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TAX POLICY AND FIRMS' FINANCING AND INVESTMENT DECISION

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Thesis

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CONTENTS

CHAPTER 1: GENERAL INTRODUCTION

1.1 MOTIVATION

Whether a firm is able to finance a profitable investment project is of central importance for capital accumulation and, thus, for society's welfare. In a world as assumed by Modigliani-Miller (1958), in their famous irrelevance theorem, the question would not be raised because under their underlying assumptions the source of finance does not affect firms' cost of finance. Thus, firms' investment and finance decision are independent. However, if their assumptions are relaxed and markets are no longer frictionless, the source of finance and, therefore, the cost of finance, is crucial in determining whether an investment project is undertaken or not. This highlights the key point of their theorem as by "showing what doesn't matter [one] can also show, by implication, what does" (Miller 1988, p.100).

Modigliani-Miller's irrelevance theorem marks the beginning of the literature on corporate finance that focuses on the impact of capital market frictions as asymmetric information, transaction costs and taxation on firms' cost of finance. Most of the existing research can either be summarized by the pecking-order or trade-off theory. The pecking-order theory, developed by Myers (1984), outlines that firm's costs of retained earnings, debt and new shares differ due to asymmetric information in the equity and debt market. Following this theory, retained earnings are the least expensive source of finance as they are not affected by asymmetric information, followed by debt and new shares, which is the most expensive source of finance. Instead, the trade-off theory deals only with the use of debt. It explains firms' debt use by the trade-off between the costs and benefits of debt as a source of finance. The most relevant and prominent benefit of debt is the tax advantage. As Modigliani and Miller (1963) highlight, debt is tax favoured as interest payments are deductible from the corporate income tax base, unlike dividend payments. To explain why firms still use equity to some extent, Kraus and Litzenberger (1973) point out the cost of financial distress, which is positively related to firm leverage. Miller (1977) adds that higher tax rates on interest income (compared to equity income) may also explain why firms do not only use

debt to finance their investment.[1] Another reason suggested by De Angelo and Masulis (1980) focuses on non-debt tax shields as these reduce the tax benefit of debt financing. Although pecking-order and trade-off theory have not yet been combined, they are not mutually exclusive. They complement each other as both help explain firms' costs of capital, which is reflected in firms' capital structure choice and determines whether a profitable investment is carried out or not. A further crucial determinant of firms' cost of capital, although not related to market frictions, is captured by firms' life cycle (Mueller 1971). According to this theory firms may either be in a growing or in a mature stage. The first stage is characterized by low retained earnings and the second, in contrast, by sufficient retained earnings compared to firms' capital demand. Thus, firms' cost of finance is also likely to be influenced by the availability of retained earnings.

Since optimal capital accumulation is essential for welfare maximization, economists and politicians are interested in minimizing the impact of market frictions on investment. Further, as tax rules can more easily be changed compared to asymmetric information or bankruptcy problems, they should be designed to mitigate the impact of market frictions on investment or at least to reduce tax-induced distortion in the capital market. However, before an optimal tax policy can be designed, the impact of taxes on firms' cost of finance and investment has to be understood. Although, previous theoretical work provides an understanding of the underlying relationship, empirical evidence is needed to understand the relative importance of taxes on firms' capital structure decisions. It is further important to go beyond the average impact of taxes and to understand the circumstances under which firms react or do not react to tax incentives. The goal of this dissertation is to contribute to the knowledge on the importance of taxes on firms' finance and investment decision.

To do so, in the following chapters I analyse three different aspects of how tax policy affects the costs of capital and, thus, investment. Besides the contextual framework, they share the following characteristics. Firstly, they are all linked to current issues of tax policy in Europe and thus, contribute to the public debate by evaluating the impact of recent tax reforms on firms' behaviour. Secondly, the

[1] He shows that if the tax rate on interest income exceeds the one for equity income, firms must compensate debt holders for their higher tax payments.

empirical analysis is, based on financial statements data. This kind of data allows me to use panel data for a large number of firms with a broad range of variables related to firms' capital structure and investment. Moreover, it enables me to study current tax policy as these data are available with a time lag of only 1 to 2 years. Finally, micro-econometric methods are used, either based on a structural or a quasi-experimental approach. By exploiting the panel structure of the data, I am able to account for time-invariant firm-specific effects and to use exogenous variation over time to identify the effects of interest.

The remainder of this doctoral thesis is as follows. In chapter two I assess the impact of shareholder's interest and equity income taxation on firms' capital structure choice. Chapter three concerns the relevance of the tax advantage of debt and its impact on firms' capital structure choice and investment. This study exploits, in contrast to prior research, not a change in the corporate income tax rate but rather the introduction of a thin-capitalization rule for the identification of the effects of interest. Finally, chapter four deals with the impact of corporate income taxation on investment in case of financial constraints. A summary of the work and the implications of the studies for tax policy and pathways for further research are presented in the fifth chapter.

1.2 CONTRIBUTION AND MAIN FINDINGS

The second chapter of this dissertation reports evidence on the impact of differential taxation of debt and equity returns on firms leverage ratio. Although already highlighted by Miller (1977), "the empirical magnitude of the personal tax penalty is still an open empirical question" (Graham 2006, p.609). The study presented here addresses this gap and examines a topic of great political relevance in Germany. During the second half of the 20th century, Germany's tax policy followed the synthetic income paradigm, according to which all sources of income should be taxed at the same rate. However, due to two recent tax reforms in Germany, this has changed. Currently, the system in place violates the synthetic income paradigm and the neutral taxation of capital income. In 2012, the gap between the tax rates on interest income compared to equity income amounts to almost 20% for persons in the highest income bracket. Thus, this study adds

evidence to the public debate on the impact of differential taxation on firms' capital structure choice.

To analyse the causal effect of interest I exploit the 2009 tax reform in Germany as a quasi-experiment. This allows me to exploit exogenous variation within the same institutional setting. Thus, I am able to avoid possible shortcomings of prior studies. Graham (1999) and Alworth and Arachi (2001) use firms payout ratio to identify the effect of personal taxation on firms capital structure choice. However, the results of Chetty and Saez (2006) show that the payout behaviour of firms changes in case of tax reforms. Overesch and Voeller (2010) rely on international variation. This seems questionable as international variation might capture other changes of institutions as well. The reform I use introduced a flat final withholding tax on interest income in Germany and causes the gap of almost 20 percentage points between the tax rate on income from unincorporated businesses and the new lower tax rate on interest income for individual but not for corporate shareholders.

Methodologically, I apply two different approaches. Firstly, I rely on a regression adjusted semi-parametric difference-in-difference matching strategy. This has the advantage of building up and using a suitable control group in case of time varying observed and time-invariant unobserved differences. Further, to allow a comparison with the prior literature and to validate the first approach, a more structural approach using the tax rate differential between the tax rate on business and interest income is applied. In the second approach I account explicitly for the endogeneity of the ownership structure by applying an instrumental variable approach. The instrument builds upon Gruber and Saez (2001) and is the tax rate differential, which would have prevailed if there had been no changes in the ownership structure since before the reform.

Both methods provide consistent results and indicate a negative causal effect of the tax rate on interest income on firms' leverage. My results indicate that a ten percentage increase in the interest income tax rate decreases firms' leverage by about 1.4 percentages in the first years. Although this seems quite small, my analysis suggests a much stronger long run impact as firms adjust their financial structure dominantly through new investment. Further, part of the firms may be

constrained by their financial situation or adjustment costs. Regarding firm's heterogeneity, especially smaller firms are found to react to the changed incentive. This highlights the different impact of different taxes as prior literature finds that the debt ratio of large companies reacts much stronger to changes in corporate income taxation (Dwenger and Steiner 2009).

In the third chapter, the relevance of the tax advantage of debt on firms' behaviour is analysed. My empirical analysis addresses this research question by exploiting the introduction of the interest barrier in Germany in 2008. The main aim of the regulation is to broaden the tax base by preventing profit shifting activities of multinational firms via debt financing and excessive debt financing of domestic firms. The regulation partly denies the deductibility of interest expenses if they exceed a certain share of taxable profits. Thus it partly abolishes the tax advantage of debt. To study the causal impact of the tax advantage of debt, I exploit the escape clauses within the regulation by relying on a difference-in-difference approach. The escape clauses were included in order to avoid the application of the regulation to small and medium sized firms. The most important escape clause is the exemption limit for the net interest expenses of 3 million euro. If firms exhibit net interest expenses below this limit, the interest barrier is not applied. Further my study identifies the true impact of the regulation, which is to create an incentive for firms to rely more on equity financing. Therefore, the estimated treatment effect is not related to the denied deductibility of interest expenses, but rather to the behavioural responses of firms aiming to avoid the regulation. The avoidance of the regulation is for every firm beneficial as I outline in the chapter. Consequently, I account for the moment when firms learn about the forthcoming regulation changes.

There are three main results from my analysis. Firstly, firms affected by the regulation decreased their debt ratio significantly (around 6 percentage points for firms near the exemption limit), which points to the importance of the tax advantage of debt and confirms the results of prior studies (Dwenger and Steiner 2009). Secondly, although some firms decrease their debt ratio as expected, other firms circumvent the regulation. They shift part of their assets to (newly founded) subsidiaries and therefore exploit the exemption-limit multiple times. Especially

firms with net interest expenses around the exemption limit of the interest barrier adopted this avoidance strategy. The advantage of this behaviour is highlighted by my analysis of the change of firms' reported profits. They only increased for firms that reduced their debt ratio, but not for firms that shifted part of their assets to subsidiaries. The latter group do not use more equity financing as they avoid the application of the interest barrier by exploiting the exemption limit. Thirdly, my results shed light on the impact of firms' costs of capital on investment. Despite the strong observed substitution between equity and debt, firms' investment decision was not negatively affected. This suggests that firms which are affected by the regulation do not to engage in profit shifting activities. Otherwise their tax burden would rise and as a consequence decrease their investment spending. Further, these firms seem to finance their marginal investment to a large extend with retained earnings, because their investment was not negatively affected although the cost of debt finance increased. Finally, investment spending of affected firms did not depend on available cash flow. Thus, firms' investment seems not to be constrained due to insufficient retained earnings. However, the study focuses only on short term effects. The non-negative impact on investment may therefore also be caused by the firms' expectation to be able to circumvent the regulation in the long term or that investment is fixed in the short term due to, for example, long lasting contracts.

Beyond the analysis of the tax advantage of debt, this study contributes to the question how thin capitalization rules should be designed in order to limit profit shifting activities, respectively excessive debt financing of firms effectively.

Chapter four of this dissertation assesses the impact of corporate income taxation on firms' investment in case of financial constraints. This study combines prior literature on the impact of taxation on investment (e.g. Chirinko et al 1999, Dwenger 2012) and financial constraints and investment (e.g. Fazzari et al 1988, Chirinko and van Kalckreuth 2001). Based on the theoretical considerations of Fazzari et al (1988), Bond and Meghir (1994a) and Keuschnigg and Ribi (2010), I test whether taxes affect investment in case of financial constraints in a different way. The two different tax channels that I study are, on the one hand, the cost and, on the other hand, the liquidity channel of taxation. The cost channel captures the

impact of taxation on the marginal investment project and can be expressed by the effective marginal tax rate (*EMTR*). This channel is studied in several papers (Chirinko et al 1999, Buettner and Hoenig 2011, Dwenger 2012). In contrast to the cost channel, the liquidity channel of taxation has not been directly addressed in the literature.[2] It deals with the impact of taxes on investment by reducing firms' available amount of internal cash. To capture the liquidity outflow through taxation I rely on the effective marginal tax rate (*EATR*), which is defined as tax payments scaled by the capital stock. Following the theoretical work, I only expect the *EMTR* to be decisive for the investment decision of financially unconstrained firms as their investment and finance decision are independent and, therefore, they are only affected by marginal incentives. For constrained firms the opposite should be true. Since these firms face a wedge between the cost of internal and external finance, their investment strongly depends on available internal cash rather than on marginal tax incentives (*EMTR).*

My study also assesses the relevance of a possible negative impact of recent tax reforms in Europe which followed the principle "tax cut cum base broadening". For instance, these reforms introduced less generous depreciation allowances and stricter loss offset rules. Accordingly, they are likely to cause tax payments for firms with a low profitability. Since low profitability firms have a greater probability of being financially constrained, it is very likely that taxes affect their investment spending by reducing their internal cash.

To address criticism of prior studies analysing cash-flow sensitivity of investment (Hubbard 1998, Bond et al 2001a), I explore (partly) exogenous variation of firms' tax payments as several tax reforms came into effect during the period under analysis. Therefore, my estimated tax payment sensitivity of investment is not driven by misspecification or due to the fact that it is a proxy for future profitability as cash flow. Another critique of existing studies concerns the potential bias due to firms' self-selection into one of the two financial regimes. To address this shortcoming I apply a switching regression framework with known sample separation. By doing so, I ensure consistent coefficients. Further, the

[2] Prior literature considered this channel only indirectly by analyzing the impact of cash flow on investment. Cash flow is reduced by taxation.

method provides intuition on the splitting criteria chosen (Chatelain 2003). The two splitting criterion I use are firms' debt ratio and firms' liquidation value.

My results show that firms' investment decisions are indeed differently affected by corporate income taxation. In line with the theoretical predictions I find that the *EMTR* impacts the investment of unconstrained firms, whereas *EATR* only affects investment for financially constrained firms. Although my study shows that the bias due to firms' self-selection seems insignificant, the results of the selection equation from the switching regression provide important insights on the type of firms that face financial frictions and are thus affected by tax payments. These are firms with a low cash-flow, better growth opportunities, and firms that are less likely to be publicly traded or to pay out dividends. Thus, the results highlight the role of firms' life cycle stages on the impact of taxation on investment.

CHAPTER 2: DIFFERENTIAL TAXATION AND FIRMS' FINANCIAL LEVERAGE

2.1 INTRODUCTION

Various countries have introduced flat rate taxes on capital income recently, typically with a tax rate that is low in comparison to the progressive tax schedule applied to labour income and other personal income sources. One reason for this trend may be international tax competition, which incentivizes individual countries to tax the transnationally mobile factor capital more lightly than more immobile factors such as labour (e.g. Devereux et al 2008). I[3] observe two general approaches of how countries introduce low flat rate taxes on capital income. The first approach is the Dual Income Tax (DIT) with its variants, as introduced primarily by Nordic countries (e.g. Sørensen 1994). The DIT is intended to treat all capital income the same, regardless of whether it accrues from equity or credit capital. Thus, although the DIT departs from comprehensive income taxation, it preserves neutral taxation of capital income. However, the DIT gives rise to a practical problem, as it is difficult to determine which part of the income of a firm's owner-manager is capital income, which is supposed to be taxed at the lower capital income tax rate, and which part is labour income, as labour is supposed to be taxed at the higher labour income tax rate; usually, a normal return on capital is assumed.

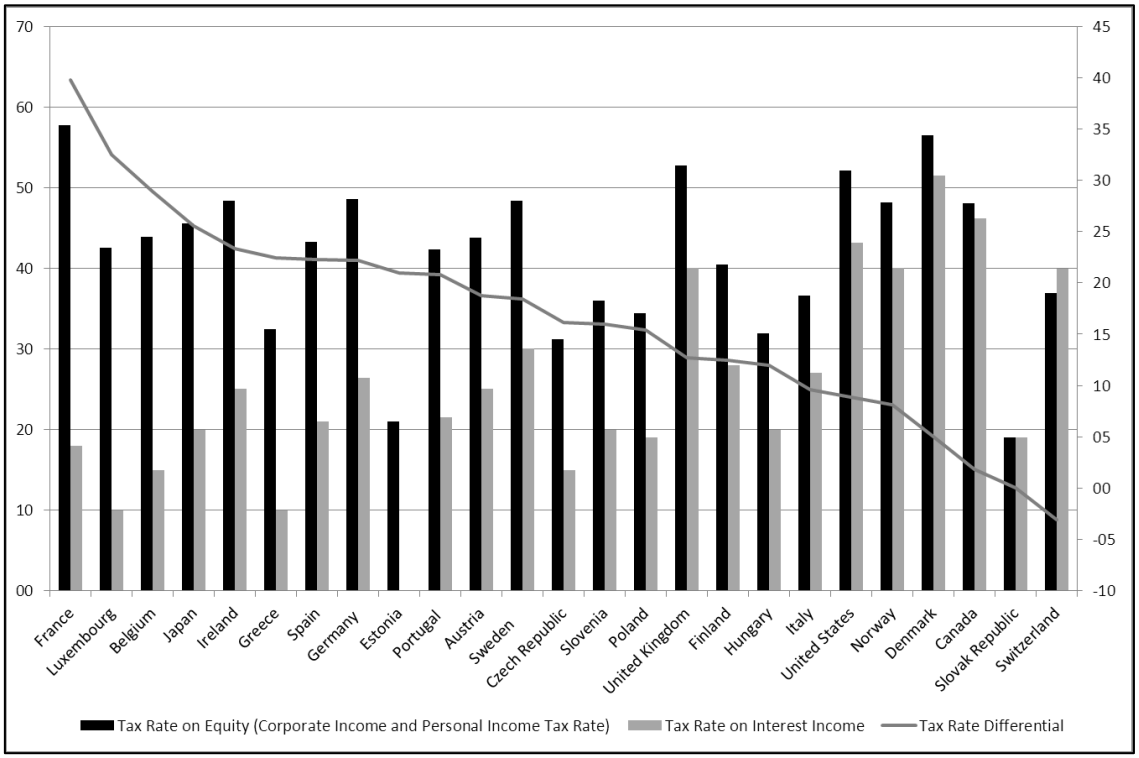
The second approach is the introduction of final withholding taxes on capital income with the distinguishing feature that they do not apply to business income generated by unincorporated firms, as in Germany in 2009.[4] This leads to a large gap (in Germany about 18.6 percentage points) between the tax rate on business

[3] This chapter is based on joint work with Frank Fossen (Fossen and Simmler 2012).

[4] Similarly, Spain introduced a flat tax of 18% on interest income from instruments with a maturity of less than one year in 2007, and France implemented an optional flat tax on interest income with a rate of 18% in 2008. Other countries with this type of capital income taxes include Austria, the Czech Republic, and Portugal (OECD 2011, Table II.4). Note that a DIT can also be implemented as a withholding tax; the distinction depends on the treatment of normal returns to unincorporated business capital.

income, which is taxed at the higher personal income tax (PIT) rate for personal shareholders, and interest income, which is subject to the lower final withholding tax.[5] Thus, final withholding taxes avoid the practical problem of the DIT of distinguishing between capital and labour income of entrepreneurs, which may be the reason why the German government did not follow the advice of the German Council of Economic Experts (2006) who had suggested introducing a DIT in Germany. However, this comes at the cost of introducing differential taxation between business income and interest income.

Figure 1: Tax rate differences between equity and interest income in selected OECD countries in 2009



Notes: The bars indicate the top marginal tax rates on equity and interest income in various OECD countries, the line the difference between these two tax rates. The left scale refers to the tax rates, the right scale to the difference between the tax rates. For details on single countries, see OECD (2011).
Sources: Authors' illustration based on OECD (2011) and Federal Ministry of Finance (2011).

Positive tax rate differentials between equity income and interest income are widespread internationally. Figure 1 compares the tax rates levied on equity

[5] Effectively, all equity income is taxed at a significantly higher rate than interest income. The tax on dividend income cumulates to a high rate that is similar to the tax rate on business income from unincorporated firms, because the corporate tax and the local business tax are not credited against the final withholding tax (see section 2.3.2).

income and interest income in various OECD countries, ordered from left to right by the difference between the two tax rates. These tax rate differentials are substantial in many countries and violate the often postulated neutrality of taxation with respect to the financing decision. It is therefore important to ask which behavioural adjustments of taxpayers are caused by this departure from the comprehensive income taxation paradigm – which states that income from all sources should be taxed at the same rate.

When interest income is taxed at a lower rate than business income, I expect firms to exploit this tax rate differential by increasing their debt ratios, i.e. total liabilities over total assets. For example, an entrepreneur has incentives to reduce her equity stake in her business in order to avoid the high tax on business income and invest her funds in the banking system instead, where returns are taxed at the low tax rate on interest income. Her business is then financed by the banking system in turn. I should thus observe a higher debt ratio in the firm's balance sheet. [6] If the low tax rate on interest income relative to business income increases leverage exclusively for the purpose of avoiding taxes, this may increase the risk of bankruptcy beyond what is socially optimal. This chapter therefore analyses whether and how much firms adjust their financial structures in reaction to differential taxation between business and interest income. My hypothesis is that a lower tax rate on interest income, relative to business income, increases the debt ratio.

To identify the effect, I exploit the introduction of the final withholding tax in Germany in January 2009 as a quasi-experiment. As the tax gap between business and interest income of 18.6 percentage points only opened up for personal shareholders, but not for corporate shareholders, who are always taxed at the corporate tax rate regardless of their type of income, the degree that this policy change affects a firm depends on the fraction of natural persons in the ownership structure. This heterogeneity in exposure to the treatment between firms allows me to identify the effect of the tax rate differential on the debt ratio chosen by firms.

[6] For a formal treatment, see Kiesewetter and Lachmund (2004), Homburg et al (2007), and Beckmann and Schanz (2009). The latter two take in particular into account the regulations that came into effect in Germany in 2008.

I apply a regression adjusted semi-parametric difference-in-difference matching strategy based on firm level panel data to identify the effect of the differential taxation. This approach accounts for a potential selection on observables as well as on time-invariant unobservables and avoids functional form assumptions. In addition, I use a more structural approach, where the debt ratio is modelled as a function of the effective tax rate differential, which depends on the ownership structure, and other factors. This allows generalizing the results and facilitates comparing them to extant literature. I use the instrumental variable (IV) technique to account for potential endogeneity of the shareholder structure. As an additional source of variation, I exploit local business tax rates, which differ across the more than 10,000 German municipalities.

The results from the two approaches consistently indicate that a positive tax rate differential between business income (high PIT rate) and interest income (low final withholding tax rate) increases the debt ratio of firms, albeit only to a small degree. A cut in the tax rate on interest income by 10 percentage points increases the debt ratio by 0.42 percentage points. Specifically, the introduction of the final withholding tax on capital income in Germany in 2009 on average increased the debt ratio by about 1.4% relative to the average debt ratio. I show that effects are stronger for smaller firms, firms that invest, firms not carrying forward a loss from the previous year, and firms that do not appear to be constrained on the credit market.

My analysis of the effect of personal taxes on leverage is distinct from the large literature on the effect of corporate taxes on the use of debt financing as a tax shield. The latter effect results from the fact that interest expenses can be deducted from the tax base, whereas opportunity costs of equity cannot in most countries, including Germany and the US (see Auerbach 2002, Graham 2003, and Feld et al 2011, for surveys, and Dwenger and Steiner 2009, for a micro data study for Germany). The research question on how the corporate tax rate affects the use of debt financing as a tax shield differs from my research question on how a personal tax rate *differential* between equity returns and interest income affects the capital structure. As the corporate tax rate did not change in Germany between 2008 and 2009, the general tax advantage of debt financing because of interest deduction

remains constant in the period used in my main estimations and does not influence my analysis of *changes* in the debt ratio due to *changes* in the personal tax rate differential.

