 (0.011)	-0.010 (0.011)	-0.013 (0.011)	-0.012 (0.011)	-0.013 (0.011)	-0.010 (0.011)
TREAT	-0.007 (0.011)	-0.007 (0.011)	-0.008 (0.011)	-0.006 (0.011)	-0.008 (0.011)	-0.008 (0.011)	-0.007 (0.011)	-0.007 (0.011)
$TREAT \cdot TIME(-)$	-0.005 (0.016)	-0.005 (0.016)	-0.005 (0.016)	-0.006 (0.015)	-0.005 (0.016)	-0.005 (0.016)	-0.005 (0.016)	-0.006 (0.015)
SALES		0.004 (0.002)						0.008*** (0.003)
COLLATERAL			0.009 (0.014)					0.014 (0.019)
ROA				-0.085*** (0.023)				-0.096*** (0.026)
CURRENTRATIO					0.000 (0.000)			0.000 (0.000)
ZSCORE						-0.004* (0.002)		-0.003 (0.003)
NTR							-0.000 (0.002)	-0.002 (0.002)
Constant	0.008 (0.008)	-0.032 (0.026)	0.002 (0.012)	0.007 (0.008)	0.007 (0.008)	0.014 (0.009)	0.019 (0.081)	-0.015 (0.083)
Observations	480	480	480	480	480	480	480	480
adjusted R-squared	0.011	0.016	0.012	0.039	0.011	0.017	0.011	0.061
F statistic	1.808	1.978	1.467	4.778	1.372	2.107	1.358	3.415

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.

Source: DAFNE database, 2005 and 2006, own calculations.

Table 20: Results of the regression, robustness check placebo reform 2006

N ROBUSTNESS CHECK, SIMPLIFIED EBITDA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	0.007 (0.011)	0.006 (0.011)	0.007 (0.011)	0.006 (0.011)	0.007 (0.011)	0.007 (0.011)	0.014 (0.023)	0.010 (0.023)
TREAT	0.010 (0.011)	0.011 (0.011)	0.010 (0.011)	0.009 (0.011)	0.010 (0.011)	0.006 (0.011)	0.010 (0.011)	0.005 (0.011)
<i>TREAT · TIME (-)</i>	-0.046*** (0.016)	-0.046*** (0.016)	-0.046*** (0.016)	-0.046*** (0.016)	-0.046*** (0.016)	-0.046*** (0.015)	-0.046*** (0.016)	-0.045*** (0.015)
SALES		0.001 (0.002)						0.004* (0.002)
COLLATERAL			0.005 (0.013)					-0.022 (0.015)
ROA				-0.045 (0.033)				-0.059* (0.034)
CURRENTRATIO					-0.000 (0.000)			0.000 (0.000)
ZSCORE						-0.006*** (0.002)		-0.008*** (0.002)
NTR							0.001 (0.002)	0.000 (0.002)
Constant	-0.013 (0.008)	-0.028 (0.025)	-0.016 (0.011)	-0.010 (0.008)	-0.013 (0.008)	-0.001 (0.008)	-0.043 (0.077)	-0.041 (0.079)
Observations	568	568	568	568	568	568	568	568
adjusted R-squared	0.028	0.029	0.028	0.031	0.028	0.052	0.028	0.067
F statistic	5.419	4.172	4.091	4.551	4.059	7.761	4.099	4.450

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.

Source: DAFNE database, 2005 and 2006, own calculations.

Table 21: Results of the regression, robustness check simplified EBITDA

O ROBUSTNESS CHECK, VARIOUS INDUSTRIES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV	Δ LEV
TIME	0.002 (0.013)	0.002 (0.013)	0.002 (0.013)	0.002 (0.013)	0.002 (0.013)	0.004 (0.013)	-0.031 (0.028)	-0.037 (0.028)
TREAT	0.008 (0.013)	0.009 (0.013)	0.008 (0.013)	0.008 (0.013)	0.007 (0.013)	0.008 (0.013)	0.008 (0.013)	0.007 (0.013)
$TREAT \cdot TIME(-)$	-0.030 (0.019)	-0.029 (0.019)	-0.029 (0.019)	-0.030 (0.019)	-0.028 (0.018)	-0.031* (0.018)	-0.030 (0.018)	-0.029 (0.018)
SALES		0.002 (0.003)						0.005 (0.003)
COLLATERAL			0.020 (0.015)					0.023 (0.017)
ROA				-0.018 (0.041)				-0.022 (0.042)
CURRENTRATIO					0.000* (0.000)			0.000* (0.000)
ZSCORE						-0.003** (0.001)		-0.003** (0.001)
NTR							-0.003 (0.002)	-0.004* (0.002)
Constant	-0.013 (0.009)	-0.030 (0.032)	-0.024* (0.013)	-0.012 (0.010)	-0.013 (0.009)	-0.009 (0.009)	0.114 (0.096)	0.083 (0.101)
Observations	532	532	532	532	532	532	532	532
adjusted R-squared	0.009	0.010	0.012	0.010	0.015	0.018	0.013	0.035
F statistic	1.641	1.310	1.655	1.279	2.015	2.471	1.678	2.130

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.

Source: DAFNE database, 2005 and 2006, own calculations.

Table 22: Results of the regression, robustness check of various industries

Impressum:

Arbeitskreis Quantitative Steuerlehre, arqus, e.V.

Vorstand: Prof. Dr. Ralf Maiterth (Vorsitzender),

Prof. Dr. Kay Blaufus, Prof. Dr. Dr. Andreas Löffler

Sitz des Vereins: Berlin

Herausgeber: Kay Blaufus, Jochen Hundsdoerfer,

Martin Jacob, Dirk Kieseewetter, Rolf J. König,

Lutz Kruschwitz, Andreas Löffler, Ralf Maiterth,

Heiko Müller, Jens Müller, Rainer Niemann,

Deborah Schanz, Sebastian Schanz, Caren Sureth,

Corinna Treisch

Kontaktadresse:

Prof. Dr. Caren Sureth, Universität Paderborn,

Fakultät für Wirtschaftswissenschaften,

Warburger Str. 100, 33098 Paderborn,

www.arqus.info, Email: info@arqus.info

ISSN 1861-8944