My hypothesis, which states that a decrease in the personal tax rate on interest income increases firms' debt usage when the personal tax rate on business income remains constant, is consistent with Miller (1977, section III); see also Farrar and Selwyn (1967). He argues that the personal tax cost of interest income, which was high relative to the personal tax cost of equity income in the USA at that time, could explain why firms did not use more debt despite the tax benefits of interest deduction. Graham (2003, p.1080) summarizes the implication of Miller's (1977) analysis in his "Prediction 3: High personal taxes on interest income (relative to personal taxes on equity income) create a disincentive for firms to use debt". As the German tax reform under consideration led to lower personal taxes imposed on interest income than on equity income (like in most countries nowadays, including the US, as demonstrated in Figure 1), this "personal tax penalty of debt" turns into an additional personal tax benefit of debt.[7]

Empirical evidence on the effect of differential personal taxation on the financial structure of companies is scarce (see e.g. the survey of Graham, 2003, section 1.4). Using aggregate data, Gordon and MacKie-Mason (1990) report that the debt ratio of corporations increased slightly in response to the US Tax Reform Act of 1986, which increased the tax advantage of debt when taking the personal tax into consideration. Graham (1999) and Alworth and Arachi (2001) rely on heterogeneity between firms with respect to their payout policies to identify the effect of personal taxation on the use of debt. They find a significant, positive effect of differential taxation (defined as the difference between the tax rates on equity returns minus the tax rate on interest income) on the ratio of debt/market value (Graham 1999)[8] and on the change of the debt ratio (Alworth and Arachi 2001). Studies that find that payout policies themselves react to changes in taxation

[7] If there is no personal tax penalty of debt in most countries today in the sense of Miller (1977), other reasons must explain the observation that firms do not use 100% debt financing despite the tax benefits. Reasons discussed in the literature include that firms trade off tax benefits of debt with increased bankruptcy risk and exploit non-debt tax shields first (e.g. Kraus and Litzenberger 1973, Scott 1976, DeAngelo and Masulis 1980, Bradley et al 1984).

[8] In Graham (1999), the estimated coefficient is negative, because the tax rate differential is defined as the tax rate on interest income minus the tax rate on equity returns.

(Chetty and Saez 2006; Jacob and Jacob 2012) cast doubt on the use of the payout ratio as identification strategy, however. Furthermore, firms that pay dividends clearly differ from firms that do not, e.g. with respect to the (unobservable) degree of financial constraints they face (Fazzari, Hubbard and Peterson 1988, 2000). Using international firm level data, Overesch and Voeller (2010) exploit variation in taxation between European countries and find a significant negative effect of the tax rate on interest income on the debt ratio of firms. Fuest and Weichenrieder (2002) use aggregated country data and similarly find that lower taxes on personal interest income versus corporate income decrease the share of corporate savings in total private savings. It remains an open question, however, if the differences in firms' debt policies found between the countries can be interpreted as causal effects of taxation or at least partly stem from other differences between the countries which cannot be completely controlled for.

This chapter is structured as follows. In section 2.2 I describe how I exploit the 2009 German tax reform to identify the effect of differential taxation on the debt ratio. Section 2.3 details the empirical methodology, and section 2.4 introduces the individual firm panel data that I use. In section 2.5 I present the results, while section 2.6 concludes the analysis.

2.2 GERMAN TAX REFORM AS A QUASI-EXPERIMENT

To identify the effect of a tax rate differential between business income and interest income on the debt ratio, I exploit the introduction of the flat final withholding tax in Germany in January 2009 as a quasi-experiment. This reform substantially reduced the tax rate on interest income for personal taxpayers in the highest PIT bracket from 44.3% PIT[9] in 2008 to 26.4% final withholding tax[10] in

[9] The rate of 44.3% refers to the marginal PIT rate of 42%, which was applicable for taxable income in the bracket between €52,152 (about US$ 73,000 on 1/1/2009) and €250,000 (US$ 351,000) in 2007-2008 and between €52,552 and €250,400 in 2009 for single tax filers (or double these amounts for married joint filers), plus the mandatory so-called solidarity surcharge. In 2007, a new top PIT bracket, the so called "rich tax", above this bracket was introduced with a marginal PIT rate of 45% (47.5% including the solidarity surcharge). It became effective for business income one year later in January 2008. In the following, I assume that most shareholders of partnership businesses fall into the former top income tax bracket, but not into the new "rich tax" bracket, so I will use the marginal tax rate of 44.3% in my calculations. There is also a saver's tax allowance, which I do not consider to be relevant for marginal decisions of most business owners because it is quite low: The tax-exempt amount of annual interest and dividend income and capital gains (before 2009, capital gains were taxable only if a security was held for less than one year) was €750 (US$ 1,053) per

2009. In contrast, the top marginal tax rate on income from unincorporated businesses remained unchanged at about 45% at the level of the personal shareholder.[11] Thus, the tax reform in 2009 led to a large gap of 18.6 percentage points between the unchanged top marginal tax rate on business income and the new low flat tax rate on interest income.

Similarly to the top marginal tax rate on business income, the top marginal cumulative tax rate on *dividends* also remained nearly unchanged at about 49% at the shareholder level in 2009.[12] Thus, taxation of equity returns did not change significantly in 2009, regardless of whether they accrued from unincorporated businesses (business income) or corporations (dividend income). So in principle the differential taxation effect I am investigating affects both unincorporated businesses and corporations similarly. In the empirical analysis, I focus on unincorporated partnership businesses for reasons I explain in section 2.4.

Importantly, the large tax gap between business and interest income only opens up for firms with natural persons as shareholders, who are subject to the PIT. Firms with exclusively corporations as shareholders are unaffected by the introduction of the final withholding tax, because corporate shareholders are always taxed at the tax rate for corporations of about 29.9%, regardless of whether they derive interest income or income from equity holdings.[13] Therefore, the degree the introduction of the final withholding tax affects a firm depends on the fraction of

person in 2007 and 2008 and €801 (US$ 1,125) since 2009; the allowance doubles for married joint filers.

[10] The rate of 26.4% refers to 25% final withholding tax plus solidarity surcharge.

[11] This rate refers to the PIT and solidarity surcharge rate of 44.6%, as explained above, plus the local business tax, which is largely credited against the PIT. If the local business tax rate, which is set by the municipality, is high, the local business tax cannot be credited completely, which explains the average rate of about 45%. The tax rate does not take into account the regulations regarding the 2008 introduced *Theasuarierungsbeguenstigung*. This regulation offers a reduced income tax rate of 28.25% for non-withdrawn profits (on application). If the profits are withdrawn they are taxed with 26.4%. Homburg et al (2008) and Hechtner et al (2011) show that the probability of a tax payer to use this scheme depends on the time-horizon and the marginal income tax rate of the taxpayer. However, even for tax payers with very high income, the advantage is quite small. Further the regulation is strongly complex (Knirsch et al 2008). Therefore, I do not account for the regulation in the following analysis.

[12] Before 2009, the tax rate on dividends was calculated as corporate tax + solidarity surcharge + local business tax + 50% dividend taxation rule for the PIT (shareholder-relief system); the last summand was replaced by the final withholding tax on the full dividend in 2009, which yields a similar tax rate for shareholders in the top PIT bracket.

[13] The combined tax for corporations is calculated as corporate tax (rate 15% since January 1, 2008) + solidarity surcharge + local business tax. Depending on the local business tax rate set by the municipality, the combined tax rate for corporations is 29.9% on average.

natural persons in the ownership structure. The larger the fraction of personal shareholders as opposed to corporations, the higher the potential benefit from the reform. This heterogeneity in exposure to the treatment allows me to identify the effect of the tax rate differential on the debt level chosen by firms.[14] Table 1 summarizes the tax rates on business and interest income before and after the introduction of the final withholding tax for personal shareholders and corporate shareholders.

Table 1: Tax rates on business and interest income in 2008 and 2009

Personal shareholders (top PIT bracket without "rich tax")	**2008**	**2009**	**Difference between 2008 and 2009**
Income from unincorporated businesses	~45.0	~45.0	0
Interest income	44.3	26.4	-17.9
Difference between business income and interest income	~0.7	~18.6	
Corporate shareholders	**2008**	**2009**	**Difference between 2008 and 2009**
Income from unincorporated businesses	~29.9	~29.9	0
Interest income	~29.9	~29.9	0
Difference between business income and interest income	0	0	

Notes: The table shows marginal tax rates calculated as the combined statutory tax rates of the various relevant taxes. Tax rates marked with ~ depend on the local business tax rate set by the municipality; here, average rates are displayed.

Another independent source of variation is the local business tax.[15] Its rates vary not just across the more than 10,000 municipalities in Germany, but also over time, because municipalities are entitled to determine their own multipliers (local business tax rate = 0.035 * *multiplier*/100) and change them at any time.[16] For

[14] One may wonder if instead of replacing equity with debt, partnership businesses might replace equity owned by personal shareholders with equity held by corporate shareholders as a reaction to the reform. Then the personal shareholder could invest freed funds in the banking system to benefit from the low tax rate on interest income, and the banks could finance the corporation's acquisition instead of directly financing the partnership firm. However, I observe that only 382 of 50,987 partnership firms in my sample changed their ownership structure between 2008 and 2009. Presumably, personal shareholders are reluctant to pass ownership rights and excess profits to corporate shareholders for tax purposes.

[15] The German local business tax is a subject of research in the context of tax competition and fiscal equalization transfers (Buettner 2006, Egger et al 2010).

[16] The uniform basic tax rate was reduced from 0.05 to 0.035 on January 1, 2008, along with other changes that partly offset this tax rate reduction. The local business tax is mostly a tax on profits, although some additions and reductions apply, e.g. financing expenses are partly added back to the local business tax base (Bach and Fossen 2008). For companies operating in multiple municipalities, the total tax base is distributed according to an apportionment formula, and each

personal shareholders of unincorporated businesses, the local business tax is largely credited against the PIT. The marginal local business tax burden that remains after crediting is calculated as

$$\theta = [multiplier/100 - min(3.8; multiplier/100)*1.055]*0.035 \quad (2.1)$$

Thus, if the multiplier equals 380*1.055=400.9, it is fully credited against the PIT (if the PIT liability is sufficiently high); if it is higher, a positive tax burden remains; and if it is lower, there is partial overcompensation (due to the solidarity surcharge that introduces the factor 1.055). Simulations using the microsimulation model BizTax for business taxation (Bach and Fossen 2008) indicate that in 2008, about a quarter of all unincorporated businesses in Germany could not fully credit their local business tax against the PIT because the local business tax multiplier was too high. In my sample, the distribution of the local business tax burden θ for income from unincorporated businesses with exclusively natural persons as shareholders has a mean of 0.12% and a standard deviation of 1.02; the minimum is -0.73% and the maximum 3.11%. For the identification of the effect of the tax rate differential between business income and interest income on the debt ratio, the important point is that the higher the local business tax rate, the higher the combined tax rate on business income for personal shareholders (which is 45% on average), and thus the larger the tax rate differential introduced by the 2009 reform.

2.3 METHODOLOGY

2.3.1 REGRESSION-ADJUSTED DIFFERENCE-IN-DIFFERENCE MATCHING STRATEGY

To analyse how the differential taxation of business and interest income affects the debt ratio of firms, I use two different methodologies. The first approach is derived from the evaluation literature; specifically, I implement a regression-adjusted semi-parametric difference-in-difference matching strategy similar to Heckman et al (1997). The second is a more structural approach that is more comparable to the extant empirical literature on taxes and corporate finance: I regress the debt ratio on the tax rate differential and control variables (in first differences and accounting for the endogeneity of the tax rate differential). In this section, I first

municipality applies its multiplier to its allocated share. As I can only observe a company's registered office, I can only use the multiplier associated with this location.

describe the matching approach, and proceed with the more structural approach in section 2.3.2.

The difference-in-difference matching technique has two main advantages. Firstly, it accounts for potential selection on observables *and* on time-invariant unobservables, and, secondly, it avoids reliance on functional form assumptions.

As explained above, I base my identification strategy on the share of natural persons in a firm's shareholder structure.[17] I define treatment and control groups for matching as follows. As the introduction of the final withholding tax in Germany in 2009 reduced the tax rate on interest income for natural persons as shareholders, but not for corporations as shareholders, firms belong to the treatment group when more than half of their equity is held by natural persons in Germany. The control group consists of firms with more than half of their equity held by corporations. I consider the cut-off point of 50% reasonable because the majority of the shareholders in terms of equity held are likely to dominate the financing decisions of the firm. However, the results are not sensitive to different choices of this threshold.[18]

Matching methods solve the fundamental problem of the unobserved counter-factual: If the same company could be observed both with and without the treatment (i.e. the reduction of the tax rate on interest income on January 1, 2009), the causal effect of the treatment on the outcome (i.e. the change in the debt ratio between 2008 and 2009) would simply be the difference in the outcome. The idea of the matching method is to compare treated and control companies that are sufficiently similar to derive the causal effect. One matches treatment and control group observations on a set of all relevant variables X such that the conditional mean independence assumption is fulfilled.[19] If I used standard matching, in this application the assumption would be that the expectation of the debt ratio would be identical for the treatment and control groups in the absence of the tax reform, conditional on the matching variables.

[17] The variation in local business tax rates is used in the second, more structural approach only.
[18] In fact, 35.076 of the 38.339 partnership firms in my sample observed in 2008 have a personal ownership share of more than 99%, and 2.171 are almost exclusively owned by corporations
[19] Stuart (2010), Caliendo and Kopeinig (2008) and Caliendo and Künn (2011) provide comprehensive overviews and an application of matching methods.

As I have access to panel data, I am able to apply difference-in-difference matching instead, which relies on the considerably less restrictive assumption that the expected *change* in the debt ratio between 2008 and 2009 would be the same for the treatment and control observations in the absence of the policy change. This accounts for potential unobserved time-invariant differences between treatment and control groups, which might be correlated both with treatment assignment and the debt ratio. Unexplained differences in the level of the debt ratio between firms with different shareholder structures thus do not bias the results from difference-in-difference matching.

A crucial requirement is that all relevant variables that affect treatment assignment and the outcome are included in *X* for matching (ignorable treatment assignment assumption). Based on the literature of organizational choice, I include the debt ratio (total liabilities/total book assets), log firm size (balance sheet total in thousand euro), tangibility (ratio tangible assets/total assets), log firm age (in years), the local business tax rate, as well as fifteen industry dummy variables, to capture differences in diversifiable risk. For matching I use the 2008 values of these variables, i.e. the values before the tax reform. In additional specifications, I further add the ratio of EBITDA (earnings before interest, taxes, depreciation and amortization) over total assets in *X*. In these estimations, a large number of firms have to be excluded from the sample, however, because these firms only provide balance sheet information and the required income statements are not available.

Since *X* includes various continuous variables, I use the estimated one-dimensional propensity score to define proximity between observations. The propensity score is the probability of receiving treatment, i.e. the probability of being a firm with more than half of its equity held by personal shareholders, conditional on *X*. Rosenbaum and Rubin (1985) show that conditioning on *X* is equivalent to conditioning on the propensity score. The propensity score is estimated by running a logistic regression of the treatment indicator on *X*. As distance measure I use the linear propensity score,[20] which improves the balance between the treatment and control groups (Rosenbaum and Rubin 1985).

[20] This distance measure is given by $D_{ij} = \left|\text{logit}(e_i) - \text{logit}(e_j)\right|$, where e_k is the propensity score for observation *k*.

For matching treatment and control group observations, I use the semi-parametric approach of kernel matching. For each treated firm, I assign a kernel-weighted outcome average of the control group observations. The shorter the distance between a treated and a non-treated observation, the greater is the weight. Due to its superiority in terms of efficiency, I choose the Epanechnikov kernel (Cameron and Trivedi 2006).[21] To test the sensitivity of my matching strategy, I also apply a 5-to-1 nearest neighbour calliper matching.[22] This strategy assigns the five closest control group observations to a treatment group observation. The calliper prevents poor matches by ensuring that no observations are matched that are too distant in terms of the linear propensity score. I apply a calliper of 0.25 standard deviations of the estimated linear propensity score as proposed by Rosenbaum and Rubin (1985).[23]

I match control observations to the treated firms with replacement. This can improve balance since control firms that are similar to multiple treated observations may be used multiple times (Stuart 2010). Furthermore, I restrict the analysis to the region of common support, i.e. I drop treatment observations with a linear propensity score exceeding the maximum or falling below the minimum linear propensity score of the control group.

The last feature of the matching strategy is the regression adjustment. Since matching estimators can be rewritten as weighted regressions, it is also possible to include additional control variables in the regression that potentially affect the outcome. Although this is not necessary for consistency if the propensity score is modelled correctly, it improves the efficiency of the regression. Moreover, Bang and Robbins (2005) show that regression-adjusted matching estimators remain consistent if either the propensity score model *or* the regression model is specified correctly. Thus, regression-adjusted matching can be considered double-robust.

The dependent variable in the regression adjustment is the outcome variable, i.e. the change in the debt ratio between 2008 and 2009. The regressor of main

[21] As bandwidth parameter, I follow Heckman et al (1997) and choose 0.06.
[22] Matching strategies differ by their weighting functions. Heckman et al (1997) and Smith and Todd (2005) advocate kernel matching.
[23] Rosenbaum and Robin (1985) show that a calliper of 0.2 standard deviations removes 98% of the bias in a normally distributed covariate and propose 0.25 standard deviations of the linear propensity score as calliper.

interest is the binary treatment indicator that equals one for firms with more than half of their equity held by persons, and zero otherwise. Additional covariates, all in first differences, are log firm size, tangibility, log firm age, and EBITDA/total assets (the latter in some specifications only because of missing values). Since tangibility and firm size might be affected by changes in the financial structure, I include lagged values of these control variables, i.e. their changes between 2007 and 2008.[24]

I use Huber-White heteroscedasticity robust standard errors in my analysis, not least because estimated propensity scores are used for the weighting of the regression. There is some evidence that using an estimated propensity score leads to an *over*estimation of the variance of the estimated coefficients (Stuart 2010) and thus yields conservative confidence levels. I confirm this conjecture for my application, as I obtain generally smaller standard errors in a robustness check when I use bootstrapping to estimate standard errors.

2.3.2 MORE STRUCTURAL APPROACH

My second, more structural approach has the advantage of being more directly comparable to the extant empirical literature on taxation and finance because I estimate a coefficient of a tax rate differential that may be compared across time and location contexts. Considering a continuous tax rate differential instead of a binary treatment indicator also implies that I use more information. Furthermore, in this approach I exploit additional variation through the local business tax rate, which varies across the more than 10,000 municipalities in Germany. The disadvantage in comparison to the semi-parametric matching approach is the necessity of a functional form assumption.

I estimate linear approximations of the relationship between the debt ratio and the tax rate differential of the form

$$\left(\frac{total\ debt}{total\ assets}\right)_{it} = \alpha + \beta\tau_{it}^{diff} + \Gamma X_{it} + \eta_i + \delta_t + \varepsilon_{it} \qquad (2.2)$$

[24] The results do not change when I use an IV approach instead, where I include the potentially endogenous change of these two control variables between 2008 and 2009 and use the twice-lagged levels as their IVs. In the specifications including the change in the ratio EBITDA/total assets, I also use its twice lagged level as its IV, as it might be endogenous as well.

where the dependent variable is the debt ratio of company *i* in year *t*, τ_{it}^{diff} is the tax rate differential between the tax rates on business income and interest income effective for *i* in *t* (with coefficient β), X_{it} is a vector of control variables (with coefficient vector Γ), η_i and δ_t are unobserved firm- and time-specific effects, ε_{it} is an idiosyncratic error term, and α is a constant. η_i could capture unobserved firm-specific costs of debt usage, for example, and δ_t reflects the influence of the business cycle, which is especially relevant in the period under consideration because of the world-wide financial and economic crisis (although the effects were not as severe in Germany as in other countries).

The firm-specific tax rate differential is calculated as a weighted difference between the tax rates on business and interest income:

$$\tau_{it}^{diff} = \sum_{j=1}^{J_{it}} \alpha_{jit} (\tau_{jit}^{business} - \tau_{jt}^{interest}) \tag{2.3}$$

where J_{it} is the number of shareholders and α_{jit} is the equity share of shareholder *j* in firm *i* in year *t*. The statutory tax rates on business income $\tau_{jit}^{business}$ and interest income $\tau_{jt}^{interest}$ depend both on the type of shareholder *j* and the year *t*; most importantly, $\tau_{jt}^{interest}$ was decreased in 2009 for personal, but not corporate shareholders, as explained in section 2.2.[25] Furthermore, $\tau_{jit}^{business}$ depends on the local business tax rate levied in the municipality where firm *i* is located (section 2.2).

As control variables, in X_{it}, I include non-tax determinants of the debt ratio, i.e. lagged log firm size, lagged tangibility and log firm age. In some specifications, I additionally include the ratio EBITDA/total assets, excluding firms with missing income statements from the sample. To eliminate the unobserved firm-specific effects η_i, I estimate equation (2.2) in first differences. In additional estimations based on more than the two years 2008 and 2009, I also include time dummy variables to control for the business cycle effects δ_t.

[25] Since I do not observe total income of shareholders, I follow Rajan and Zingales (1995) as well as Overesch and Voeller (2010) and assume for the calculation of the tax rate differential that personal shareholders are in the highest PIT bracket (without the "rich tax", see section 2).

A firm's ownership structure, which is captured by the weights α_{jit}, may itself be affected by taxes, which could lead to endogeneity of the tax rate differential (2.3). This effect could arise, for example, if the tax reform in 2009 changed incentives to own a partnership through a holding company instead of owning it directly as an individual. I account for this potential endogeneity with an IV approach. The idea is similar to Gruber and Saez (2002). To construct the instrument, I simulate the tax rate differentials in 2008 and 2009 that would have prevailed had the shareholder structure remained unchanged since 2007; in other words, I use $\alpha_{ji,2007}$ in the calculation of $\tau_{i,2008}^{diff,iv}$ and $\tau_{i,2009}^{diff,iv}$ to avoid introducing the potentially endogenous weights $\alpha_{ji,2009}$ that may have been affected by the tax reform (to be sure, I also avoid $\alpha_{ji,2008}$ which might partly anticipate the tax reform). I then use the difference $\tau_{i,2009}^{diff,iv}$ - $\tau_{i,2008}^{diff,iv}$ as the IV for the first differenced tax rate differential $\tau_{i,2009}^{diff}$ - $\tau_{i,2008}^{diff}$. This purges the tax rate differential from any effect of the tax reform on the ownership structure, e.g. the potential installation of holding companies. There is no endogeneity of tax rates with respect to other firm characteristics such as a firm's profits because I use combined statutory tax rates, which provide sufficient variation.

As mentioned before, in my main estimations I use the years immediately prior to and after the reform only, i.e. 2008 and 2009. In further estimations, I also use years back to 2004.[26] In these latter estimations, I additionally control for the combined tax rate on business income effective for firm *i* in year *t*. As my estimation sample is comprised of partnership businesses that divide their income among and pass it through to the shareholders (see section 2.4), the effective tax rate on business income again depends on the shareholder structure:

$$\tilde{\tau}_{it}^{business} = \sum_{j=1}^{J_{it}} \alpha_{jit} \tau_{jit}^{business} \tag{2.4}$$

The identifiers in this weighted sum are defined as above. This control variable is important when including years both before and after 2008, because the statutory corporate income tax rate (CIT) was decreased from 25% to 15% on January 1,

[26] The instrument for the change in the tax rate differential is calculated the same way in all the years, analogous to what I describe above for the change between 2008 (period *t*-1) and 2009 (period *t*), i.e. I use the twice lagged shareholder structure ($\alpha_{ji,t-2}$) to simulate the tax rate differentials $\tau_{i,t-1}^{diff,iv}$ and $\tau_{it}^{diff,iv}$.

2008, which decreased $\tau_{jit}^{business}$ when shareholder *j* is a corporation. This control variable thus accounts for the effect of the business income tax rate on the use of debt financing as a tax shield because of the deductibility of interest payments from the tax base. To avoid potential endogeneity due to changing shareholder structures, I instrument $\widetilde{\tau}_{it}^{business}$ with a simulated business tax rate $\widetilde{\tau}_{it}^{business,iv}$ using the twice-lagged shareholder structure, completely analogous to my instrument for the tax rate differential. When I base my estimations on 2008 and 2009 only, it is not necessary to separately control for the tax rate on business income, as it did not change between these years and is thus included in the firm specific fixed effects η_i, which are eliminated by first differencing the data.[27]

2.4 FIRM PANEL DATA

The database for my study is the comprehensive financial statements collection *DAFNE* provided by Bureau van Dijk. The panel data contain individual balance sheets, income statements and ownership information for German firms. The ownership information includes the name, the type, the county of residence and the equity share of each direct shareholder.[28] The main source for this database is the official registrar of companies in Germany. Since 2006 the database has covered nearly all publishing companies in Germany; these are firms with limited liability (incorporated or unincorporated), as they have to obey legal publication requirements.[29] Before, primarily larger companies were included in *DAFNE*. In my baseline estimations, I use the years immediately prior to and after the introduction of the final withholding tax, i.e. 2008 and 2009. In additional estimations, I include all years back to 2004; there is no sufficient data for more recent years. I merge local business tax rates provided by the Statistical Offices

[27] Strictly speaking, this is only true when the shareholder structure remains constant between these two years. In my sample only about 2% of the firms exhibit any changes in their shareholder structure between 2007 and 2009. If I include the business income tax rate as a control variable in the estimations based on 2008 and 2009 only, it is insignificant and can thus be dropped from the final specification.

[28] The data distinguish between the following types of shareholders: Individuals or families, banks, insurance companies, financial companies, other companies, mutual and pension funds/trusts/nominees, state, and employees and managers.

[29] Corporations have to publish their financial statements according to §325 German Commercial Code. The same publication requirements apply also to unincorporated firms with limited liability (such as the legal form *GmbH & Co. KG*, which is explained further below).

(2004-2009) to the database by using the firms' postal codes as provided in *DAFNE*.

In this study I focus on partnership businesses, which represent a widespread and important legal form in Germany. In 2009, partnerships and sole proprietorships accounted for 38% of aggregate taxable turnover in Germany (Federal Statistical Office 2011). The main reason for my choice is that in addition to the tax reform of interest on January 1, 2009, there was a business tax reform that came into effect January 1, 2008, which primarily affected corporations; the most important change was a reduction in the CIT rate from 25% to 15%. Therefore, for corporations it is more difficult to disentangle potential delayed effects of the 2008 reform from the effects of the introduction of the final withholding tax a year later.[30] As in other countries, partnerships in Germany are not legal entities and therefore not subject to the CIT. Instead, profits of partnerships are passed through to the receiving shareholders and subject to their PIT according to the tax transparency principle (as opposed to the deferral principle for corporations). In addition, partnerships are subject to the local business tax at the firm level; the local business tax is largely credited against the PIT of personal shareholders, however, as explained in section 2.2.[31]

Changes in the taxation of incorporated and unincorporated businesses could influence organizational choice, as suggested by the literature, which is mostly based on US data (Gordon and MacKie-Mason 1994; Goolsbee 1998a, 2004).[32]

[30] The introduction of the final withholding tax in 2009 was also somewhat more complicated for corporations than for partnerships. First, the shareholder relief system for dividends was replaced with the final withholding tax (although this did not change the effective tax burden for shareholders in the highest PIT bracket). Second, capital gains, which before 2009 were tax exempt when the equity was held for more than a year, became subject to the new final withholding tax if the equity was acquired on or after January 1, 2009.

[31] One may wonder if partnerships can benefit from the low final withholding tax introduced in 2009 simply by converting equity held by a shareholder into a credit liability lent by the same person (shareholder loan). German tax law rules this out, however, by treating interest income from shareholder loans the same as business income, i.e. it is subject to the PIT of the shareholder and not the flat final withholding tax. If partnerships adjust their leverage, they therefore have to involve financial intermediaries who are different from the shareholders (and the shareholders may invest their funds elsewhere in the banking system).

[32] Using time series data for 1900 to 1939, Goolsbee (1998a) finds only small effects of taxes on the organizational form, whereas in Goolsbee (2004) he reports much larger effects based on cross-sectional data. Thoresen and Alstadsaeter (2008) find that the introduction of a Dual Income Tax increases the probability of incorporation for an active owner of a human capital intensive business. The reason is that in case of incorporation all income is subject to the relatively low tax

However, I observe only 32 changes of the legal form from unincorporated to incorporated businesses and 81 changes from incorporated to unincorporated business between 2007 and 2009 in my sample of 38,339 firms, so this adjustment channel does not seem to be relevant for my study. High costs involved in changing legal forms in Germany may explain why I do not observe more changes. Moreover, reorganization is often accompanied by the disclosure of hidden assets, which firms may want to avoid.

I base my analyses on a specific legal form of partnership firms with limited liability called *GmbH & Co. KG.* These are partnerships (*KG*) with limited liability as a consequence of their construction with a limited liability company as a general partner (the *GmbH*). They accounted for 20% of aggregate taxable turnover of all businesses in Germany in 2009 (Federal Statistical Office 2011) and for more than half the contribution of all partnerships and sole proprietorships. With respect to their limited liability, these limited partnerships are similar to corporations, but their tax treatment is that of any other unincorporated business. In contrast to other partnerships and sole proprietorships, since 2006 I observe almost the entire population of these limited partnerships in my data, because due to the limited liability strict publication requirements apply for them that are very similar to those of corporations.

From all limited partnership businesses observed I exclude firms without corporate or personal shareholders because of the different taxation rules for banks and trusts; where less than 75% of the shareholders are domestic; or where less than 75% of the shareholder structure is observed.[33] Further, I drop firms with liabilities above €20 million (about US$ 28 million on 1/1/2009), as these firms are potentially affected by the interest ceiling rule, which was introduced in January 2008 and limited the deductibility of net interest payments above one million euro from the tax base (assuming an interest rate of 5%).[34] Financial and

rate on capital income, whereas otherwise income is split up into labor and capital income assuming a normal return on capital, which results in a higher overall tax burden.

[33] In two robustness checks, I required that 60% (90%, resp.) of the shareholders structure be observed. The results did not change significantly.

[34] In fact for 2008 the threshold of the interest ceiling rule amounts to three million euro, since the German government increased the threshold retroactively in spring 2009. Due to the retroactive change I only include firms with interest expenses below the lower threshold. As a sensitivity check

holding companies are excluded from the sample as well because of their different determinants of the debt ratio. The final estimation sample used in my main specifications comprises 76,678 firm-years in 2008 and 2009 and 125,368 firm-years over the larger time frame between 2004 and 2009.

The outcome variable, the debt ratio of the firms, is calculated as the ratio of total liabilities/total book assets.[35] In my estimations of the effect of differential taxation on the debt ratio, I follow the extant literature and consider the following non-tax factors as control variables (all monetary variables are deflated using the Consumer Price Index):

Firm size: The firm size may indirectly influence the financial structure as it might be a proxy for the quality of information available to outside investors, because publication requirements are linked to size criteria (Chan, Faff and Ramsay 2005). Lower uncertainty due to better information could increase the equity share since issuing equity is sensitive to information. Thus, I control for firm size and measure it as the natural logarithm of the real book value of total assets.

Age of the firm: According to the life cycle hypothesis (e.g. DeAngelo et al 2006), older firms are likely to have greater free cash flow. They may thus accumulate larger amounts of retained earnings, which would decrease the debt ratio. I use the natural logarithm of the firm age in years.

Tangibility: The extant literature suggests two opposing possible effects of tangibility on the use of debt. Harris and Raviv (1990a) as well as Almeida and Campello (2007) find a positive correlation between a company's liquidation value (which is increasing in the tangibility of a firm's assets) and the optimal debt level since a higher liquidation value reduces costs for debt holders in comparison to equity holders. On the other side, DeAngelo and Masulis (1980) argue that firms with a high share of tangible assets have higher depreciation allowances and thus benefit from this non-debt tax shield, which reduces incentives to use debt as a tax shield. I measure tangibility as the ratio tangible assets/total book assets.

I repeat the main estimations without dropping these firms and find that the results change only marginally (available from the author on request).

[35] In the robustness section 2.5.4, I alternatively explore the ratio of long term liabilities / total assets and interest payments. My notion of debt does not include pension commitments, which play a minor role in Germany because of the statutory pension insurance system.

Profitability: As common in the literature (e.g. Rajan and Zingales 1995, Graham 1999, Krämer 2012), I control for company's profitability in some specifications. Profitable firms dispose of internal finance, which may decrease their debt usage; on the other hand, they may have lower costs of financial distress and increase leverage. My measure of profitability is the ratio EBITDA/total book assets. As income statements are necessary to calculate this variable, which are missing for most firms, I only include this variable in additional specifications.

Loss in the previous year: A company that is carrying forward a loss can offset current profits against these former losses and thus has lower incentives to make use of the preferential taxation of interest income (Overesch and Voeller 2010). In the estimations using information from income statements I include a dummy variable that equals one if a firm reported a loss in the previous year and zero otherwise.

Some descriptive statistics for the dependent and control variables are presented in Table 2. The average partnership business in my sample has a debt ratio of 62%, is 13 years old and has a ratio of EBITDA/total assets of about 18% (note the significantly lower number of observations for this variable as indicated below). There are 35,860 firms with personal shareholders holding a majority equity stake (the treatment group in the matching approach) and 2,540 with mainly corporate shareholders in the sample. The firms with mainly personal shareholder have significantly higher debt ratios and are significantly smaller than firms with mainly corporate shareholders (the control group). This heterogeneity is one of the main reasons why matching can play its virtues in this application.

Between 2008 and 2009, the mean debt ratio decreases slightly for firms where corporations have the majority interest stake (the difference is significant at the 1% level), and remains constant for firms with natural persons as the majority shareholders. This may indicate that while there was a general trend towards a lower debt ratio in this time period, presumably due to tighter credit conditions during the financial crisis, the firms in the treatment group did not follow this trend and thus increased their debt ratio relative to the control group. This is the expected direction of relative change in the debt ratios due to the introduction of

the final withholding tax. The following econometric analysis identifies a causal effect and allows inference.

Table 2: Firm characteristics by ownership structure

	Full sample		More than 50% of equity held by…		*t*-test of equal means
			Corporations	Persons	
Variable	Mean	Std. dev.	Mean	Mean	*p*-value
debt ratio	0.62	0.28	0.56	0.63	0.00
debt ratio 2009	0.62	0.28	0.55	0.63	0.00
firm size (thd. €)	2,450	4,526	5,306	2,247	0.00
firm age	12.82	13.18	13.21	12.79	0.00
tangibility	0.49	0.31	0.48	0.49	0.12
Share of personal shareholders	0.93	0.24	0.09	0.99	0.00
Industries (shares):					
Manufacturing	0.17	0.38	0.25	0.17	0.35
Trade	0.18	0.38	0.17	0.18	0.00
Services	0.11	0.31	0.09	0.11	0.75
Observations	38,339		2,479	35,860	
EBITDA/total assets	0.18	0.13	0.18	0.18	0.32
loss previous year	0.11	0.31	0.12	0.10	0.87
Observations	1,505		284	1,221	

Notes: Statistics are for 2008 except for the "debt ratio 2009".
Source: *DAFNE* firm database, 2008 and 2009, own calculations.

2.5 EMPIRICAL RESULTS

2.5.1 MATCHING QUALITY

Before I report the results with respect to my research question, I first provide information on the propensity score estimation and the matching quality. The results from the logistic regression used to estimate the propensity score (see Table A-7 in the Appendix A) reflect the differences between firms with predominantly natural persons or corporations as shareholders, as this distinction defines treatment and control groups. Firms in the treatment group, where natural persons hold a majority interest stake, are smaller and slightly older on average and have higher debt ratios than the firms in the control group, *ceteris paribus*. With respect to the share of tangible assets, the groups do not differ significantly. Firms in the treatment group are more often based in communities with lower local business tax rates. The industry distribution differs between treatment and control groups as well. The significant differences suggest that matching is

important in this application to ensure that treatment and control groups are sufficiently similar.

After having estimated the propensity score, I apply kernel matching to identify suitable control observations for every firm in the treatment group. Imposing the common support condition reduces the sample size only slightly, by 0.12%. To evaluate the matching quality I refer to the standardized bias SB_x for each variable in X, which is calculated as the difference between the mean characteristic of the treated ($\bar{x}_1$) and matched control firms ($\bar{x}_2$), standardized by the square root of the average of the variances in the two groups (Rosenbaum and Rubin, 1985) and expressed as a percentage:

$$SB_x = 100 * \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(\sigma^2_{x_1} + \sigma^2_{x_2})}{2}}} \% . \qquad (2.5)$$

After matching, SB_x should not exceed about 5% for the key variables as a rule of thumb; otherwise the mean difference is considered quite large and may indicate a lack of balancing (Caliendo and Kopeinig 2008). The standardized bias before and after kernel matching is presented in Table 3. After matching the SB_x statistics are acceptable for all variables, in particular they are very low for the debt ratio and the firm size, which exhibited large biases before matching. The mean absolute standardized bias over all variables is below 5%, which indicates high matching quality.

Table 3: Standardized bias before and after matching

	Treatment group	Control group			
	Mean	Mean		Standardized bias in %	
Variable		Before matching	After matching	Before matching	After matching
local business tax rate	382%	384%	379%	4.12	4.99
debt ratio	0.63	0.56	0.63	25.23	- 1.12
log. firms size	6.83	7.69	6.84	61.37	- 0.67
log. firm age	2.12	2.16	2.09	3.78	4.08
tangibility	0.49	0.48	0.51	1.45	6.20
Industries (shares):					
Manufacturing	0.17	0.25	0.16	-20.36	1.42
Trade	0.18	0.17	0.17	1.98	1.79
Service	0.11	0.09	0.14	7.58	-7.28

Note: Statistics are for 2008.
Source: *DAFNE* firm database, 2008, own calculations.

2.5.2 DIFFERENCE-IN-DIFFERENCE MATCHING RESULTS

The results from the semi-parametric difference-in-difference matching approach appear in Table 4. The weighted regressions use the weights for the control observations obtained from matching. The first specification without control variables (M1) represents difference-in-difference matching; in specification (M2), which is preferred, I additionally employ regression adjustment by controlling for changes in log firm age, the lagged (indicated by L.) log firm size and the lagged share of tangible assets in total assets (see section 2.3.1).

In both specifications, the point estimate of the coefficient of the treatment variable is 0.009, and it is statistically significant at the 1% level.[36] This indicates that firms where natural persons hold the majority interest stake increased their debt ratio by about 1 percentage point due to the introduction of the flat final withholding tax. This corresponds to an increase of 1.4% relative to the mean debt ratio in the treatment group of 63%. The direction of the effect is consistent with my hypothesis. After the introduction of the flat final withholding tax on interest income, personal shareholders can save taxes when investing in bonded capital instead of their own businesses, so they have an additional incentive to finance their businesses with debt instead of equity. I discuss the effect size further in section 2.5.5.

Specifications (M3), (M4), and (M5) provide robustness checks where I include the ratio EBITDA/total assets, which captures profitability, as an additional variable in the set of matching variables *X*. This reduces the sample size significantly, as profit and loss accounts are not reported for most firms (as mentioned before). The standardized bias after matching only changes marginally.[37] Specification (M3) again is DiD matching without regression adjustment, in specification (M4) I include the controls as in specification (M2), and in specification (M5) I additionally use EBITDA/total assets in the regression adjustment. In the three estimations, the point estimate of the coefficient of the treatment indicator remains similar compared to the baseline specifications (M1) and (M2) (it lies within their confidence intervals). It is significant in two of the three specifications,

[36] The level of significance even increases slightly when I use bootstrapped standard errors instead of the Huber/White robust standard errors reported in the table.
[37] Results are available from the author on request.

(M3) and (M4), although the standard errors are much larger due to the strongly reduced sample size. As a further sensitivity check, in specification (M6) I employ 1 to 5 nearest-neighbour calliper matching instead of kernel matching (see section 2.3.1). The coefficient remains the same as in the baseline estimations and is significant at the 1% level.

Table 4: Regression-adjusted difference-in-difference matching estimates

Specification	(M1)	(M2)	(M3)	(M4)	(M5)	(M6)
			Matching with EBITDA/total assets			
	DiD matching	Regression adjustment	DiD matching	Regression adjustment	EBITDA/ta control	Nearest neighbour
Treatment	0.009***	0.009***	0.013*	0.013**	0.009	0.009***
	(0.003)	(0.003)	(0.007)	(0.007)	(0.006)	(0.003)
ΔL. log firm size		-0.007*		-0.036	-0.029	-0.007
		(0.004)		(0.032)	(0.024)	(0.005)
ΔL. tangibility		0.051***		0.059	0.080	0.059***
		(0.018)		(0.054)	(0.050)	(0.019)
Δlog firm age		0.011		0.029*	0.026	0.011
		(0.009)		(0.017)	(0.017)	(0.010)
ΔEBITDA/ total assets					-0.263***	
					(0.040)	
Constant	-0.010***	-0.012***	-0.022***	-0.024***	-0.025***	-0.013***
	(0.003)	(0.003)	(0.007)	(0.007)	(0.006)	(0.003)
Observations	38,274	38,274	1,429	1,429	1,429	38,279
Off com. support (in %)	0.135	0.135	5.095	5.095	5.095	0.128
Mean standardized bias	2.810	2.810	4.318	4.318	4.318	2.688

Notes: The dependent variable is the ratio total debt/total assets. Specifications (M1) through (M5) are based on kernel matching, (M6) on 1 to 5 nearest neighbor caliper matching. Heteroscedasticity robust standard errors in parentheses. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: *DAFNE* firm database, 2008-2009, own calculations.

I also conduct placebo tests where I implement the same estimation approach as in specifications (M1) and (M2), but act as if the reform had taken place in 2006 instead of 2009, using the sample 2005-2006 instead of 2008-2009. I choose 2006 for the placebo test because there were no other potentially relevant tax reforms in that year, whereas 2007 and 2008 saw the introduction of the rich tax (see footnote 9) and the CIT reform mentioned in section 2.3.2. The coefficient of the placebo treatment dummy variable is not significantly different from zero in both specifications (with and without regression adjustment), which is reassuring as it indicates that there was no differential time trend between the treatment and control groups.

2.5.3 MORE STRUCTURAL APPROACH

Table 5 shows the results from estimating the more structural equation (2.2) in first differences, which includes the change in the tax rate differential between business income and interest income as the key explanatory variable of interest; the dependent variable is the change in the debt ratio. Specification (S1) uses data from 2008 and 2009, i.e. one year each before and after the tax reform, while specification (S2) is based on the longer estimation period of 2004-2009.[38]

I instrument the change in the tax rate differential with the change I would observe if there had not been any modifications in the shareholder structure between 2007 and 2009 (see section 2.3.2). As there are only few changes in the shareholder structure in the data, the instrument is very strong, as indicated by the very large first stage *F*-statistics of the excluded instrument and Shea's Partial R^2 at the bottom of the table. In specification (S2), I additionally control for the change in the combined business tax rate to account for the business tax reform of January 1, 2008, as mentioned before. The first stage statistics show that the instrument for this control variable (which is analogous to the one just described) is highly relevant as well.

The results from both specification show that a higher differential between the tax rate on business income and the tax rate on interest income has a positive and significant effect on firms' debt ratios with point estimates of 0.042 to 0.043. This indicates that a reduction of the tax rate on interest income by 20 percentage points, while leaving the tax rate on business income unchanged (which is similar to the introduction of the flat final withholding tax in 2009), increases the debt ratio by about $20*0.042 \approx 0.84$ percentage points for firms with exclusively natural persons as shareholders, or 1.4% relative to the mean debt ratio of 62% in the sample (the effect size is further discussed below).

I turn to the control variables next. The positive and significant coefficient of the tax rate on business income in specification (S2) indicates that higher business income taxes increase the debt ratio, as expected. This confirms that debt is used as a tax shield. Decreasing the business income tax rate by 10 percentage points

[38] I prefer specification (S1), as the wider time window might potentially take in more distortions from other events that the controls might not completely capture.

(which is similar to the business tax reform of January 2008) increases the debt ratio by 1.3 percentage points. Thus, I separately identify a positive effect of business taxes and a negative effect of personal taxes on interest income on debt usage.

Table 5: Results from IV estimations in first differences

Specification	(S1)	(S2)
Estimation period	2008-2009	2004-2009
Δtax rate differential	0.042***	0.043***
	(0.012)	(0.012)
ΔL. tangibility	0.034***	0.028***
	(0.007)	(0.005)
ΔL. log firm size	-0.007***	-0.008***
	(0.002)	(0.002)
Δlog firm age	0.009***	0.014***
	(0.003)	(0.003)
Δbusiness income tax rate		0.123***
		(0.040)
year 2006		0.001
		(0.017)
year 2007		0.009*
		(0.005)
year 2008		0.014***
		(0.002)
Constant	-0.011***	-0.011***
	(0.002)	(0.002)
Observations	38,339	62,769
1st stage *F* statistic (Δtax rate differential)	76,255	38,700
Shea's Partial R^2 (Δtax rate differential)	0.924	0.894
1st stage *F* stat. (Δbusiness income tax rate)		8772
Shea's Partial R^2 (Δbusiness income tax rate)		0.552

Notes: The dependent variable is the year-to-year change in the ratio total debt/total assets. Δtax rate differential is the year-to-year difference in the tax rate differential between business and interest income. It is treated as endogenous; the simulated 1st differenced tax rate differential based on the twice-lagged ownership structure is used as the excluded instrument. Δbusiness income tax rate is treated analogously. Heteroscedasticity robust standard errors in parentheses. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: Own calculations based on the financial accounts database *DAFNE* 2004-2009.

The share of tangible assets in total assets (tangibility) has a positive and significant coefficient in both specifications. A higher liquidation value of a firm seems to support the use of debt, presumably due to better credit conditions; this effect seems to outweigh the effect of higher depreciation allowances, which should reduce the incentive to use debt as a tax shield. The coefficient for firm size has a negative sign, which is in line with the view that larger firms, which are subject to stricter publication rules, find it easier to issue equity. For the age of the firms, I expected a negative coefficient as older firms should have lower debt ratios

based on the lifecycle hypothesis, but this is not confirmed. A possible explanation for the positive effect of age on the debt ratio could be that older firms have favourable credit conditions because of their long-standing relationships with banks.

2.5.4 SENSITIVITY ANALYSIS

In specifications (S1) and (S2), tangibility and firm size enter equation (2) in lagged form. As the first differences of these lagged variables may still be endogenous in the first differenced equation, I conduct robustness checks with respect to these control variables (see Table A-8 in the Appendix). Based on the 2008-2009 data, specification (S3) includes the twice-lagged levels of the two variables in the first differenced equation, whereas (S4) includes the contemporaneous first differences, but treats them as endogenous and uses the twice-lagged levels as their instruments. Specifications (S6) and (S7) are analogous, but are based on the longer observation period of 2004-2009. The point estimates obtained are somewhat smaller, but not significantly different from the baseline estimates, so I conclude that these are robust.

In specifications (S5) (for the short time window) and (S8) (for the longer time window), I include two additional control variables in equation (2) to account for differences in profitability: the ratio EBITDA/total assets and a dummy variable indicating if a firm reported a loss in the previous year. Here my samples size shrinks significantly due to missing income statements. Since EBITDA/total assets might be endogenous with respect to the finance structure, I use its twice lagged level as instrument for the first differenced control variable. Although this time the point estimates of the coefficient of the tax rate differential increase in comparison to the baseline estimates, they are not significantly different, which again confirms robustness.

I also assess if the results are sensitive to the choice of the leverage measure. First, I use the ratio of long term debt over total assets as the dependent variable in the sub-sample where this more detailed information is available. I obtain a significant point estimate of the tax rate differential of 0.077, with a standard error of 0.029; it is not significantly different from the result from the baseline specification (S1).

Second, I use log interest payments as the dependent variable as an indicator of debt usage, which again is only available in a sub-sample. After excluding outliers with more than 25% growth in interest payments between 2008 and 2009, I obtain a significant point estimate of 0.146, which indicates that a reduction of the tax rate on interest income by 20 percentage points triggers an increase in interest payments by 2.92 percentage; the implied increase in debt usage seems consistent with the result that the debt ratio increases by 1.4%.[39] In a further robustness check I exploit international variation in global ultimate ownership and find consistent results (Appendix B).

2.5.5 DISCUSSION OF THE EFFECT SIZE

To assess if the results from the more structural approach are consistent with those from the difference-in-difference matching approach, I compare the estimated average effects of the introduction of the flat tax on capital income in Germany in 2009. In the matching model, the change in the debt ratio for the treated firms is given by the estimated coefficient, which represents the treatment effect on the treated (0.9 percentage points in the baseline estimations), while for the control observations it is zero. To obtain the mean change in the debt ratio over all firms, I weight these effects by the shares of both groups in the sample and obtain a weighted average increase in the debt ratio of 0.8 percentage points.

For the more structural approach the mean change in the debt ratio is calculated by multiplying the estimated coefficient of the tax rate differential, i.e. 0.042 in the baseline specification, with the mean change in this differential due to the introduction of the flat withholding tax, which is 16.66%; this change is smaller than the nominal reduction of the tax rate on interest income because of the weighs α_{jit} in equation (2.3), which reflect that only natural persons as shareholders benefit from the tax reform. Thus, the mean increase in the debt ratio in the sample due to the reform amounts to 0.74 percentage points based on this approach.[40]

[39] Full results are available from the author on request.
[40] It is unlikely that the local treatment effect identified in my IV estimation differs from the global effect because of the few changes in the shareholder structure.

I conclude that both the matching and the more structural approaches provide consistent results, as the point estimates are similar and statistically not significantly different from each other. A methodological implication beyond this application is that I validate the general structural model with a semi-parametric event study: If the structural model were misspecified, the estimate would be expected to be biased, while the matching estimate would still be consistent; in this case, I would expect a significant difference between the two estimates.

My estimate from the structural model can be compared with the results from the literature mentioned in the introduction to a limited extent. Alworth and Arachi (2001, Table 7) regress the *change* of the debt ratio on the *level* of a composite term of the tax rates on interest income, dividends and capital gains. Their estimated coefficient of 0.034 implies that a reduction of 20 percentage points in the tax rate on interest income leads to an increase of the debt ratio by 0.68 percentage points every year, somewhat less than my estimated one-time change of 0.84 percentage points. Their estimated ratio of the coefficients of the tax rates on corporate income and on interest income is about 3 to 1, similar to my estimated ratio (0.123 to 0.042).

Comparability with Graham (1999, Table 6) is limited because he uses debt to market value as the dependent variable. My result can best be related to one of his estimations, where he uses the corporate tax rate and the personal tax penalty, i.e. a composite term of the tax rates on interest income, dividends and capital gains, as separate independent variables. His estimated coefficient for the composite term is -0.219; thus, a 20 percentage-points reduction in the tax rate on interest income leads to an increase in the debt to market value of more than 4 percentage points, which is a much larger response than mines. As Graham runs this OLS regression on a 1994 cross-section of data without accounting for firm-specific effects, a bias in this estimate cannot be ruled out. Overesch and Voeller (2010, Table 4), who use the same definition of the debt ratio as the dependent variable as I do, also estimate a much larger coefficient for the tax rate on interest income of -0.56. However, the standard error of their estimate of 0.27 is so large that mine much more precisely estimated coefficient of the tax rate differential of 0.042 is still included in their 95% confidence interval (the sign must be switched for

comparison because the tax rate on interest income is subtracted in my differential). Note that these three studies rely on completely different identification strategies than this study (i.e. cross-country variation in tax codes or firms' payout policies) and on data for different countries.

My estimated increase in the debt ratio by 1.4% in relative terms due the introduction of the final withholding tax may seem quite small, given the strong incentives. A possible explanation for the small reaction could be that some firms are financially constrained. As mentioned, even before the tax reform, debt finance was tax favoured (like in most other countries), as it can be used as a tax shield due to the deduction of interest payments from the tax base. Firms may thus have exploited this by increasing their debt ratios as much as possible prior to and independent of the reform being implemented. If their optimization led them into a corner solution before the reform, i.e. they could not increase their debt further due to finance constraints, it is clear that they could not react to the additional incentive to use debt introduced with the final withholding tax. This explanation seems especially plausible as the tax reform was implemented during the financial crisis, when firms may have had problems to obtain additional debt finance. Furthermore, I am measuring short-term effects. If adjustment of the finance structure takes more than a year of time, I am not capturing the full long-term effects. In the next section, I investigate effect heterogeneity, which provides some support for these explanations.

2.5.6 HETEROGENEOUS EFFECTS

I use variants of the baseline specification (S1) to investigate differences in the responsiveness of the debt ratio to the tax rate differential by different types of firms (Table 6). In specification (H1), I am interested in effect heterogeneity between industry classes. To analyse these differences I include interaction terms of the tax rate differential with dummy variables indicating that a firm belongs to i) agriculture, forestry, fishery, mining and quarrying; ii) utilities; iii) construction; iv) trade; v) transportation, storage, information and communication; vi) real estate and renting; and vii) services.[41] The manufacturing sector constitutes the

[41] As the change in the tax rate differential is treated as endogenous in the IV estimation, changes in its interaction terms are also endogenous. Therefore, the changes in the interactions of the IV for the tax rate

base category. For the manufacturing sector, the estimated coefficient of the tax rate differential is 0.055 and significant; this is a larger point estimate than that from the pooled estimation (0.042). Firms active in utilities and trade exhibit significantly weaker responses than manufacturing firms; perhaps for these industries, non-tax determinants of the debt ratio are relatively more important. For the highly regulated and oligopolistic utilities industry, the effect even goes in the other direction.

In specification (H2), I investigate whether firms with higher tangibility – and thus higher depreciation allowances and a higher non-debt tax shield – respond less to the tax rate differential. The results confirm this hypothesis, as the estimated coefficient of the interaction term between the tax rate differential and the mean-adjusted firms' tangibility is negative and significant.

In specification (H3) I analyse whether the size of the firm matters for the debt adjustment. *A priori* I had no clear expectation of the sign of the interaction term. On the one hand, larger firms could react more strongly as adjusting the finance structure might involve some fix costs, e.g. bank negotiations, such that only for large firms the tax benefit exceeds the fixed adjustment costs. On the other hand, it is also possible that smaller firms are more responsive, since personal shareholders, who benefit from the tax reform, may have more influence on the finance structure of smaller firms due to their smaller number and closer relationship to the firm. The estimated negative coefficient between the mean-adjusted firm size and the tax rate differential suggests that the latter mechanism dominates.

It is possible that firms adjust their debt ratio primarily when they invest by financing the investment predominantly by debt or equity. In specification (H4) I test this hypothesis by including the mean-adjusted investment quota (defined as the ratio of the change in tangible book assets/beginning-of-period stock of tangible book assets) and its interaction with the tax rate differential. The results confirm the hypothesis that firms investing more also adjust their capital structure more. As the investment quota is mean-adjusted, a firm with the mean investment

differential are used as additional instruments. First stage statistics for the changes in the industry dummy interactions are satisfactory. They are not shown for brevity, but available from the author on request. First stage statistics for the other specifications are provided at the bottom of the table.

quota (which is 10% in my sample) has a coefficient of the tax rate differential of 0.047. If a firm's investment quota is ten percentage points higher, the effect of the tax rate differential is 0.1 * 0.278 = 0.0278 higher and thus amounts in total to 0.075. This may suggest that the long-term effect of the introduction of the final withholding tax will be larger than the estimated short-term effect, as firms subsequently invest over time and then may simultaneously adjust their debt ratios.[42]

In specification (H5), I analyse whether firms that are carrying forward a loss respond less to a change in the tax rate differential, as one would expect as these firms have reduced tax incentives. The estimated coefficient of the interaction term between the dummy variable indicating a loss in the previous year and the tax rate differential is significantly negative indeed and amounts to -0.082. Consistently, the point estimate for the tax rate differential's coefficient for the remaining firms increases to 0.071. Thus firms that are carrying forward a loss do not respond to the incentive created by the tax rate differential.

In the last specification (H6), I check whether financially unconstrained firms react more strongly to a change in the tax rate differential. Similarly to van Binsbergen et al (2010), I classify those firms as financially unconstrained if the debt issuance or debt reduction scaled by total assets exceeds the 66th percentile or if the equity issuance or reduction exceeds the 66th percentile, as this demonstrates flexibility of the capital structure which one would not expect in the presence of financial constraints. The estimated coefficient of the interaction term between the dummy variable indicating a financially unconstrained firm and the tax rate differential is 0.077 and significant. Thus, for unconstrained firms the effect of the tax rate differential adds up to 0.091 (0.077 + 0.014), which is more than double the size of the baseline estimate. This suggests that financially unconstrained firms indeed adjust their debt ratios much more after tax changes than constrained firms, and that the small size of the average effect is partly due to constrained firms, which cannot further increase their debt ratios.

[42] Since investment might be endogenous, I additionally use an IV approach to assess robustness. As the excluded instrument for an individual firm's investment quota, I use the average investment quota of all firms within the same 3-digit industry (without the firm's own investment quota). The coefficient of the interaction term is positive and significant again (0.925 with a standard error of 0.268). I report the OLS results in the table because the first stage statistics do not sufficiently support the strength of the instrument for investment.

Table 6: Effect heterogeneity

Specification	(H1)	(H2)	(H3)	(H4)	(H5)	(H6)
Δtax rate differential	0.055***	0.042***	0.042***	0.047***	0.071**	0.014*
(base for (H1): manufacturing)	(0.014)	(0.012)	(0.012)	(0.012)	(0.033)	(0.009)
ΔL. tangibility	0.033***	0.036***	0.035***	0.018*	0.072**	0.034***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.028)	(0.007)
ΔL. log firm size	-0.007***	-0.007***	-0.005**	-0.021***	-0.014	-0.006***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.013)	(0.002)
Δlog firm age	0.010***	0.010***	0.006	0.009***	0.028**	0.009***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.011)	(0.003)
Δ(tax rate diff. * agriculture)	0.024					
	(0.032)					
Δ(tax rate diff. * utilities)	-0.118***					
	(0.015)					
Δ(tax rate diff. * construction)	0.010					
	(0.011)					
Δ(tax rate diff. * trade)	-0.044***					
	(0.010)					
Δ(tax rate diff. * transportation)	0.006					
	(0.015)					
Δ(tax rate diff. * real estate)	-0.007					
	(0.009)					
Δ(tax rate diff. * services)	-0.006					
	(0.010)					
Δ(tax rate diff. * L. tangibility)		-0.026***				
		(0.009)				
Δ(tax rate diff. * L. log firm size)			-0.017***			
			(0.002)			
Δinvestment quota				-0.005*		
				(0.003)		
Δ(tax rate diff. * investment quota)				0.278***		
				(0.020)		
Δloss previous year					0.015*	
					(0.008)	
Δ(tax rate diff. * loss prev. year)					-0.082*	
					(0.053)	
Δfinancially unconstrained						-0.015***
						(0.005)
Δ(tax rate diff. * fin. unconstr.)						0.077**
						(0.031)
Constant	-0.011***	-0.011***	-0.010***	-0.011***	-0.024***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)
Observations	38,339	38,339	38,339	38,339	1,505	13,702
1st stage *F* stat. (Δtax rate diff.)	9,617	38,166	38,132	24,795	96,113	20,699
Shea's Partial R^2 (Δtax rate diff.)	0.938	0.924	0.924	0.892	0.962	0.887
1st stage *F* stat. Δ(interaction term)		4,352,936	2,393,474	52,172	313,381	20,699
Shea's Part. R^2 Δ(interaction term)		0.972	0.967	0.983	0.997	0.887

Notes: The dependent variable is the year-to-year change in the ratio total debt/total assets. Δtax rate differential is the year-to-year difference in the tax rate differential between business and interest income. It is treated as endogenous; the simulated 1st differenced tax rate differential based on the twice-lagged ownership structure is used as the excluded instrument. The 1st differenced interactions of this simulated exogenous tax rate differential are used as instruments for the 1st differenced interactions of the endogenous tax rate differential. ΔL. tangibility, ΔL. log firm size and Δlog firm age are mean-adjusted here to facilitate interpretation of the coefficients. Heteroscedasticity robust standard errors in parentheses. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: Own calculations based on the financial accounts database *DAFNE* 2008-2009.

2.6 CONCLUSION

Various countries have implemented, or are considering implementing, flat rate taxes on interest income. Typically the tax rate on interest income is low in comparison to marginal tax rates on income generated by unincorporated businesses, as the latter type of income is subject to a progressive personal income tax. The resulting tax rate differential creates additional incentives to increase leverage, as business owners save taxes if they finance their business with debt rather than equity and invest their funds in bonded capital instead, e.g. in the banking system, where returns are taxed at the low tax rate on interest income. To estimate how much firms adjust their behaviour by increasing their debt usage due to these tax incentives, I exploit the introduction of a flat final withholding tax in Germany in 2009 as a quasi-experiment. This policy reform reduced the tax rate on interest income by 18 percentage points. I use individual firm level panel data to identify the effect on the debt ratio.

In line with the hypothesis, the results from a difference-in-difference matching approach indicate that partnership firms, where personal shareholders hold a majority equity stake, increased their debt ratios (total liabilities/total assets) by 1.4% due to the introduction of the final withholding tax. As my analysis shows, this finding is consistent with the results from a more structural approach where the debt ratio is modelled as a function of the tax rate differential. The coefficient of the tax rate differential implies that a reduction of the tax rate on interest income by 10 percentage points increases the debt ratio by 0.42 percentage points. I find larger effects for smaller firms, firms that invest, firms not carrying forward a loss from the previous year, and firms that do not appear to be financially constrained.

The rather small reaction of firms' debt usage suggests that even a significant differential between the tax rates on business and interest income does not seem to cause large distortions through behavioural adjustment. The estimated increase in leverage is not expected to lead to an alarming rise in bankruptcy risk. Therefore, a flat tax on interest income, which can be implemented comparably simply as a final withholding tax, may be in case the long run effect is not much larger a viable alternative to a Dual Income Tax, which may be conceptually more

appealing due to the equal treatment of equity and debt, but which is more complicated to implement.

However, noteworthy I estimate short-term effects within one year after the implementation of the tax reform. Further, since my analysis of heterogeneous effects suggests that firms do not completely adjust their financial structure immediately, but rather gradually when they decide how to finance new investment, and as during the financial crisis credit may have been hard to obtain, it is very likely that the long-term effect are larger. Subsequent research should therefore be directed towards estimating long-term effects. Another important avenue for future research is to investigate how taxes on interest income affect investment behaviour.

2.7 APPENDIX A: SUPPLEMENTARY ESTIMATION RESULTS

Table A-7: Logistic regression of the propensity score

	Logit coefficient	Std. error
local business tax rate	-0.126***	(0.041)
debt ratio	1.125***	(0.077)
log firm size	-0.495***	(0.017)
log firm age	0.142***	(0.024)
tangibility	0.122	(0.087)
Industry dummy variables for:		
agriculture, forestry and fishing	0.834***	(0.312)
mining and quarrying	-0.937***	(0.221)
manufacturing	0.261*	(0.138)
electricity and gas supply	-0.018	(0.165)
water supply	-0.812***	(0.199)
construction	1.133***	(0.159)
wholesale and retail trade	0.537***	(0.140)
transportation and storage	0.075	(0.155)
information and communication	-0.695***	(0.183)
accommodation and food service activities	0.469**	(0.215)
real estate activities	1.225***	(0.140)
professional, scientific and technical activities	1.015***	(0.147)
administrative and support service activities	0.440***	(0.168)
public administration and defence	0.753	(0.758)
human health and social work activities	-0.149	(0.233)
Constant	5.094***	(0.239)
Observations	38,339	
Pseudo R^2	0.093	

Notes: The dependent variable is the treatment indicator. It equals one for firms with more than half of their equity held by personal shareholders and zero otherwise. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: *DAFNE* 2008, own calculations.

Table A-8: Additional robustness checks

Specification	(S3)	(S4)	(S5)	(S6)	(S7)	(S8)
Estimation period		2008-2009			2004-2009	
Treatment of control variables	Twice lagged levels as controls	Endoge-nous controls (with IV)	Incl. profita-bility (with IV)	Twice lagged levels as controls	Endoge-nous controls (with IV)	Incl. profita-bility (with IV)
Δtax rate differential	0.031**	0.035***	0.054*	0.030**	0.031**	0.056*
	(0.012)	(0.013)	(0.031)	(0.013)	(0.014)	(0.031)
ΔL. tangibility			0.089***			0.050*
			(0.029)			(0.030)
ΔL. log firm size			-0.009			-0.015*
			(0.013)			(0.009)
Δlog firm age	0.006*	-0.003	0.021	0.011***	-0.003	0.027**
	(0.004)	(0.004)	(0.013)	(0.003)	(0.004)	(0.011)
Δbusiness income tax rate				0.089**	0.041	0.076
				(0.041)	(0.032)	(0.070)
L2. tangibility	-0.004**			-0.007***		
	(0.002)			(0.001)		
L2. log firm size	-0.002***			-0.003***		
	(0.000)			(0.000)		
Δtangibility		0.209***			0.269***	
		(0.056)			(0.044)	
Δlog firm size		0.213***			0.306***	
		(0.038)			(0.043)	
ΔEBITDA/total assets			-0.272***			-0.255***
			(0.082)			(0.072)
Δloss previous year			0.018**			0.015***
			(0.008)			(0.005)
year 2006				0.006	0.010	0.082**
				(0.021)	(0.024)	(0.040)
year 2007				0.007	-0.001	0.022***
				(0.005)	(0.005)	(0.008)
year 2008				0.011***	0.005*	0.020***
				(0.002)	(0.003)	(0.006)
Constant	0.010**	-0.005*	-0.027***	0.013***	-0.003	-0.027***
	(0.004)	(0.002)	(0.005)	(0.003)	(0.003)	(0.005)
Observations	38,339	38,339	1,505	62,771	62,768	3,264
1st stage *F* stat. (Δtax rate diff.)	70,916	33,637	57,200	37,944	28,759	36,738
Shea's P. R^2 (Δtax rate diff.)	0.922	0.913	0.957	0.889	0.921	0.938
1st stage *F* statistic (Δtangibility)		24			19	
Shea's Partial R^2 (Δtangibility)		0.004			0.003	
1st stage *F* stat. (Δlog firm size)		225			274	
Shea's Partial R^2 (Δlog firm size)		0.011			0.014	
1st st. *F* stat. (ΔEBITDA/ta)			34			40
Shea's P. R^2 (ΔEBITDA/ta)			0.080			0.063
1st stage *F* statistic (ΔCIT rate)				8655	8672	3151
Shea's Partial R^2 (ΔCIT rate)				0.552	0.550	0.648

Notes: The dependent variable is the year-to-year change in the ratio total debt/total assets. Δtax rate differential is the year-to-year difference in the tax rate differential between business and interest income. It is treated as endogenous; the simulated 1st differenced tax rate differential based on the twice-lagged ownership structure is used as the excluded instrument. Δbusiness income tax rate is treated analogously. In specifications (S4) and (S7) ΔL. tangibility and ΔL. log firm size and in (S5) and (S8) ΔEBITDA/total assets are instrumented with the twice lagged levels. Heteroscedasticity robust standard errors in parentheses. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.

Source: Own calculations based on the financial accounts database *DAFNE* 2003-2009.

2.8 APPENDIX B: GLOBAL ULTIMATE OWNERS

In this chapter, I use firms' immediate shareholder structures in my identification strategy. One might argue that ultimate ownership matters; several companies may be stringed between the firm and the ultimate owner in the ownership chain. Therefore, in a robustness check I exploit international variation in global ultimate ownership and use an identification strategy similar to that of Overesch and Voeller (2010). This approach makes use of the fact that different global owners face different tax rates for interest income. Besides Germany in 2009, France and Spain also significantly changed their taxes on interest income in 2007 and 2008. Spain introduced a flat tax on capital income on January 1, 2007. Interest income from instruments with a maturity of less than one year, which was taxed progressively as general income before the reform (tax rate: between 15 and 45%), is taxed with a flat rate of 18% now (OECD, 2007, p. 113). France implemented an optional flat tax on interest income with a rate of 18% on January 1, 2008 (Public Finance General Directorate, 2009). Before the reform, interest income was taxed as general income with a rate between 5.5% and 40%.

In my data, for many firms I observe the name, the type, and the country of residence of the global ultimate owner, who is defined as a shareholder who i.) has the largest ownership share and ii.) owns at least 25.01% of the firm, and iii.) who is independent in the sense that the shareholder is not owned to the extent of more than 25% by another shareholder. The ultimate owner is found recursively by deciding if the shareholder who fulfils conditions i.) and ii.) is independent, otherwise the shareholders of this largest owner are examined likewise. Using the sub-sample of firms with a natural person as the global ultimate owner, I regress the debt ratio on the tax rate on interest income faced by this ultimate owner and the control variables used before, again in first differences to account for time-invariant firm effects.[43] International interest tax rates are derived from publications by the German Federal Ministry of Finance (2006-2011). Because of the potential endogeneity of the ownership structure, I again apply an IV

[43] For comparability with the results presented above I only include unincorporated businesses in the sample. Furthermore, I only consider shareholders from countries where sufficient observations are present, i.e. Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Great Britain, Greece, Germany, Ireland, Italy, Japan, Luxemburg, Netherlands, Norway, Poland, Spain, Sweden, Switzerland, and the United States.

estimation; as the excluded instrument I use the interest tax rate which would have prevailed if the location of the global ultimate owner had not changed since the year before the previous year. When a firm is observed in the data for the first or second time I assume that the ultimate owner of the firm did not change to avoid losing too many observations.

The results are presented in Table B-9. I use all years from 2004 to 2009, thus variation in the tax rate on interest income comes from the tax reforms in Spain, France, and Germany. The standard errors reported are clustered by the global ultimate owner's country of residence and are robust to heteroscedasticity. The estimated coefficient of the tax rate on interest income can be compared to the estimated coefficient of the tax rate differential between business income and interest income in the baseline specification (S1) with reversed sign, i.e. -0.042, as I control for the tax rate on business income separately. The point estimates from the two specifications lie within each other's confidence intervals, so the baseline estimate is robust to this alternative identification strategy based on the global ultimate owner. The first stage statistics for the relevance of the instrument are sufficiently large, as shown at the bottom of the table.

Table B-9: Global ultimate owners' interest tax rates

	Coefficient	Std. error
Δtax rate on interest income	-0.060*	(0.036)
Δbusiness income tax rate	0.061***	(0.003)
ΔL. log firm size	-0.009***	(0.000)
ΔL. tangibility	0.028***	(0.000)
Δlog firm age	0.014***	(0.000)
year 2006	0.026***	(0.006)
year 2007	0.018***	(0.006)
year 2008	0.016**	(0.006)
Constant	-0.015**	(0.006)
Observations	62,568	
1st stage *F* statistic (Δtax rate on interest income)	11	
Shea's Partial R^2 (Δtax rate on interest income)	0.261	

Notes: The dependent variable is the year-to-year change in the ratio total debt/total assets. Δtax rate on interest income is the year-to-year difference, instrumented with the simulated 1st differenced tax rate on interest income based on the twice lagged ownership structure. Standard errors in parentheses are clustered by the global ultimate owner's country of residence and are robust to heteroscedasticity. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: Own calculations based on the financial accounts database *DAFNE* 2004-2009.

CHAPTER 3: THE IMPACT OF INTRODUCING A GENERAL INTEREST BARRIER

3.1 INTRODUCTION

Prior studies show that profit shifting is a severe problem for governments in Europe and the US.[44] While growing international tax competition has led to a general decline in statutory corporate tax rates, several countries – especially larger countries – have introduced or tightened thin capitalization rules (TCR) in order to broaden the tax base.[45] Although all TCRs have the same main objective, to prevent firms from shifting profits abroad, they differ in many characteristics between countries and have considerably changed over time.

With respect to profit shifting, it is helpful to differentiate between two types of TCRs.[46] The most prevalent type is the "Fixed Ratio Approach", which restricts (or completely denies) the deductibility of interest expenses to shareholders if the ratio of (internal or total) debt to equity financing exceeds a "safe haven" level set in the law.[47] This type of TCR has been analysed in a few studies so far. Buettner et al (2012) exploit international variation in the application of TCRs to examine the impact of these traditional type TCRs on firms' debt ratio.[48] They find that TCRs are quite successful in reducing internal debt. However, their results suggest further that the reduction of internal debt is accompanied by an increase in external debt, which indicates a substitution between both types of debt. Overesch and Wamser (2010) and Wamser (2008) confirmed both results (reduction of internal and

[44] See Huizinga and Laeven (2008), Weichenrieder (2009), Egger et al (2010), Buettner and Wamser (2012), and Becker and Riedel (2012).
[45] See Haufler and Runkel (2012) and Fuest and Hemmelgarn (2005) for a theoretical analysis of TCRs within the context of international tax competition.
[46] For an overview see Webber (2010).
[47] The term "Fixed Ratio Approach" was introduced by the OECD (1987).
[48] In detail, they analyze TCRs in 36 countries using a firm level panel data set of affiliates of German multinationals combined with information on corporate taxation in each of these countries.

substitution of internal with external debt) by studying only the German TCR in the period 1996 to 2004.[49]

Although these studies do not consider directly the impact of TCRs on the tax base, their results suggest that TCRs do not broaden the tax base to a large extent - given the partial substitution between internal and external debt. A further disadvantage of traditional type TCRs, which intend to restrict shareholder debt financing, is that tax authorities have to prove that a creditor is a shareholder or related person and not a third party. This is often demanding given the complex group structures.

Probably due to these two major disadvantages, a new type of TCRs is observed in recent years. This type does not offer a safe haven with respect to a certain debt to equity ratio but restricts at first the deduction of interest payments, independent of the recipient, to a certain share of a company's taxable profits. Only in the second step, companies may make claims for certain escape options. Countries, which introduced this kind of TCRs, are Germany and Italy.

To assess the effectiveness and firms' behavioural responses to this new type of TCRs is the aim of this study. For this purpose I[50] analyse the TCR introduced in Germany in 2008 that restricts the amount of deductible interest expenses, independent of the creditor, to 30% of EBITDA, adjusted for tax purposes, and applies to all firms.[51] However, since the German government was not interested in harming its own economy by implementing this broad concept, the TCR includes several escape clauses as well. The most important one for the majority of firms is

[49] Weichenrieder and Windischbauer (2008) add to the aforementioned studies the observation that investment was not negatively affected by the tightening of the German TCR in 2001. They explain *inter alia* this result with the fact that firms worked around the legislation by setting up holding entities, for which a less strict safe haven ratio applied (for instance 1:9 instead of 1:3 in the regulations up to 2000). However, another explanation might be the substitution of internal with external debt.

[50] This chapter is based on joint work with Hermann Buslei (Buslei and Simmler 2012).

[51] After completing this study, I became aware of a similar analysis by Dressler and Scheuering (2012). In contrast to their study I analyse not only the reaction of firms' debt ratio, but the impact on reported profits and investment as well. Moreover, I consider a specific firm behaviour as a response to the regulation, which is the option for firms to split up their assets to avoid the application of the interest barrier. Further, there are methodological differences between the studies. The most important is probably that Dressler and Scheuering (2012) rely for their classification of treatment and control group *inter alia* on the year 2007. Within this year, however, the regulation was already known, thus this year should be treated as after the reform as in this study, otherwise one of the main assumptions of the difference-in-differences approach is violated as self-selection is possible. Thus the true impact of the regulation is not uncovered. See also section 3.6.3.

the tax exemption limit for the net interest expenses of 1 million euro.[52] These escape clauses are exploited for the identification of the causal effects using a difference-in-differences approach (DiD). [53]

The questions I study in this chapter are: (1) Do firms adjust their capital structure to avoid the application of the TCR? In this regard, I focus in particular on whether firms exploit the exemption limit of the interest barrier by splitting up firms assets to avoid the application of the TCR without changing the debt ratio. This option was discussed prior to the reform. (2) Does firms' profitability in Germany increase due to the TCR? I examine explicitly the impact of the TCR on firms' profitability to fill the gap present in prior studies. Although one would expect that profitability increases if the debt ratio is reduced, the relation need not be proportional as firms might find other ways to shift profits abroad, for instance via transfer prices. (3) What is the impact of the TCR on investment?[54]

Noteworthy, compared to other applications of the DiD approach, the treatment in this study is the threat that the TCR *will* apply in case firms' ratio of interest expenses to taxable profit remains unchanged.[55] I rely on the threat instead of its application itself as avoidance of TCR is advantageous for almost every firm. [56] Therefore, basing the study on the actual application of the interest barrier would provide misleading results as the application already depends on firms' reactions. The treatment group in this study consists, therefore, of firms for which the TCR would apply if they did not change their net interest expenses. In contrast, firms in the control group are independent of their own decisions not affected by the TCR. They have either interest expenses below the interest exemption threshold or they

[52] The threshold of 1 million euro was increased by the Peoples' Relief Act (Bürgerentlastungsgesetz) (temporarily) and the Growth-Enhancement Act (Wachstumsbeschleunigungsgesetz) (permanently) in 2009 to 3 million euro. However this was after December 31, 2008.

[53] There are already some studies analyzing this "interest barrier" with respect to the number of affected companies and the additional tax revenue using a micro simulation approach (Bach and Buslei 2009, Blaufus and Lorenz 2009, and PSP 2008). All these studies, however, assumed that firms' do not avoid the application of the TCR but pay the additional taxes.

[54] In my empirical analysis I capture the short-term changes in tax base and investment. In the medium- and long-term, investment may have a different impact on the tax base.

[55] With the application of the TCR I mean that without an appropriate adjustment the firm faces a higher tax burden due to non-deductible interest expenses.

[56] Firms will avoid the application of the TCR as the additional tax burden, which arises due to the application of the TCR, is always greater than, or under best circumstances equal to, the additional tax burden, which arises from a reduction of the debt ratio. See section 3.2.

are entitled to another escape clause.[57] To determine whether the TCR would apply to a firm, I use the firm characteristics before the announcement of the new TCR. The reactions I analyse are firms' behavioural responses to avoid the application of the TCR and their related effects on investment and the tax base.

My analysis is based on two subsamples of financial statements data for all incorporated German firms from the firm data base DAFNE, provided by Bureau von Dijk. The first sample includes only firms with a net interest result near the exemption threshold of 1 million euro. For these firms, the "equity escape clause", which I cannot model, is of minor importance. In the second sample I include all firms that are affected by the TCR. This allows me to draw more general conclusions about the effectiveness of the whole regulation.

I find that firms strongly react to the new regulation. In order to avoid the limited deductibility of interest expenses, they either decrease their debt ratio or split up their assets to use the exemption threshold. The latter however seems to be an option only for firms near the threshold, at least in the short-term. In general no negative investment effects are found. This suggests that firms are able to substitute equity for debt at low costs and that debt is not their marginal source of finance. However, investment might also be fixed in the short-term due to, for example, long-lasting contracts. Further, my analysis points out that the newly introduced TCR is quite successful in broadening the tax base.

The outline of the chapter is as follows. In the next section I briefly motivate the behavioural responses I expect. Section three provides a summary of the new TCR in Germany and the timing of the law, followed by a description of the empirical methodology. Section five presents my dataset. Results are reported and discussed in section six, section seven concludes.

3.2 THEORETICAL BACKGROUND

Whether firms react to the TCR depends on the costs associated with and without a reaction. If the first exceed the latter, firms react; if not they don't. Since under the new TCR all interest expenses are subject to the regulation, three cases have to be

[57] The escape clauses are described in detail in Section 3.3. These are the stand-alone, EBITDA and equity escape clauses. Further, I analyze whether firms avoid the application of the TCR by splitting up their assets to exploit the exemption limit.

distinguished to understand firms' incentives. These are (1) firms which shift profits abroad via debt financing, (2) firms with internal shareholder financing within Germany and (3) firms with excessive bank financing.

Before going into the detail, I outline the potential additional costs of no reaction and on which factors they depend. Under the new TCR interest expenses are only deductible up to 30% of firms' EBITDA. Thus, only if firms' interest expenses are above the ratio additional costs may arise. In this case firms' average tax rate on profits in this year increases by the amount of the statutory tax rate multiplied by the amount of non-deductible interest expenses divided by profits. However, since in principle non-deductible interest expenses can be carried forward and be deducted in later periods given a sufficiently high EBITDA in these periods (see section 3.3), the additional costs results in the best case only from the delay in the deductibility. If for example firms' discount rate is 5% and the deduction of the interest expenses happens 5 years later, the additional costs are 22% of the tax advantage of the interest expenses ($1-0.05^5$). However, the carry-forward of non-deductible interest payment might become worthless if the firm goes bankrupt. Thus, the additional costs in case of refraining from a reaction depend also on firms' bankruptcy risk. In case of a yearly 5% risk of bankruptcy the expected additional costs amount to almost 40% of the tax advantage of interest payments.[58] So far, I assumed that firms' EBITDA is volatile but in the long run sufficiently high such that all interest expenses can be fully deducted. If this is not the case, the additional costs increase further Thus, taken together, although interest payments, which are not deductible in the current year, may be deducted in later periods, the additional costs are substantial.

I now turn to the three cases mentioned above and describe the costs, which arise in each case, if the firm does or does not react to the TCR. I begin with a firm, which shifts profits abroad. Let me consider an easy example. Suppose there are two countries, a high tax (h) and a low tax (l) one. The tax rates are τ^h and τ^l .Further, there exists a firm that operates in both countries and may either use equity or internal debt to finance its capital stock. Without a TCR, the firm shifts profits from

[58] The expected benefit in case only timing differences matter amounts to 78% of the tax benefit. The probability that the firm still exists in 5 years amounts to 77% ($95\%^5$). Multiplying both results in an expected benefit of 60% of the tax advantage of the interest payments or costs of 40% of the tax advantage.

the high to the low tax country via internal debt finance. The tax rate on profits is τ^l. If a TCR is in place, I have to distinguish whether EBITDA is sufficiently high or not. Since the firm shifts profits it is reasonable to assume that EBITDA is sufficiently high. If the firm does not stop shifting profits, the application of the TCR leads to a double taxation as interest expenses are deductible neither in the current nor in later periods. The overall tax rate is thus $\tau^l + \tau^h$. In contrast if the firm stops shifting profits and finances all investment with equity, the profits accrue in the high tax country and are taxed at the rate τ^h. Comparing the costs without ($\tau^l + \tau^h$) and with reaction (τ^h) it is obvious that only in the case where τ^l equals zero, the firm is indifferent between the limited deductibility of interest expenses due to the TCR and a substitution between equity for debt. If one takes further into account costs for internal debt financing or a strictly positive tax rate in the low tax country, a profit-shifting firm will always try to avoid the TCR.

The effect of the TCR on investment depends not on the comparison of the costs with and without a reaction but on the difference between the costs associated with the preferred alternative (in this case "react") and the costs before the TCR was introduced. For the profit shifting firm this is ($\tau^h - \tau^l$), which is also the incentive to shift profits abroad.

The second type of firms, which may be affected by the TCR, are those with excessive bank financing. Suppose such a firm is financed half with debt and half with equity. The rate of return amounts for both to 10%, the tax rate on profits to 50%. Without the application of the TCR, the after tax rate of return of equity amounts to 5%. If the TCR is applied the rate of return is reduced to 0% as interest expenses are no longer deductible, neither in the current nor in later periods, or to something in between 5 and 0% if they can be deducted in later periods. In case the firm substitutes its debt with equity, the rate of return on equity, however, would remain at 5%. Thus, only in the case where the rate of return on debt amounts to 0%, the firm would be indifferent between the limited deductibility of interest expenses due to the TCR and a reduction of the debt ratio. Therefore, also for firms with excessive bank financing it is always beneficial to reduce its interest expenses. The additional tax burden that the TCR causes equals the difference between the tax rate on equity and the tax rate on debt. In Germany, this difference

is positive (around 22 %-points).[59] However, whether this affects investment depends on firms' marginal source of finance. If this is debt, negative investment effects are likely; if it is retained earnings, no effects should show up. Nevertheless negative investment effects might still be caused if firms do not have sufficient equity to replace its debt. I check this by accounting for differences in the cash-flow sensitivity of treated and control firms.

The last case to consider is shareholder debt financing of firms with shareholder interest income liable to the German income tax. Before the TCR, the income tax rate on interest income on the shareholder loan was 47.5%, assuming that the shareholder faces the highest income bracket tax rate.[60] No profits have been taxed at the company level. In case profits are distributed the tax rate amounts to 48.4%.[61] Thus, the shareholder is almost indifferent between interest income and distributed profits. However, if the TCR applies, then the tax rate on interest income increases by the tax rate on corporate profits (around 30%) and is, therefore, always higher than the tax rate on distributed profits. Thus, also these firms have the incentive to avoid the TCR by reducing their leverage. The additional costs of investment are the difference between the tax rates, which is almost zero.

Thus, for every firm it is beneficial to avoid the application of the TCR. This implies that the effectiveness of the TCR can only be evaluated by the behavioural responses that the regulation causes. Thus, I use the threat that the regulation will be applied as the treatment in this study. With respect to investment I expect on average negative investment as for profit-shifting firms and firms with excess bank financing the increase of equity financing comes at some costs. For the first group this depends on the difference between the tax rate in the low and the high tax country, for the latter group on the tax rate difference between equity and debt if

[59] Due to the introduction of the flat tax on interest income in 2009, the tax rate on interest income amounts to 26.4% and is much smaller than for dividends (distributed profits from incorporate business), which amounts to 48.3%. The tax rate on distributed profits is the sum of the corporate income tax (including solidarity surcharge) and the local business tax (15.8% + 14% = 29.8%) plus a flat tax on the shareholder level, which amounts to 26.4%. Thus, the overall tax burden amounts to 48.3% (29.8% + (100% – 29.8%)*26.4%).
[60] Tax rate includes the solidarity surcharge of 5.5%. The flat tax on interest income does not apply as I assume that the shareholder holds more than 10% of the equity of the firm (Art 32d, I Income tax code).
[61] See footnote 59.

firms' marginal source of finance is debt. Further, for firms with excessive bank financing another problem might be a lack of internal cash to replace its debt.

3.3 INSTITUTIONAL BACKGROUND

Up to 2007, Germany had a traditional type TCR with a safe haven (equity to debt) amounting to 1 to 1.5 in place.[62] However, anecdotal evidence, the practical difficulties to proof a shareholder or a related person as creditor and the results of empirical studies convinced German politicians that profit shifting by multinationals was still considerable and that it came, to a large extent, at the expense of Germany, despite the existing TCR.[63] Therefore, a new TCR was designed and introduced as one part of the major corporate tax reform in 2008.

This new interest barrier is, in several ways, more restrictive than the regulations that preceded it. It takes into account interest payments from all types of creditors and applies to all types of companies. According to the basic rule of the new regulation interest payments are only deductible as long as they are balanced by interest income or, in case interest payments exceed firms' interest income, as long as the exceeding payments are less or equal to 30% of earnings before interest, taxes, depreciation and amortization (EBITDA), adjusted for tax purposes (see Art. 4h German Income Tax Code). The restricted deductibility applies to corporate income, local business, and the income tax. Interest payments that are not deductible in one year may be carried forward indefinitely and - given sufficiently high levels of EBITDA in later years - may then be deducted.[64]

In order to prevent small firms and firms with a somehow "sufficient" equity financing from an additional tax burden, the interest barrier comes with several

[62] In the first version of the TCR, enacted in 1994, the debt/equity ratios were more generous and only foreign shareholders were subject to the regulation. The first reform in the year 2001 brought less generous ratios. A second reform in the year 2004 extended the TCR to all shareholders (see Körner, 2004). In all versions, the regulation applied only to interest payments on loans provided by substantially participating shareholders of limited liability companies (share > 25%, article 8a German Corporate Tax Code in the year 2007) or by related persons and non-related persons with a right to recall. Further, an exemption limit of 0.25 million euro was granted.

[63] See Rödder and Stangl, 2007, p. 479, Deutscher Bundestag, 2007, p. 29 for a motivation of the new law and Thiel (2007) for summary of the practical issues.

[64] A carry-forward of unused EBITDA was not included in the initial regulation, but added later on. See Rödding, 2009.

"escape clauses". Small companies should not face a burden, as the initial code in the year 2008 included a tax exemption limit of 1 million euro.

The second escape clause applies to stand-alone companies. There are two variants of this escape. The first refers to single companies that do not belong to a group and do not rely on significant shareholder debt financing (basic stand-alone, Art. 8a, 2 Corporation Tax Code). The second variant refers to members of consolidated tax groups. If all members of a group form a single tax group, the whole group is regarded (and treated in the same way) as a single company. The whole group is thus exempted from the interest barrier if no harmful financing by owners is present. I refer to this as the tax group stand-alone.

The third escape type is provided for members of a group that do not qualify as a tax group. A group member may deduct all interest payments if the member's equity rate (equity over total assets) is not lower than the equity rate in the whole group, according to the consolidated statement of the group including the company under consideration (equity escape).[65] Like the second escape type, also this third type is granted only for member companies of groups if limits for shareholder debt financing are not violated by any member in the whole group.

Another escape option is directly related to the above mentioned exemption limit. Firms with interest expenses above the exemption limit may incorporate new subsidiaries and shift some of their assets over to these new entities. If this is possible, I would expect firms to do so since in this case the firms and their subsidiaries are not affected by the interest barrier and can still shift profits and/or have high leverage ratios.

Since for the empirical investigation in the following the announcement of the regulation is important, I briefly outline it here: The first details concerning the deductibility of interest payments were included in a report of a working group of the federal government and the *Länder* early in November 2006, followed by a first draft bill for this reform by the German government on February 5, 2007. The law passed the last stage of the legislation process (Bundesrat) on July 6, 2007 and was published on August 14, 2007. The parts relevant for this study were enacted at

[65] The initial regulation of the corporation tax reform 2008 included a tolerance level of 1 percentage point.

the beginning of the year 2008.[66] Thus, as I rely on financial statements data, which are yearly data and start typically from January 1st, I will use 2006 as the pre-reform year as in this year the regulation was basically unknown.

Noteworthy, although it is not relevant for the causal analysis, the regulation as described above was never applied since it was retroactively changed in 2009 due to the 2008/2009 economic downturn. On the one hand the exemption limit was raised to 3 million euro, initially in a temporary move with the Peoples' Relief Act in July 2009, then permanently with the Growth-Enhancement Act of December 2009. On the other hand, a higher tolerance level for the "equity escape" and an EBITDA carry forward were introduced in the 2009 Growth Enhancement Act. Since these changes were not discussed seriously before the beginning of the year 2009, the modifications had no impact on the financial decisions in 2008 that determined firms interest result in this year. However, due to these changes, I only include observations up to the year 2008.

3.4 METHODOLOGY

To analyse the causal effects of the TCR on firms' financing and investment decisions and on their profitability I rely on a difference-in-difference approach.[67] By using this approach the effect of a reform is measured by comparing the outcome for a treatment (which is affected by the reform) with a control group, both before and after a reform. Since the TCR has not been created to be applied but rather to set an incentive to reduce profit shifting and excessive bank financing as outlined in section 3, I rely on the threat of the TCR application. Thus, the effect I estimate is a behavioural response to avoid the application of the TCR by reducing the debt ratio or by splitting up firms assets such that the absolute amount of interest expenses is reduced.[68]

To apply a valid difference-in-difference design two important requirements have to be fulfilled. Firstly, treatment and control group should exhibit the same trend in

[66] The probably most important change of the reform was the reduction in the tax rate of the corporation tax from 25 to 15%.
[67] For a general introduction, see Meyer (1995).
[68] In principle, since net interest expenses are the relevant criterion, firms might also try to increase their interest income by reclassifying other income flows as interest income. However, I believe that this is only an option for a small number of firms and, thus, do not consider this behavioral reaction in the following.

the absence of the treatment. In other words, it is required that there are no other confounding treatments. Since there is no formal proof, I show in the data section exemplarily for the debt ratio that treatment and control group followed a common trend until the new TCR was announced. Further, although there have been other changes (reduction of the corporate tax rate, changes in the adding-back regulation for the local trade tax) due to the corporate tax reform in 2008, I do not know of any regulation that treated firms differently with respect to marginal incentives beyond the TCR.[69]

The second assumption, on which the DiD approach is based, states that treatment has to be exogenous, meaning that no selection into treatment and control group is possible. I ensure this by forming treatment and control group using 2006 and thus pre-reform firm characteristics, since, at this time, the changes in the TCR were not yet known.[70]

Given my data, I am, in principle, in the position to identify those firms in the sample that are entitled to use any of the above outlined escape clauses.[71] The only escape clause I cannot model is the equity escape clause. To account for this regulation, the entire group structure must be known, which is not possible as I only have data for German firms. In order to account for this shortcoming and still be able to draw conclusions for the whole regulation, I form two samples. In the first sample I only include firms for which the equity escape should be of minor relevance. These are firms with interest expenses near the exemption limit. Since the equity escape is quite complex and might result in changes in the group structure, which are costly, I believe that for these firms the reduction of the debt ratio is their first choice to avoid the application of the TCR. I assume that these

[69] When assuming that both marginal and average incentives matter**,** my estimated treatment effect might, in addition to the reaction to the TCR, also capture the effect that the control group probably benefits more from the 100,000 euro allowance, which was introduced for adding back certain parts of finance expenses, i.e. interest payments, at a rate of 25%. The control firms I look at in my baseline specification have interest expenses above 500,000 euro, thus the additional burden due to adding-back certain finance expenses is 4/5 times 0.25 times the tax rate, which is around 14%, depending on the community. For treated firms with interest expenses of 1.2 million euro, the additional burden is 11/12 times 0.25 times the tax rate. Compared to before the reform, the incentive to reduce debt is therefore larger for the treated firms. The difference in the tax burden between the two firms is, however, only 0.4%, thus the bias of estimated effects should be rather small.

[70] See Section 3.3.

[71] With the restriction that I am not able to control for harmful shareholder financing, thus small uncertainties remain.

firms have interest expenses up to 1.5 million euro.[72] On the other hand, in the second sample I include all firms that are affected by the TCR in the treatment group in order to draw conclusions about the general impact of the new regulation. Due to the fact that I cannot model the equity escape clause, I probably underestimate the impact of the interest barrier on those firms with an interest result above the exemption limit and for whom the equity escape clause is not suitable.

Further, since modelling the entitlement to the EBITDA escape clause involves a high degree of uncertainty, due to missing information on the necessary tax adjustments of the EBITDA, as I rely on financial statements, I start by considering only the basic stand-alone and the tax group stand-alone. In the robustness section the results, in which I control for the entitlement to the EBITDA escape, are presented.[73]

To avoid misclassification at the threshold and to ensure that firms in the control group are not affected by the TCR,[74] I exclude in both samples firms with net interest expenses between 0.8 and 1.2 million euro. Moreover, since firms can be assumed to be forward looking, I drop from both samples all 2007 observations, as during this year firms probably started adjusting their debt (see the graphical analysis in section 3.5).

Finally, the treatment group in the first (second) sample consists of firms with net interest expenses between 1.2 and 1.5 million euros (above 1.2 million euros) and which are not entitled to basic-stand or tax group stand-alone escape. In the control group of sample 1 (2) firms with net interest expenses between 0.5 and 0.8 million euros (0.2 and 0.8 million euros) and firms which are entitled to either of the two escape clauses are included.[75]

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[72] In a robustness check I changed these limits; the results did not alter and thus are not sensitive to these specific limits.

[73] Before I decided on the definition of the treatment and control in my analysis, I estimated a heterogeneous treatment specification. In this estimation, I checked whether firms for whom the TCR applied, but which were also applicable to a specific escape clause behave differently from firms that were not able to use the escape clause. Firms who were applicable to the EBITDA escape did not behave differently (see section 3.6.3).

[74] A firm with a net interest result of 0.95 million euros would, for example, be treated by the TCR if it invests 100,000 euro and finances the investment with new debt.

[75] I choose the lower bound for the control group (0.2 million euros) such that the ratio of the number of firms in treatment and control group remained unchanged.

The specification, on which I base my estimation equation to analyse the impact of the new interest barrier on firms' debt ratio, profitability and investments, is exemplarily shown for the debt ratio as dependent variable in equation (3.1). C*onst* is a constant, *μ(i)* is a firm specific effect, and *Treatment* is a dummy that is one for the treated firms (as defined above). *After* is a dummy, which is one for years after the 2007. *ε* is an *iid* error term. All other factors that affect the debt ratio are summarized in *X (i,t).* These variables are, in my study, for the debt ratio as dependent variable the tax rate on business income, firm size, firm age, firms' share of tangible assets, and the ratio of EBITDA to total assets. The construction of the variables is described in section 3.4.

Treatment captures differences between treatment and control group with respect to the debt ratio and *After* time difference between before and after the reform. The effect I am interested in is given by *γ*, which sums up the different development of the debt ratio for the firms that are affected by the TCR.

$$Debt\ Ratio\ (i,t) = Const + \mu(i) + ß\ Treatment\ (i) + \theta\ After\ (i,t) + \gamma\ (Treatment(i) * After(i,t)) + \rho\ X(i,t) + \varepsilon(i,t) \quad (3.1)$$

To avoid biased results due to firm specific effects, I estimate equation (1) in differences between 2008 and 2006 (equation (3.2)). The dependent variable is, thus, the change in the debt ratio between 2008 and 2006. Noteworthy, since I estimate in differences and construct the two groups based on the firm characteristics in 2006, I do not have to control for time differences between the treatment and control group.

$$\Delta Debt\ Ratio\ (i) = \theta\ \Delta After\ (i) + \gamma\ \Delta(Treatment\ (i) * After\ (i)) + \rho\ \Delta X\ (i) + \Delta\varepsilon\ (i) \quad (3.2)$$

To analyse whether firms have split up their assets in order to avoid the interest barrier, I rely on a slightly different estimation design. In case a firm splits up, I expect that the number of subsidiaries increases compared to firms that do not split up. Thus, in case firms split up their assets to avoid the application of the TCR, I would expect that their behavioural responses with respect to the debt ratio and the profitability are less strong. Their capital stock, however, should decrease more compared to treated firms that do not split up. Since the number of additional subsidiaries may vary for different industries, I construct a binary variable that is one if the number of subsidiaries increases between 2006 and

2008. To account for different trends in the debt ratio of firms, for whom the number of subsidiaries increases, I include the dummy indicating whether the number of subsidiaries increased or not itself in the estimation equation (D(Δsubsidiaries(i))). Further, to analyse the effect of interest, I include the interaction term between this dummy and the Δ *Treatment * After)* variable. The coefficient of this variable captures how the debt ratio has changed for these firms. The equation I estimate is given in (3.3).

$$\Delta Debt\ Ratio\ (i) = \theta\, \Delta\, After(i) + \pi\, \Delta\, After(i) * D(\Delta subsidiaries(i)) + \gamma\, \Delta\, (Treatment(i)*After(i)) + \varphi\, \Delta\, (Treatment(i)*After(i))* D(\Delta subsidiaries\ (i)) + \rho \Delta X(i) + \Delta \varepsilon(i) \quad (3.3)$$

For the analysis of the impact of the interest barrier on firms' investment and profitability the same econometric approach is used. For both dependent variables I include the same control variables, except the EBITDA to total assets. In the specification with investment as dependent variable I additionally account for the change in turnover. The construction of the variables follows in the next section, where I also describe the data set on which the study is based.

3.5 DATA

The database for my study is the financial statements collection DAFNE provided for German firms by Bureau van Dijk. The main source for this data base is the registrar of companies in Germany. The dataset contains individual balance sheets, profit and loss accounts, and information on ownership structures. For years after 2005 the database covers nearly all incorporated firms in Germany, as for these firms strict publication requirements apply.[76] For unincorporated business the database is only representative for limited partnerships with a limited liability company as general partner (*GmbH & Co. KG*). However, as I are interested in firms with net interest expenses above 0.2 million euro and probably only a few partnerships with unlimited liability have interest payments above this amount,

[76] In principle all German companies with a limited liability have to publish their financial statements according to Art. 325 of the Commercial Code, only subsidiaries that meet special requirements (see Art. 264 III Commercial Code) are not obliged to do so. To the best of my knowledge only a few thousand companies, out of nearly a million incorporated businesses, fulfill these requirements.

the insufficient representation of these firms in my database should not have a severe impact on the results of my empirical analysis.

From the description of the rules of the interest barrier given above, it is obvious that the information on the net interest result is crucial for the analysis. The net interest result can generally be calculated based on the information in DAFNE, however the relevant information is directly observed only for a subsample of the data. The reason is that the disclosure rules are less strict for the income statement than for the balance sheet. Small companies are not legally required to publish their income statement at all.[77] In the DAFNE wave that I use for my empirical study (wave January 2012), I observe in total around 870,000 (940,000) companies with valid balance sheet information available for the year 2006 (2008).[78] From these companies, around 100,000 (90,000) also provide an income statement. For a subsample of these I also have information on the ownership structure, which is important for determining whether a firm is entitled to use TCR escape clauses. Therefore, for the basic analysis using the two subsamples outlined above, I only include firms for which income statements and ownership information are available. However, since the selection of companies with an income statement and the selection of companies with the necessary ownership information are probably non-random, I extend the analysis such that all firms are included in a sensitivity analysis (section 3.6.3).

Noteworthy, from all samples, I exclude financial firms as well as firms within the sectors of public administration and defence, education, health and social work, other community activities, as well as firms with negative equity. The number of observations in sample 1 (2) amounts to 767 (4,591), of which 174 (1,075) exhibit net interest expenses above 1.2 million euro. Of these, 98 (493) are either entitled

[77] The criteria for size are total assets, sales and number of employees. Small companies fulfill at least two of the following three conditions: 1. total assets are equal or less than 4.015 million euro, sales are equal or less than 8.030 million euro and the number of employees is equal to or less than 50. A medium sized company does not fulfill at least two of the conditions that determines a small company and does fulfill at least two of the following three conditions: 1. total assets are equal to or less than 16.060 million euro, sales do not exceed 32.120 million euro and the number of employees does not exceed 250. For a large company, at least two of the values for assets, sales and employees must exceed the respective thresholds for a medium sized company. Moreover all companies listed at an organized bond market are considered as large companies. See article 267 of the German commercial code.

[78] All numbers refer to companies with non-consolidated statements. Companies for which only a consolidated statement is available are omitted in the empirical analysis.

to the basic stand-alone or to the tax group stand-alone. Thus, 76 (564) observations form my treatment group.

I turn to the construction of variables next. For my first research question the dependent variable is the change in the debt ratio between 2008 and 2006. I follow the literature and define the debt ratio as the ratio of total liabilities to total assets. In addition to the interaction term between the dummy indicating treatment and the dummy indicating the year after the reform, I include the following other determinants as covariates for the debt ratio as dependent variable: firm size (log of total assets in thousand euro), log firm age, firms' share of tangible assets (ratio of tangible assets to book value of total assets) as well the ratio of EBITDA to the book value of total assets. Further, I include the tax rate on business income to control for changes due to the German corporate tax reform in 2008. For incorporated firms the tax rate on business income captures the corporate income tax and the trade tax.[79] For unincorporated business the tax rate depends on the shareholder structure, as these firms divide their income between the shareholders and pass it through to the shareholders. For non-natural persons as shareholder, the tax rate captures the tax rate on corporate income and the trade tax; for natural persons it is the tax rate on business income plus trade tax.[80]

To analyse whether the interest barrier broadens the tax base (firms' profitability), I use the change in the profit according to the financial statements before taxes, scaled by the book value of total assets, between 2008 and 2006. I refer to this as firms' profitability. In the estimation, I further control for the following other determinants of firms' profitability: log firm age, firm size, firms' tangibility and the business tax rate.

For my last research question, the outcome variable is the change of capital stock between 2008 and 2006, scaled by capital stock in 2006. I refer to this variable as the investment (quota). In addition to the control variables included in the

[79] The business tax rate is the sum of corporate income tax rate (including solidarity surcharge) and local business tax rate. Before 2008, the tax rate amounted to roughly 40%; after 2008 30%. I obtained the local business tax rates by merging the local business tax rates provided by the Statistical Offices (2004-2009) to the database using the firms' postal codes provided in *DAFNE.*

[80] For non-natural persons see footnote 79. For natural persons the tax rate (income tax rate including solidarity surcharge plus local business tax rate) amounts to 44.6%. See chapter two for further details.

equation for profitability, I include log sales (in thousands of euro). In an additional specification, I further use firm cash flows to analyse how investment depends on internal available cash. I define cash flow to be the sum of profits plus depreciation scaled by the capital stock for 2006 and 2007.

The entitlement to basic stand-alone, tax group stand-alone and the EBITDA escape clause were modelled as follows.

Basic Stand-Alone Clause: In principle a single firm is considered as a stand-alone firm if it does not belong to a group and does not rely on significant shareholder debt financing. I assume that every firm that has a German natural person as global ultimate owner is a stand-alone firm. This consideration is based on the fact that given a natural person is the ultimate owner, the firm may actually stand-alone or, if this is not the case, the firm is part of a group, which can be tax consolidated. In both cases, the TCR does not apply.

Tax Group Stand-Alone-Clause: In case the firm had a profit and loss agreement in place and the global ultimate owner is a German company, I consider the firm as being a part of a tax consolidated group and, thus, assume that the TCR does not apply.

EBITDA-Clause: In case a firm has a ratio of interest expenses to for tax purposes adjusted EBITDA in 2006 below 30%, the TCR does not apply. I construct the for tax purposes adjusted EBITDA by adding back the depreciation allowance, the net interest result and the provisions, which are not allowed for tax purposes to the before tax profit.

Since basic stand-alone and tax group stand-alone are very similar, I sum them up into one escape clause, which I name stand-alone escape.

Descriptive statistics of the variables used in the estimation for the whole sample and for treatment and control group (sample 1) are presented in Table 10. On average a firm in sample 1 has, in 2006, a debt ratio of 65%, an investment rate of 9% and a ratio of profit to total assets of 4.7%. Firms in the treatment group differ with respect to profitability and the debt ratio to firms in the control group, but not with respect to the investment quota. Treated firms have lower debt ratios, but also a lower profitability. With respect to the control variables, treatment and

control group differ significantly in their firm size and in their share of tangible assets. Further, both groups operate in different industries. Descriptive statistics for sample 2, which are similar to the one discussed here, are presented in Table A-15 in the Appendix A.

Table 10: Firm characteristics 2006 (Sample 1)

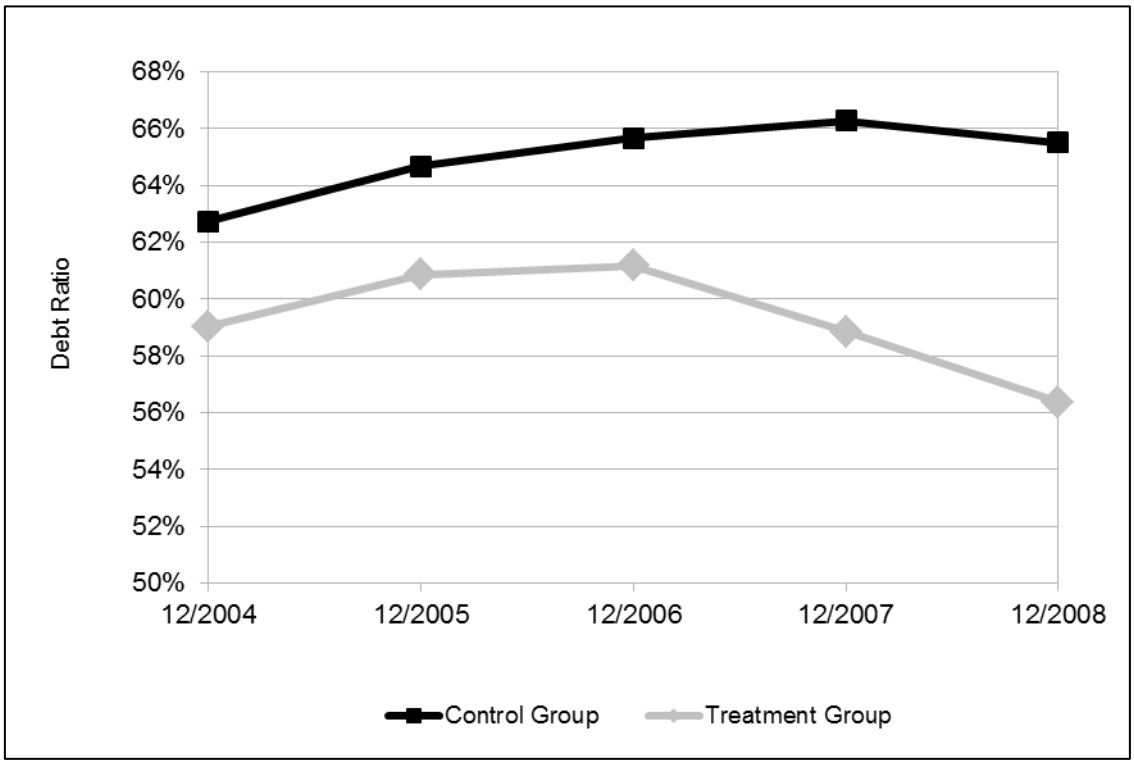
	Full Sample		Control Group	Treatment Group	t-test
	767		691	76	
Variable	**Mean**	**Std. dev.**	**Mean**	**Mean**	***p*-value**
debt ratio	0.65	0.19	0.66	0.61	0.05
investment quota	0.091	0.354	0.095	0.054	0.38
profitability	0.047	0.084	0.050	0.029	0.04
firm age	30.4	30.5	30.8	26.8	0,29
tangibility	0,493	0,290	0,467	0,724	0,00
firm size (thd. €)	51,170	116,961	48,050	79,536	0.03
corporate tax rate	0,396	0,031	0,398	0,385	0,00
cash flow/total assets	0.44	1.06	0.47	0.21	0.05
D(No. Subsidiaries)	0.18	.	0.18	0.17	0.58
EBITDA escape clause	0.31	.	0.29	0.49	0.00
Industries (shares):					
manufacturing	0,34	.	0,36	0,17	0,00
trade	0,24	.	0,26	0,09	0,00
services	0,05	.	0,04	0,11	0,00

Notes: Statistics are for 2006 except for D(No. Subsidiaries), which is for 2008. Sample 1 includes firms with net interest expenses between 0.5 and 0.8 or between 1.2 and 1.5 million euro. Firms in the treatment group have net interest expenses between 1.2 and 1.5 million euro and are not entitled to the stand-alone or to the consolidated tax escape clauses. The remaining firms belong to the control group.
Source: *DAFNE* firm database, 2006, own calculations.

I plot the development of debt ratio for treatment and control group (Figure 2). Noteworthy, treatment and control group exhibit a similar trend before the TCR was announced (around 12/2006 in Figure 2).[81] Thus, a common trend of treatment and control in the absence of the treatment seem to be a realistic assumption. Further, the graphical analysis already shows a strong decline in the debt ratio for treated firms, which can be attributed to firms' behaviour to avoid the application of the TCR.

[81] For profitability and investment, the figures look very similar. These are not reported, but are available upon request.

Figure 2: Evolution of the debt ratio for treatment and control group



Notes: Mean debt ratios for treatment and control group in Sample 1 are shown. The treatment group consists of firms with net interest expenses between 1.2 and 1.5 million euro in 2006 and that are not entitled to the basic stand-alone or tax group stand-alone escape clause. The control group includes firms with net interest expenses between 0.5 and 0.8 million euro or that are entitled to one of the stand-alone escape clauses. For further descriptive statistics see Table 10, for sample 2 see Table A-15 in the appendix.
Source: *DAFNE* firm database, own calculations.

3.6 RESULTS

I start with presenting my results of the impact of the TCR on firms' finance structure, investment and profitability for the first sample. In this sample only firms with an interest result around the exemption limit of the interest barrier are included. In the second part, the results for all firms potentially affected by the TCR follow, while in the last subsection the sensitivity of the results is examined.

3.6.1 RESULTS FOR FIRMS AROUND THE EXEMPTION LIMIT

The results for my main specification without taking into account the possibility that firms split up their assets for sample 1 are reported in Table 11. The dependent variable in equation (1) is the change in the debt ratio between 2008 and 2006; in (2) the change in the capital stock between 2008 and 2006, scaled by the capital stock in 2006; and in (3) the change in the profitability between 2008

and 2006. In all specifications I control for the change of the tax rate on business income, of the firm age as well as the level of firm's size and share of tangible assets in 2006. I use the levels of the latter two variables instead of the change as the change might be endogenous.[82] Further, as shown above (Table 10) there are strong differences in the levels of these variables between treatment and control group. Thus controlling for the levels ensures unbiased estimates. For the debt ratio as dependent variable I additionally include the ratio of EBITDA to total assets, which is common in the literature. In the investment equation I add the change of log sales.

With respect to the debt ratio, I expect that firms, for whom the TCR would apply without behavioural reactions, actually avoid the application by reducing their debt ratio (or by splitting up their firms assets such that the absolute value of the net interest expenses falls below the threshold). The results reveal that firms that would have been affected by the TCR without a change in their net interest expenses reduced their debt ratio by about 5.3%-points, roughly ten percentage of the mean debt ratio, which is 65% in my sample (Table 11). Further analysis shows that internal and external debt is reduced equally by these firms (Table A-16, Appendix A). This is as expected since the new TCR in Germany does not distinguish between different types of creditors.

The analysis of the change of firm's tax base is motivated by the literature that finds a substitution effect between internal and external debt under the old German TCR. Although this substitution is not very likely to be present under the new regulation, as it does not distinguish between different types of creditors, the development of equity financing and the tax base of a firm might differ. Multinational firms could use other ways to reduce their taxable income, for example transfer pricing. Thus, a decrease of firms' debt ratio does not have to cause a proportionate increase in the tax base. However, the hypothesis that the TCR broadens the tax base is clearly supported by my results. Firms for which the TCR would have applied exhibit an increase in their profitability of 2%-points between 2006 and 2008 (equation (2)). Thus, a reduction in the debt ratio of 1%-

[82] I tried two other specifications in order to check the sensitivity of the results. When I use the change in the firm size and the share of tangible assets instead of the level the coefficients of interest are somewhat smaller in absolute values. The same is true for an instrumental variable approach using the twice lagged levels as excluded instruments.

point causes an increase in firms' profitability by around 0.37%-points. To put this into perspective, I estimate this relationship using data for 2005 and 2006. The impact found is somewhat lower (0.3), but quite comparable. It seems, therefore, that the treated firms neither face severe costs of increasing their equity nor find other ways to reduce their tax payments, as one would otherwise expect that firms' profitability would not have increased as much.

Table 11: Effect of TCR on debt ratio, investment and profitability (Sample 1)

	(1)	(2)	(3)	(4)
Dependent variable:	Δdebt ratio	investment	Δprofitability	investment
Δ(Treatment * After)	-0.053***	0.079	0.020***	0.120
	(0.012)	(0.114)	(0.007)	(0.126)
Cash flow (CF)				0.342***
				(0.119)
Δ(Treatment * After) * CF				-0.367***
				(0.111)
Δ(log Firm age)	-0.007	0.083**	-0.000	0.000
	(0.006)	(0.038)	(0.005)	(0.000)
Δ(Tax rate business inc.)	0.080	-1.797**	-0.011	-1.489**
	(0.091)	(0.753)	(0.091)	(0.696)
L2. log Firm size	0.004	-0.050	-0.013***	-0.047
	(0.005)	(0.034)	(0.004)	(0.034)
L2. Tangibility	0.035***	-0.707***	0.029***	-0.186
	(0.012)	(0.163)	(0.011)	(0.154)
Δ(EBITDA/Total assets)	-0.343***			
	(0.068)			
Δ(log Sales)		0.017**		
		(0.007)		
Δ(After)	-0.059	0.951**	0.108**	0.540
	(0.050)	(0.381)	(0.044)	(0.331)
Observations	767	767	767	767
R^2	0.116	0.064	0.023	0.196

Notes: The treatment group consists of firms with net interest expenses between 1.2 and 1.5 million euro in 2006 and that are not entitled to the basic stand-alone or the tax group stand-alone escape clause. The control group includes firms with net interest expenses between 0.5 and 0.8 million euro or that are entitled to one of the stand-alone escape clauses. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: DAFNE firm database, years 2006 and 2008, own calculations.

With respect to my last research question, the results (equation (2)) indicate that, at least in the short-term, no negative investment effects are caused by the TCR. This suggests that there are no profit-shifting firms, or that these firms cannot change investment in the short-term. Thus, negative investment effects due to the

additional tax burden only show up in the long-term. However, another explanation could also be that these firms are able to avoid additional tax payments in the long-term. Which explanation dominates is beyond the scope of this study, but may be tackled using a longer post-2008 time period. For firms with excessive bank financing or shareholder financing, my findings present evidence that firstly their marginal source of finance is retained earnings instead of debt and secondly that these firms do not face severe costs of adjusting their equity. The latter explanation is probably due to the fact that the TCR mostly affects large companies, which have sufficient internal cash to finance their investments. I check this by estimating equation (4), where I analyse differences in the cash flow sensitivity of investment for treatment and control group. I expect a lower cash flow sensitivity for treated firms because these firms are large and thus have probably sufficient retained earnings to finance their investment. The results support my argument. Investment is only sensitive to internal cash for the control group. This indicates that, due to the fact that mostly large firms are affected by the regulation, which have sufficient internal cash, no negative investment effects for firms with excessive bank financing or shareholder financing are caused by the TCR.

I turn now to the question of whether firms exploit the exemption limit of 1 million euro by splitting up their assets. The treatment effects for firms that split up their assets are shown at the bottom of Table 12. They are equal to the sum of the coefficients for Δ(*Treatment * After*) and *Δ(Treatment * After) * D(No. Subsidiaries).* The standard errors are calculated using the delta method.

First, the results point out that the estimated coefficients in the first specification are slightly downward biased, since controlling for firms that split up increases the treatment effect to 6.2%-points (Table 12). In contrast, treated firms that split up their assets did not decrease their debt ratio. Further, the results of the investment equation show that my proxy, the change of the number of subsidiaries, works quite well as firms for which the number of subsidiaries increased reduce their capital stock considerably. However, these are no negative investment effects in general as the capital stock is only shifted to newly founded subsidiaries. Further,

the results for profitability show that the tax base of firms that split up their assets did not increase due to the introduction of the TCR (last row of the table).

Table 12: Effect of TCR on debt ratio, investment and profitability with consideration of firms that split up their assets (Sample 1)

	(1)	(2)	(3)
Dependent variable:	Δdebt ratio	investment	Δprofitability
Δ(Treatment * After) (1)	-0.062***	0.135	0.019***
	(0.020)	(0.123)	(0.005)
Δ(Treatment * After) * D(Subsidiaries)	0.051**	-0.302**	0.004
	(0.024)	(0.103)	(0.022)
D(Subsidiaries)	-0.009	0.067	0.003
	(0.007)	(0.064)	(0.006)
Δ(log Firm age)	-0.008*	0.086***	-0.000
	(0.004)	(0.013)	(0.010)
Δ(Tax rate business income)	0.083**	-1.815*	-0.012
	(0.037)	(0.899)	(0.044)
L2. log Firm size	0.005	-0.053	-0.014***
	(0.005)	(0.036)	(0.004)
L2. Tangibility	0.036***	-0.711***	0.030***
	(0.007)	(0.196)	(0.009)
Δ(EBITDA/Total assets)	-0.344***		
	(0.043)		
Δ(log Sales)		0.017***	
		(0.003)	
Δ(After)	-0.061	0.978***	0.112**
	(0.055)	(0.324)	(0.038)
Observations	767	767	767
R^2	0.120	0.065	0.023
Coefficient: (1) + (2)	-0.011	-0.167	0.023
p-value coefficient (1) + (2)	0.348	0.082	0.276

Notes: The treatment group consists of firms with net interest expenses between 1.2 and 1.5 million euro in 2006 and that are not entitled to the basic stand-alone or the tax group stand-alone escape clauses. The control group includes firms with net interest expenses between 0.5 and 0.8 million euro or that are entitled to one of the above named escape clauses. L2 refers to twice-lagged levels, here 2006. *p*-value for coefficient (1) + (2) is calculated using the delta method. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: DAFNE firm database, years 2006 and 2008, own calculations.

My results so far present evidence that the new TCR in Germany is successful in reducing firms' debt ratio. The analysis shows in line with Weichenrieder and Windischbauer (2008) further that firms use different strategies to avoid the interest barrier. Firms that have the possibility to split up, do so with the result that the TCR does not affect their finance behaviour compared to firms that cannot split and reduce their debt ratio by several percentage points. Compared to the old regulation, where effects on the tax base are questionable since firms substituted internal by external debt (Wamser 2008 or Buettner et al 2012) or used holding

structures to circumvent the regulation (Weichenrieder and Windischbauer, 2008), the new TCR seems, at least in the short-term, quite successful in broadening the tax base. As Weichenrieder and Windischbauer (2008), I do not find negative investment effects. This suggests that there are no profit-shifting firms, that affected firms have sufficient retained earnings and that this is also their marginal source of finance. However, the findings may also be explained by fixed investment in the short-term such that the real effects only show up in the long-term or that affected firms will find other ways around the TCR in the long-term.

3.6.2 RESULTS FOR ALL FIRMS POTENTIALLY AFFECTED BY THE TCR

The results presented above are based only on firms with an interest result around the exemption level of 1 million euro. To allow a general statement on the effects of the new TCR in Germany, in this section I use all firms that are potentially affected by the TCR. I start again with the baseline specification and then turn to the specification in which I control for firms that split up their assets. Noteworthy, I expect weaker results as I am not able to account for the equity escape, which I assume to be more important for larger firms

The results for the baseline specifications of the three equations are reported in Table 13. Firms for which the TCR would have applied, had they had not reacted, reduced their debt ratios by 2%-points on average (equation (1)).[83] Additional regression analysis (Table A-16, Appendix A) shows that the reduction of internal debt is somewhat stronger (3.3%-points) compared to external debt (2.2%-points). The profitability of the firms, for whom the TCR would apply without a behavioural reaction, increases by 0.8%-points; the impact of a 1%-point reduction in the debt ratio on firms' profitability amounts to 0.4%-points. This is similar to what I estimated using data for the years 2005 and 2006. Further, also for all firms that were potentially affected by the TCR, no negative investment effects show up. Equation (4) suggests that this is at least partially caused by

[83] Since Dressler and Scheuering (2012) also use "all available firms", the results are comparable. My effect is larger than the change of 1.2 percentage points found by Dressler and Scheuering (2012). The main reason for the difference is the inclusion of the year 2007 in the pre-reform period by these authors. The results of the robustness check (see below in section 6.3) suggest, a considerable part of the adjustment of the debt ratio already took place in the year 2007. The inclusion of this year in the pre-reform period induces thus an underestimation of the impact of the interest barrier on the debt ratio.

sufficient internal cash flow. In general all results from the first sample are confirmed. The effects are only smaller in absolute terms. This seems to suggest that larger firms used the equity escape clause more often. Since I cannot account for it, estimated coefficients are downward biased.

Table 13: Effect of TCR on debt ratio, investment and profitability (Sample 2)

	(1)	(2)	(3)	(4)
Dependent variable:	Δdebt ratio	investment	Δprofitability	investment
Δ(Treatment * After)	-0.020***	0.035	0.008*	0.041
	(0.006)	(0.032)	(0.004)	(0.033)
Cash flow (CF)				0.207***
				(0.041)
Δ(Treatment * After) * CF				-0.160**
				(0.064)
Δ(log Firm age)	-0.002	0.040**	0.002	0.000
	(0.003)	(0.018)	(0.002)	(0.000)
Δ(Tax rate business inc.)	0.086*	-1.596***	-0.042	-1.424***
	(0.044)	(0.401)	(0.040)	(0.389)
L2. log Firm size	0.005***	0.002	-0.004***	0.002
	(0.001)	(0.011)	(0.001)	(0.011)
L2. Tangibility	0.020***	-0.811***	0.015***	-0.464***
	(0.006)	(0.076)	(0.005)	(0.080)
Δ(EBITDA/Total assets)	-0.373***			
	(0.024)			
Δ(log Sales)		0.015***		
		(0.005)		
Δ(After)	-0.064***	0.467***	0.023*	0.202*
	(0.014)	(0.112)	(0.012)	(0.114)
Observations	4,591	4,591	4,591	4,591
R^2	0.098	0.051	0.004	0.089

Notes: The treatment group consists of firms with net interest expenses above 1.2 million euro in 2006 and that are not entitled to the basic stand-alone or the tax group stand-alone escape clauses. The control group includes firms with net interest expenses between 0.2 and 0.8 million euro or that are entitled to one of the above named escape clauses. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

I turn to the specification in which I account for firms that might split up their assets (Table 14). The results are less strong compared to the first sample. Firms that have been affected by the TCR, but split up their assets, reduced their debt ratio less (1.5 %-points compared to 2.2%-points) and exhibit no increase in profitability. Their capital stock remained basically unchanged. This might either

by caused by the fact that I are not able to account for firms using the equity escape or by the fact that larger firms cannot easily split up their assets as smaller firms.

Table 14: Effect of TCR on debt ratio, investment and profitability with consideration of firms that split up their assets (Sample 2)

	(1)	(2)	(3)
Dependent variable:	Δdebt ratio	investment	Δprofitability
Δ(Treatment * After) (1)	-0.022***	0.039	0.010*
	(0.008)	(0.034)	(0.005)
Δ(Treatment * After) * D(Subsidiaries)	0.007	-0.030	-0.008
	(0.012)	(0.044)	(0.005)
D(Subsidiaries)	-0.005*	-0.009	0.002
	(0.003)	(0.033)	(0.003)
Δ(log Firm age)	-0.002	0.039*	0.002
	(0.002)	(0.020)	(0.005)
Δ(Tax rate business income)	0.087***	-1.595**	-0.041
	(0.025)	(0.549)	(0.023)
L2. log Firm size	0.005**	0.003	-0.004**
	(0.002)	(0.008)	(0.002)
L2. Tangibility	0.020***	-0.812***	0.015**
	(0.004)	(0.063)	(0.006)
Δ(EBITDA/Total assets)	-0.373***		
	(0.027)		
Δ(log Sales)		0.015***	
		(0.004)	
Δ(After)	-0.065***	0.461***	0.022
	(0.021)	(0.048)	(0.017)
Observations	4,588	4,588	4,588
R^2	0.098	0.051	0.004
Coefficient: (1) + (2)	-0.015	0.008	0.001
p-value coefficient (1) + (2)	0.058	0.862	0.893

Notes: The treatment group consists of firms with net interest expenses above 1.2 million euro in 2006 and that are not entitled to the basic stand-alone or the tax group stand-alone escape clauses. The control group includes firms with net interest expenses between 0.2 and 0.8 million euro or that are entitled to one of the above named escape clauses. Heteroscedasticity-robust standard errors are reported. L2 refers to twice-lagged levels, here 2006. Standard errors are clustered by 10 branches. *p*-value for coefficient (1) + (2) is calculated using the delta method. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.
Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

3.6.3 SENSITIVITY ANALYSIS

To check the sensitivity of the results, I start with extending the analysis presented above to account for the EBITDA escape clause as well and then take into account firms for which information on the income statement and/or on the ownership

structure is missing. In the last part of this section I address the question whether the financial crisis biases my results.

I left out the EBITDA escape clause in the main specification since firms that are – following my modelling – entitled to this escape clause do not seem to behave differently than firms that are not entitled to any of the escape clauses. I show the results and explain it in detail in Appendix B.

To check the sensitivity of the results, I include in my baseline specifications an additional dummy for firms that are entitled to EBITDA escape clause as well the interaction term for *TREATMENT* AFTER* and EBITDA escape clause. The results for sample 1 are presented in Table A-17 (Appendix A). They show that neither the treatment effects of the baseline specification change significantly, nor the interaction terms for the treated firms that are entitled to the EBITDA escape clause are significant. This could mean that since EBITDA is volatile and therefore to some extent uncertain, firms are not able to use this escape clause. Thus, even if their ratio of interest expenses to EBITDA is less than 30%, they still reduce their debt ratio to ensure that in "bad" years the TCR will not apply. This could be especially possible for 2008, as in this year the regulation does not include a carry forward of an unused share of deductible interest expenses to EBITDA. Further, one should note that all interest expenses that are not deductible increase the net interest expenses in the next year. However, another explanation could also be that there is measurement error such that I am not able to identify firms that are entitled to the EBITDA escape clause. If this is the case, I would underestimate the true effect of the TCR. Since I am not able to distinguish between these explanations, I leave it for further research, which should use tax data to properly address this issue.

As a second sensitivity check, I include all observations, even if income statements or ownership information are missing. To classify firms into treatment and control group I apply a regression-based imputation using the observed balance sheet characteristics in 2006.[84] The results for my baseline specification for all firms are

[84] The imputation was done with an OLS regression where the following covariates are included: Unpaid contributions on subscribed capital, fixed assets, assets in between fixed and current assets, current assets, equity, special item with an equity portion, accruals, liabilities, deferred income (all scaled by the book value of total assets), intangible assets, tangible assets, financial assets (all scaled by the book value of

reported in Table A-18 in the Appendix A. Please note that due to missing income statements for some firms, I neither control for EBITDA to total assets for debt ratio and nor for changes in sales for investment as dependent variable. The estimated treatment effects are somewhat smaller than for sample 2, which is due to the fact that I cannot account for the escape clauses. Treated firms reduce their debt ratio by about 1%-point and increase their profitability by 0.7%-points. Again, no negative investment effects were found. Therefore, I can also rule out that selection drives my results.

At least, I address the question whether the economic downturn in 2008 biases my results. In case the downturn affected all firms equally, the results would still be consistent as in this case my treatment and control group would have been affected in the same way. Thus, by comparing both groups before and after the reform the effect of the financial crisis drops out. However, it may be argued that the effect of the economic downturn differs by firm size. Since the control group is on average smaller than my treatment group, the effect I estimate could thus be due to the different impact of the financial crisis on firms depending on their size. But since I control for firms' size in levels of 2006 in the estimation, the potentially different effect of the financial crisis should be captured by this variable and thus not bias the treatment effect.

Further support in favour of my results is obtained from running a regression using only 2006 and 2007 (see Table A-19, Appendix A). In case the crisis drives the results, I expect no differences between treatment and control group when comparing 2006 and 2007 as the crisis started at the earliest in 2008. The results however show that firms for which the TCR would have applied reduced already their debt ratio in 2007 by about 3%-points. Further, an increase in their profitability of about 1.7%-points is observed. Thus, qualitatively these results are similar to the ones presented above. Therefore, the bias due to the financial crisis if present at all seems fairly small.

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fixed assets), inventories, receivables and other assets, securities, cash-in-hand (all scaled by the book value of current assets), liabilities up to one year, liabilities with a majority of more than one year, loans, liabilities to banks, payments on account of orders, trade payables, liabilities from central settlement, liabilities on bills accepted and drawn, liabilities to shareholders, payable to affiliated enterprises, payable to enterprises in which participation are held, other liabilities (all scaled by the book value of liabilities). Further, I include the log of total assets as well as legal form and industry dummies. The R^2 of the regression is 0.47. The results are not shown but are available upon request from the author.

3.7 CONCLUSIONS

National governments use two instruments to avoid the up to now observed profit shifting of multinational firms. On the one hand, tax competition has led to a significant decrease in corporate tax rates, on the other hand, countries, typically the large and high-tax ones, have implemented TCRs in order to prevent profit shifting. The so far prevalently implemented TCRs restrict the deductibility of interest expenses to shareholders if the debt to equity ratio exceeds a certain threshold. Since this regulation had some shortcomings, for instance the substitution between internal and external debt, Germany introduced a new TCR in 2008. According to this regulation, interest expenses are only deductible up to a certain share of EBITDA if they exceed an exemption limit. To evaluate the effectiveness of the regulation and the related effect in firms' investment is the aim of this study. For the identification of the causal effects of the TCR, which is firms' behaviour to avoid the application of the TCR, I use the escape clauses within the German interest barrier and apply a difference-in-difference approach.

My results show that firms with interest expenses near the exemption limit avoid the application of the regulation either by reducing their debt ratio or by splitting up the firms' assets. While in the first case the TCR is shown to be successful in broadening the tax base, in the latter case it does not. Firms that split up do not decrease their debt ratio and their profitability seems to increase less than the profitability of firms that do not split up. This points out, that in principle the new TCR seems to be more effective than the old regulation, as no substitution between internal and external debt is possible. The main caveat however comes in due to the attempt of the government not to stress small and middle sized firms, which they ensured due to an exemption limit. This limit however severely hampers the effectiveness of the regulation, which is especially important in the light of the increase of the exemption limit from 1 to 3 million euros in 2009. Thus, it seems very unlikely that the new regulation will be effective in the long run as with the new exemption limit splitting firms' assets is a more realistic option for firms. However, this should be validated by future research.

With respect to firms' investment, my results suggest that the TCR does not cause negative investment effects in the short run. This means, on the one hand, that

firms do not face severe adjustment costs when substituting equity for debt, which is probably due to the fact that mostly large companies are affected by the regulation. On the other hand, this to suggest that their marginal source of finance is not debt. However, another explanation could also be that investment is fixed in the short-term such that negative investment effects are only caused in the long-term, or that firms will find ways in the long-term to avoid TCR application.

Another question I have to leave open for future research concerns the basic rule of the regulation. In the analysis firms, which exhibit interest expenses to EBITDA above 30% did not behave differently as firms with a ratio below. However, since I rely on financial statements data, I are not able to distinguish whether this is due to measurement error or due the fact that firms are not willing to take the risk of non-deductible interest expenses as EBITDA is volatile. Further, future research should also address whether the equity escape, which intends to exempt large groups with foreign members and “sufficient” equity financing, is used by groups and which effects this has on debt shifting and investment.

3.8 APPENDIX A: SUPPLEMENTARY TABLES AND ESTIMATION RESULTS

Table A-15: Firm characteristics (Sample 2)

	Full Sample		Control Group	Treatment Group	t-test
	4,591		4,027	564	
Variable	**Mean**	**Std. dev.**	**Mean**	**Mean**	***p*-value**
debt ratio	0.66	0.19	0.66	0.62	0.00
investment quota	0.119	0.630	0.124	0.086	0.23
profitability	0.050	0.097	0.054	0.021	0.00
firm age	29.3	32.0	29.0	31.5	0,09
tangibility	0,474	0,294	0,435	0,747	0,00
firm size (thd. €)	144,375	1,198,066	77,077	624,886	0.00
corporate tax rate	0,397	0,031	0,399	0,388	0,00
Cash flow/total assets	0.50	1.15	0.55	0.17	0.00
D(No. Subsidiaries)	0.16	.	0.15	0.16	0.60
EBITDA escape clause	0.32	.	0.29	0.52	0.00
Industries (shares):					
manufacturing	0,33	.	0,36	0,12	0,00
Trade	0,26	.	0,28	0,09	0,00
Services	0,06	.	0,05	0,12	0,00

Notes: Statistics are for 2006, except D(No. Subsidiaries), which is for 2008. Sample 2 contains firms with net interest expenses between 0.2 and 0.8 euro or above 1.2 million euro in 2006. Firms in the treatment group exhibit interest expenses above 1.2 million euro and are not entitled to either the basis stand-alone or the consolidated tax group escape clauses. The remaining firms belong to the control group.
Source: *DAFNE* firm database, 2006, own calculations

Table A-16: Change in internal and external debt due to TCR

Sample	Sample 1		Sample 2	
Dependent variable	Internal debt ratio	External debt ratio	Internal debt ratio	External debt ratio
Δ(Treatment * After)	-0.038	-0.043**	-0.035***	-0.021***
	(0.027)	(0.017)	(0.013)	(0.007)
Δ(log Firm age)	-0.021**	-0.013*	-0.003	-0.003
	(0.011)	(0.008)	(0.005)	(0.003)
Δ(Tax rate business income)	-0.018	0.148	-0.163**	0.149**
	(0.214)	(0.129)	(0.080)	(0.065)
L2. log Firm size	-0.003	0.001	-0.006*	0.005***
	(0.011)	(0.007)	(0.003)	(0.002)
L2. Tangibility	0.001	0.023	0.022*	0.014*
	(0.026)	(0.015)	(0.013)	(0.008)
Δ(EBITDA/Total assets)	0.124	-0.260***	0.015	-0.322***
	(0.115)	(0.065)	(0.045)	(0.029)
Δ(After)	0.033	-0.027	0.048	-0.071***
	(0.103)	(0.068)	(0.032)	(0.018)
Observations	767	767	4,591	4,591
R^2	0.010	0.050	0.005	0.045

Notes: The treatment group consists in sample 1 (sample 2) of firms with net interest expenses between 1.2 and 1.5 million euro (above 1.2 million Euro) in 2006 and that are not entitled to the basic stand-alone or the tax group stand-alone escape clauses. The control group in sample 1 (sample 2) includes firms with net interest expenses between 0.5 and 0.8 million euro (0.2 and 0.8 million euro) or that are entitled to one of the above named escape clauses. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.

Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

Table A-17: Accounting for firms that are entitled to the EBITDA escape clause (Sample 1)

	(1)	(2)	(3)
Dependent variable	Δdebt ratio	investment	Δprofitability
Δ(Treatment * After)	-0.061***	-0.014	0.020*
	(0.018)	(0.086)	(0.011)
Δ(Treatment * After) * D(EBITDA	0.013	0.208	-0.015
	(0.023)	(0.212)	(0.013)
D(EBITDA ESCAPE)	0.004	-0.025	0.020***
	(0.007)	(0.091)	(0.007)
Δ(log Firm age)	-0.007	0.084**	-0.001
	(0.006)	(0.038)	(0.005)
Δ(Tax rate business income)	0.084	-1.785**	-0.001
	(0.091)	(0.756)	(0.091)
L2. log Firm size	0.005	-0.050	-0.009*
	(0.005)	(0.039)	(0.005)
L2. Tangibility	0.034***	-0.719***	0.031***
	(0.012)	(0.166)	(0.011)
Δ(EBITDA/Total assets)	-0.344***		
	(0.068)		
Δ(log Sales)		0.017**	
		(0.008)	
Δ(After)	-0.072	0.964**	0.059
	(0.054)	(0.429)	(0.050)
Observations	767	767	767
R^2	0.117	0.065	0.032

Notes: The treatment group consists of firms with net interest expenses between 1.2 and 1.5 million euro in 2006 and that are not entitled to either the basic stand-alone or the tax group stand-alone escape clauses. The control group includes firms with net interest expenses between 0.5 and 0.8 million euro or that are entitled to one of the above named escape clauses. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.

Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

Table A-18: Results for all firms that are potentially affected by the TCR

	(1)	(2)	(3)
Dependent variable:	Δdebt ratio	Investment	Δprofitability
Δ(Treatment * After)	-0.010***	-0.015	0.007**
	(0.004)	(0.021)	(0.003)
Δ(log Firm age)	-0.002	0.053***	0.001
	(0.002)	(0.013)	(0.002)
Δ(Tax rate business income)	0.073***	-0.786***	-0.033
	(0.027)	(0.197)	(0.032)
L2. log Firm size	0.007***	0.002	-0.004***
	(0.001)	(0.008)	(0.001)
L2. Tangibility	0.003	-0.635***	0.015***
	(0.003)	(0.044)	(0.004)
Δ(After)	-0.078***	0.443***	0.025**
	(0.011)	(0.090)	(0.010)
Observations	11,931	11,931	7,050
R^2	0.004	0.046	0.004

Notes: The treatment group consists of firms with net interest expenses above 1.2 million euro in 2006 and that are not entitled to either the stand-alone or the consolidated tax group escape clauses (if firms ownership information is available). The control group includes firms with net interest expenses between 0.2 and 0.8 million euro or that are entitled to one of the above named escape clauses. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.

Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

Table A-19: Effect of TCR on debt ratio, investment and profitability using only 2006 and 2007 (Sample 1)

	(1)	(2)	(3)
Dependent variable	Δdebt ratio	investment	Δprofitability
Δ(Treatment * After)	-0.029***	0.111	0.017*
	(0.010)	(0.122)	(0.011)
Δ(log Firm age)	-0.001	-0.026	0.004
	(0.005)	(0.025)	(0.007)
L. log Firm size	0.002	-0.015	-0.006
	(0.004)	(0.022)	(0.005)
L. Tangibility	0.022**	-0.307***	0.005
	(0.010)	(0.116)	(0.010)
Δ(EBITDA/Total assets)	-0.405***		
	(0.060)		
Δ(log Sales)		0.022***	
		(0.008)	
Δ(After)	-0.028	0.404	0.054
	(0.041)	(0.254)	(0.052)
Observations	773	779	772
R^2	0.155	0.034	0.006

Notes: The treatment group consists of firms with net interest expenses above 1.2 million euro in 2006 and that are not entitled to either the basic stand-alone or the tax group stand-alone escape clauses (if firms ownership information is available). The control group includes firms with net interest expenses between 0.2 and 0.8 million euro or that are entitled to one of the above named escape clauses. L refers to lagged levels, here 2007. Heteroscedasticity-robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels.

Source: *DAFNE* firm database, years 2006 and 2007, own calculations.

3.9 APPENDIX B: HETEROGENEOUS TREATMENT SPECIFICATION

To test whether firms that are entitled to one of the escape clauses behave differently from firms that are not entitled to any of them, I estimate firstly a specification in which the entitlement to one of the escape clauses is modelled as heterogeneous treatment effect. I construct dummy variables for stand-alone escape clause as well as for the EBITDA escape clause. These variables are interacted with the *Treatment* * *After* and the *After* variable from equation (3.1). Then I construct differences between 2008 and 2006. The dummies for the entitlement of another escape clause are modelled in such a way that the treatment effect is still given by γ. The estimation equation is given below for one other escape clause. Note that since I model the entitlement based on the firms' characteristics in 2006 and estimate in differences, I do not have to control for time invariant differences between the firms that are entitled and those that are not. The coefficient θ captures the change in the debt ratio for firms that are entitled to the escape clause before and after the reform, φ captures how firms with interest expenses above 1 million euro, but which are entitled to another escape clause, change their debt ratio. If I capture these firms perfectly, I expect that $\gamma = -\varphi$, since there should be no difference between firms with interest expenses below the threshold and above the threshold.

$$\Delta \text{Debt Ratio}(i) = \theta\, \Delta\, \text{After}(i) + \vartheta\, \Delta\, (\text{After}(i) * \text{EscapeClause}(i)) + \gamma\, \Delta\, (\text{Treatment}(i) * \text{After}(i)) + \varphi\, \Delta\, (\text{Treatment}(i) * \text{After}(i) * \text{EscapeClause}(i)) + \rho\, \Delta X(i) + \Delta\, \varepsilon(i) \quad (3.5)$$

The results for sample 1 are shown in Table B-20.[85] They show that firms that are entitled to the stand-alone escape clause do not change their debt ratio (coefficient (1) + (2) at the bottom of the table) differently than firms in the control group. However, the results also suggest that treated firms, which are entitled to the EBITDA escape clause, do not behave significantly different from firms that are not entitled as the interaction term is not significantly different from zero(coefficient (1) + (3) at the bottom of the table). Therefore, I did not take into account whether

[85] For sample 2 the results also do not change significantly. They are not reported but are available upon request.

a firm is entitled to the EBITDA escape clause or not when forming treatment and control group.

Table B-20: Heterogeneous treatment specification (Sample 1)

Dependent variable	Δdebt ratio
Δ(Treatment * After) (1)	-0.058***
	(0.017)
Δ(Treatment * After) * D(Stand-alone escape) (2)	0.045***
	(0.017)
Δ(Treatment * After) * D(EBITDA escape) (3)	0.010
	(0.016)
Δ(After) * D(Stand-alone escape)	0.007
	(0.010)
Δ(After) * D(EBITDA escape)	0.004
	(0.008)
Δ(log Firm age)	-0.007
	(0.006)
Δ(Tax rate business income)	0.085
	(0.096)
L2. log Firm size	0.007
	(0.006)
L2. Tangibility	0.036***
	(0.013)
Δ(EBITDA/Total assets)	-0.342***
	(0.070)
Δ(After)	-0.095
	(0.061)
Observations	767
R^2	0.119
Coefficient: (1) + (2)	-0.012
p-value: coefficient (1) + (2)	0.383
Coefficient: (1) + (3)	-0.047
p-value: coefficient (1) +(3)	0.001

Notes: See text above for details. L2 refers to twice-lagged levels, here 2006. Heteroscedasticity robust standard errors are reported. Stars (***/**/*) indicate significance at the 1%/5%/10% levels. *p*-value for the coefficient (1) + (2) and (1) + (3) are calculated using the delta method.
Source: *DAFNE* firm database, years 2006 and 2008, own calculations.

CHAPTER 4: INVESTMENT, TAXATION AND FINANCIAL CONSTRAINTS

4.1 INTRODUCTION

If the world functioned as assumed by Modigliani and Miller (1958) in their famous theorem, firms' finance and investment decisions would be independent of each other and the discussion of financial constraints would be purely theoretical. Under these conditions, corporate income taxation affects investment only through changing the marginal costs of investment. However, a large body of literature suggests that capital markets are not perfect because of asymmetric information and transaction costs. While these reasons for incomplete capital markets and their effects on investment spending are often analysed, the potentially different effect of taxation on investment in case of binding financial constraints is neglected even though it is named as an important aspect in one of the first papers on financial constraints (Fazzari et al 1988). Closing this gap is the aim of this chapter.

Building upon the hierarchy of finance setting, this study questions whether corporate income taxation affects financially constrained and unconstrained firms differently. Theory on corporate taxation and financial constraints suggests this, arguing that for unconstrained firms only the effective marginal tax rate (*EMTR*) matters for the evaluation of investment projects, whereas for constrained firms only the effective average tax rate (*EATR*) is decisive since tax payments affect firm liquidity (Fazzari et al 1998, Bond and Meghir 1994a, Keuschnigg and Ribi 2010). Further, these firms cannot react to marginal investment incentives as they are constrained by their financial situation (Edgerton 2010).[86] In order to test this hypothesis, I use the neoclassical investment approach, where the *EMTR* is

[86] Edgerton (2010) show that investment incentives are most effective when cash flows are high. He compared three different explanations for this finding. These are financial constraints, adjustment costs and uncertainty. Although financial constraints are partly supported by his results, adjustment costs receive the most support.

included in the investment equation through the user cost of capital *(UCC)* and *EATR* is explicitly included as a determinant of internal finance. I evaluate the hypothesis by estimating the investment model for financially constrained and unconstrained firms separately while controlling for a potential self-selection of firms into the different financial regimes and comparing the estimated coefficients.

My approach addresses two important critiques on previous studies of financial constraints. Firstly, due to several tax reforms in the time period used in this study, I use exogenous variation in firms' tax payments to identify the effect of the *EATR* on investment. This is similar to the approach by Rauh (2006), who uses mandatory contribution to pension schemes to analyse the impact of financial constraints. Using exogenous variation prevents estimated coefficients to be driven by the fact that cash flow is a proxy for the omitted variable future profitability in case of reduced form models or as a consequence of model misspecification for structural models as argued by Schiantarelli (1996), Hubbard (1998), and Bond et al (2003).

Secondly, as I control for the self-selection of firms into the different regimes, the potential bias due to the endogeneity of the splitting criteria, which might be present in previous studies, is eliminated.[87] To do so, I apply an endogenous switching regression with known sample separation.[88] Estimation is done via a two-stage standard Heckman-type technique. In a first step I estimate the selection equation via maximum likelihood, calculate the inverse Mills ratios and include them in the structural equation. In the second step, the structural equations are estimated using system GMM to address measurement error, attenuation, and simultaneity bias.

The splitting criteria I use in this study are related to firms' cost of external finance. The first splitting criterion is firms' debt ratio and is motivated by the findings by

[87] Prior studies often analyse financial constraints by splitting the sample according to a criterion that reflects the different degree of firms' financial constraints, estimating both samples separately and comparing the estimated cash flow coefficients. Similar to this, but additionally restricting the other coefficients to be the same for both groups, is the approach that includes an interaction term in order to analyse whether firms with a specific characteristic respond differently to a change in cash-flow (see for example Guariglia (2008). A survey of the existing empirical studies is given by Schiantarelli (1996), Hubbard (1998) and Stein (2003).

[88] Besides ensuring consistent coefficients using the switching regression framework, the method provides additional intuition on the discriminatory power of the sample selection criteria (Chatelain 2003).

Harris and Raviv (1990b) and Cooley and Quadrini (2001). They highlight the positive impact of firms' leverage on the external cost of finance due to firms' lower liquidation value respectively the higher probability of bankruptcy. Secondly, firms' liquidation value, which is firms' tangibility scaled by total liabilities, is used. This builds upon the work by Bester (1985) and Hart and Moore (1994). Both studies present evidence on the role of collateral to attenuate information respectively commitment problems. A higher tangibility value means higher borrowing capacities, scaling by the actual amount of borrowing gives a measure of the remaining borrowing capacities.

The database of my analysis covers annual individual financial statements of middle and large sized German incorporated firms from 1991 through 2008. Using this dataset circumvents a third critique in the literature, contributed by Kaplan and Zingales (1997, 2000). They present a theoretical and empirical counterexample in which firms classified as less financially constrained (facing a lower cost premium for the use of external finance) show greater cash flow sensitivity in contrast to the findings by Fazzari et al (1988). The authors claim that the cash flow sensitivity is non-monotonic. Cleary et al (2007) specify this relationship as inversely u-shaped and explain this by the presence of two types of constrained firms, internal and external constrained firms. External constrained firms show positive and internal constrained firms negative cash flow sensitivity.[89] Since Fazzari et al (1988) analyse external and Kaplan and Zingales (1997) internal constrained firms, their results do not contradict each other as it might seem at first glance. Further, Hovakimian (2009) shows that internal constrained firms have almost the same characteristics as external constrained firms but, although they are even smaller and younger, they can obtain sufficient finance (debt and new equity) due to their good investment possibilities. Since my data contain mostly of middle and large sized companies, the presence of internal

[89] The inverse u-shaped relationship can be explained by two oppositional effects, the cost and the revenue effects. For externally constrained firms, the cost effect dominates. This effect captures the relationship that higher investment leads to higher borrowing, which increases the risk of liquidation and therefore raises the marginal cost of debt finance. For internal constrained firms, the revenue effect instead dominates, which represents the channel that increasing investment raises expected revenue that improves firms' ability to repay debt and thus reduces the marginal cost of debt finance.

constrained firms is, *a priori,* less likely. Nevertheless I check the sensitivity of the results in the robustness section.

The empirical results of this study are in line with my hypothesis; the elasticity of capital to its user costs for unconstrained firms is close to *-1*, whereas for constrained firms it is not statistically different from zero. For the *EATR,* in contrast, the reverse is true. This highlights that the effect of corporate taxation on investment depends strongly on firms' financial situation. In times of tighter credit markets, the liquidity aspect captured by the *EATR* becomes more important, whereas marginal incentives play the key role for investment if financing is (more or less) frictionless.

The remainder of this chapter is organized as follows: The next section motivates the chosen investment model and summarizes the theoretical relationship between investment, taxation, and financial constraints. The dataset and the used variables are presented in section 4.3. Next, in section 4.4, I describe the methodology, followed with the results in section 4.5. Section 4.6 concludes.

4.2 THEORY AND LITERATURE

4.2.1 THEORY OF FINANCIAL CONSTRAINTS AND CORPORATE TAXATION

According to the hierarchy of finance theory (Myers 1984), a financially constrained firm can be thought of as a firm whose investment spending rises if its retained earnings increase. The use of retained earnings as a basic source of finance comes from the fact that retained earnings are assumed to be the firm's least expensive source of finance, followed by debt and then new shares.[90] Thus, the theory states that a firm uses first retained earnings, then debt and at last new shares to finance its investment. Following this classification, one can think of three possible firm regimes (see Figure 3).[91] A firm in regime 1 (D_1) is characterized by low investment opportunities and sufficient retained earnings to finance all these projects. The firm's demand curve intersects with the supply

[90] If one takes taxation into account, debt is the cheapest source of finance due to the deductibility of interest expenses. However, if the interest rate rises with the debt ratio, retained earnings are at some point the least expensive source of finance again.
[91] This discussion is adopted from Bond and Meghir (1994a).

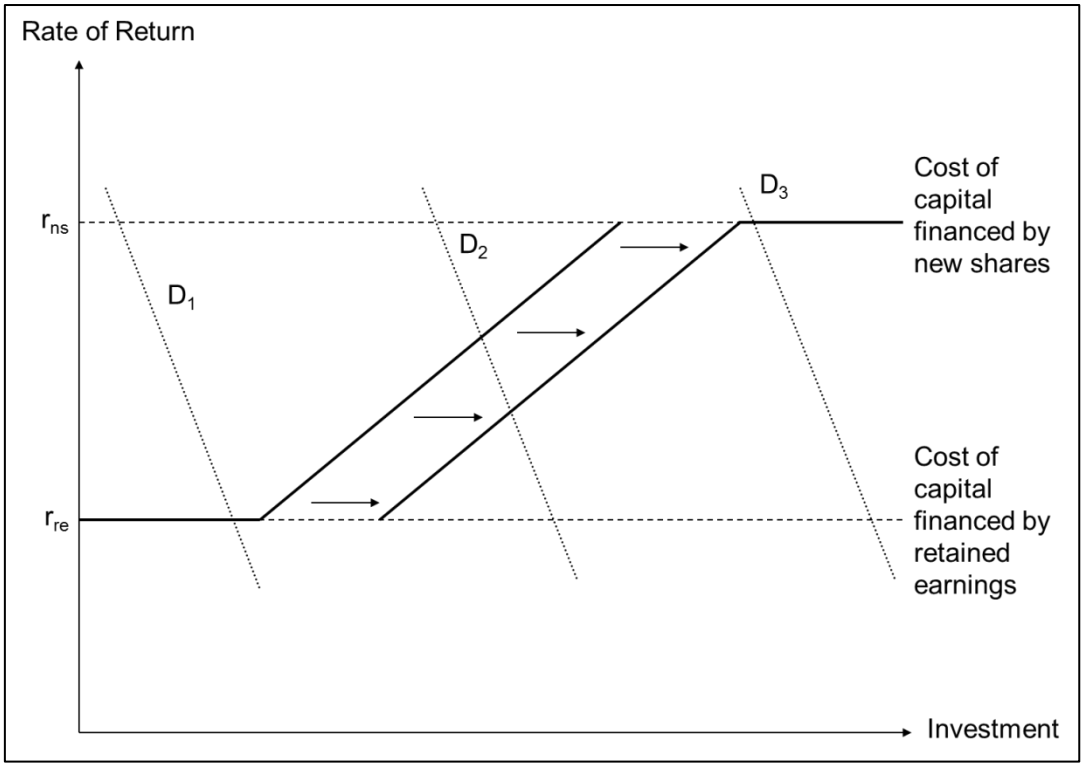
curve for retained earnings. A firm in regime 3 (D_3), however, is characterized by greater investment opportunities (higher investment for a given rate of return), such that the firm has to and can already bear the higher costs of issuing new shares to finance all its investment projects, after exhausting retained earnings and new debt. In both regimes, the investment level does not change in response to an unexpected increase of the firm's cash flow, which shifts the supply curve to the right. Regime 2 (D_2) covers financially constrained firms. These firms neither can finance all their investment projects with internal cash nor do they have so many profitable investment opportunities that they bear the higher costs of new shares. Thus, for these firms the demand intersects with the supply curve for new debt such that a positive cash flow shock that shifts the supply curve to the right allows them to finance a greater share of their investment with retained earnings as well as the same amount with debt as before. Therefore, the amount of investment for these firms depends on the cash flow.

To analyse the effects of corporate income taxation, one must distinguish between the three regimes again. The financially unconstrained firm in regime 1 invests at the margin, where marginal costs (given by r_{re}) equal marginal benefits. If one introduces corporate income taxation, the benefit of investment at the margin is reduced by the *EMTR* that the firm faces. The firm will therefore scale down its investment level from I_1 to I_2 as depicted on the left side of Figure 4. This summarizes the usual channel how corporate income taxation affects investment. However, there could be also another effect of corporate income taxation on marginal investment since tax payments reduces firms' internal finance. This reduction of the available cash flow through taxation can be captured by the *EATR*.[92] For a better understanding, I will name in the following the latter (*EATR*) the liquidity and the first *(EMTR)* the cost effect of taxation. For the firm in regime 1 this implies that in addition to the cost effect, the liquidity effect might also affect investment. However, as the investment level of these firms does not depend on cash flow, the liquidity aspect of taxation does not matter for investment. The same argumentation is true for firms in regime 3, although they face higher marginal

[92] Another impact of the *EATR* on investment is pointed out by Devereux and Griffith (1998, 2003). They present evidence for the effect of the *EATR* on discrete investment decisions, i.e. international firm's locational choice.

costs; their investment level is cash independent. Thus, only *EMTR*, not *EATR*, matters for their investment.

Figure 3: The hierarchy of finance model with debt finance

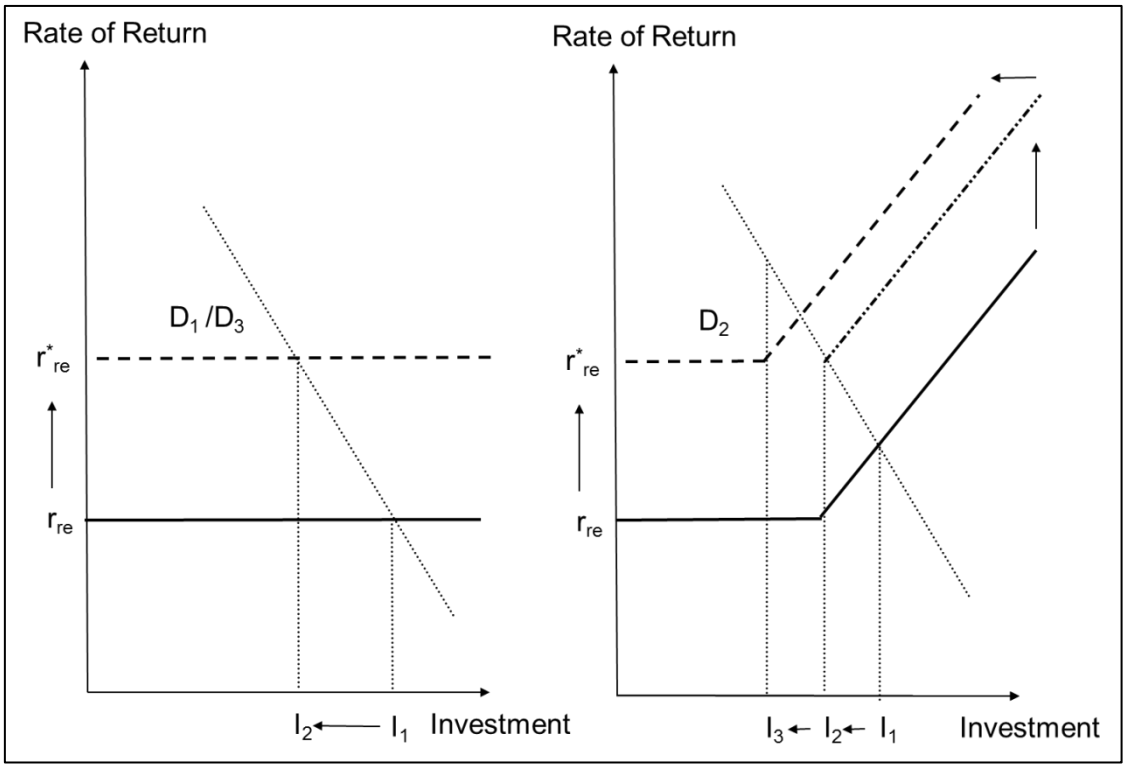


Source: Bond and Meghir (1994a)

In contrast, when considering financially constrained firms (D_2), for which internal and external finance are no substitutes, the liquidity aspect of corporate taxation matters. The case of financial constraints is depicted on the right hand side of Figure 2, where a firm with marginal costs r_{re} faces an external credit supply, which is increasing in the rate of return. If corporate income taxation is introduced, then the cost and liquidity effects of corporate income taxation must be distinguished. Firstly, the marginal cost of investment increases from r_{re} to r_{re}^* as in the case without financial constraints. Thus, due to this cost channel of corporate income taxation, the investment level decreases from I_1 to I_2. Compared to the unconstrained firms, the reduction is smaller since I_1 was not optimal for the constrained firms. Secondly, introducing corporate income taxation reduces liquidity because of a higher tax bill, which is captured by the change in *EATR* that a firm faces. As shown on the right side of Figure 4, retained earnings decrease and,

consequently, a shift of the supply curve to the left is observed, which leads to an additional reduction of the investment level for the constrained firms from I_2 to I_3. In case of a vertical supply curve, the extreme case of finance constraints, only the liquidity aspect of taxation matters for the investment decision of the constrained firm.

Figure 4: Corporate taxation in the hierarchy of finance model with debt finance



Source: Bond and Meghir (1994a)

Thus, theory suggests that the investment decision of financially unconstrained firms is dominantly affected by corporate taxation through the cost channel, which is captured by the *EMTR*, whereas the investment decision of constrained firms depends more on the liquidity aspect of taxation, expressed by the *EATR* the firm faces. Fazzari et al (1988) and Bond and Meghir (1994a) are the first to discuss the effect of corporate taxation to investment under financial constraints. Keuschnigg and Ribi (2010) summarize these considerations in a theoretical model, which includes taxation in a principal agent setting with an investor and a bank, to state clearly that even a cash-flow and an allowance for corporate equity tax system create first order welfare losses.

4.2.2 CORPORATE INVESTMENT MODELS

In principle, three different investment models are commonly used in the literature, the neoclassical, the *q*-based, and the Euler-based approach.[93] All of them have strengths and weaknesses, generally and with respect to analysing financial constraints. My decision to use the neoclassical approach is based, however, mainly on the arguments contributed by prior studies analysing financial constraints and the purpose of this study. Q-based[94] models appear more frequently in the literature.[95] This approach, like the Euler-based approach, is set up on a dynamic optimization problem through considering adjustment costs. Both models differ only with respect to the modelling of the forecast process. In Euler-based models, the forecast process must be estimated, whereas *q*-based models try to use financial market information.[96] With respect to *q*-based models, two significant problems have been identified. Firstly, the *q*-based approach has the severe shortcoming that only publicly traded companies can be included in the analysis, since the market value of the firm is necessary for the construction of *q*, which is only available for publicly traded companies.[97] These firms, however, are different from the whole population of firms as shown for investment by Asker et al (2011).[98] The second problem that must be tackled when using the *q*-based approach concerns *q* itself. The use of average *q,* which equals marginal q, *inter alia,* only if finance and investment decision are independent as shown by Hayashi (1982), seems counterintuitive.[99] Euler-based models are though preferable. However, it is pointed out that this approach does not identify financial constraints

[93] For an excellent survey to these models, see Chirinko (1993).
[94] The *q*-theory of investment is introduced by Keynes (1936), Brainard and Tobin (1968) and Tobin (1969) and is extended to models of investment assuming convex adjustment costs by Hayashi (1982).
[95] Examples are Whited (1992), Hubbard et al (1995), Gilchrist and Himmelberg (1995), Audretsch and Elston (2002), Behr and Bellgardt (2000), Behr (2005) and Almeida and Campello (2007).
[96] In *q*-based models the benefits over the life cycle for a capital good is expressed as the ratio of the market value of an additional unit of capital to its replacements costs. As shown by Hayashi (1982) under the assumption of competitive product and factor markets, linear homogenous production and adjustment cost technologies, homogenous capital and independence of investment and real and financial decision marginal *q* equals average *q*, whereas average *q* can be proxied by the market value of the firm divided by its replacement costs of capital.
[97] One way to use *q*-based models without accepting data selection is the approach used by Behr (2005). He measures *q* by using a vector autoregressive model to forecast future profitability.
[98] This may also limit the generalizability of the recent finding of Chen and Chen (2012), who present evidence that investment cash-flow sensitivity is a bad measure since it is disappearing over the last years - using a sample of publicly traded US firms.
[99] This argument is also suggested by Hubbard (1998) and Schiantarelli (1996).

if a firm is constrained the same today as tomorrow (Gilchrist and Himmelberg 1995).[100]

Compared to these two models, the neoclassical approach, introduced by Jorgenson (1963) and Eisner and Nadiri (1968), is based on a static optimization problem.[101] Although this approach may suffer, like the *q*-based approach, from measurement error[102], it allows the inclusion of unquoted firms for which debt is an important source of finance and therefore financial constraints are very likely. Further, the approach ensures the identification of financial constraints if a firm is constrained as today as tomorrow. An important additional advantage is also the intuitive inclusion of *EMTR* and *EATR* in the investment equation. The use of the neoclassical approach is thus preferable within the context of this study.

4.3 DATA AND VARIABLES

4.3.1 DATA

The panel data set I use consists of individual annual financial statements of German corporate enterprises, both publicly traded companies and corporations with limited liability (GmbH), available in the *Hoppenstedt* database.[103] The sample period covers financial years 1987 through 2008. Before estimation, the sample was cleaned. Firms with fewer than five observations were dropped. To minimize the impact of outliers, both the top and bottom 1 percentage of the distribution of change in turnover as well as the top and bottom 5 percentage of the distribution of cash flow were trimmed. Since estimation is done in first differences, the first year of observations is also lost. Therefore, the analysis is based on a dataset comprising 25,646 annual observations for 3,934 firms.

[100] Studies relying on this approach include Bond and Meghir (1994b), Gilchrist (1991), Hubbard et al (1995) and Bond et al (2003a).
[101] See for instance Chirinko et al (1999), Chirinko and van Kalckreuth (2003) and Dwenger (2012).
[102] Erikson and Whited (2000) and Bond and Cummings (2003) analyze the impact of measurement error in *q*.
[103] This is the same data base as used by Dwenger (2012).

4.3.2 VARIABLES USED IN THE MODEL

The dependent variable in the model is the investment rate, which is defined as firm-specific gross investment normalized by the replacement costs of the beginning-of-the-period capital stock $I_{i,t}/K_{i,t-1}$. Since the replacement costs of the capital stock are not available in the database, I estimate them using the perpetual inventory method, which is explained in Appendix B.

The key variable in the neoclassical model is the user cost of capital (*UCC*), which I construct based upon the work by both Jorgenson (1963) as well as Hall and Jorgenson (1967). The $UCC_{i,j,t}$ for firm i in industry j at time t is the weighted average of its asset a specific user costs $UCC_{i,a,j,t}$:

$$UCC_{i,j,t} = \sum_a \kappa_{i,t}^a * UCC_{i,a,j,t} = \sum_a \kappa_{i,t}^a \frac{p_t^I}{p_t^S} \frac{(1 - z_{a,t}) * ((1 - \tau_t)\theta_t + \delta_{j,a,t})}{(1 - \tau_t)} \qquad (4.1)$$

where $\kappa_{i,t}^a$ is the firm-specific share of asset a to total assets; p_t^I is a price deflator for investment goods at time t; p_t^S is the industry j-specific output price at time t; $\delta_{j,a,t}$ is the asset a, industry j-specific economic depreciation rate, which captures the difference between physical depreciation and expected capital gains; and $z_{a,t}$ are asset a-specific depreciation allowances by the tax system. Two types of assets are considered, property with buildings and fixed tangible assets. The *EMTR* (τ_t) captures the corporate income tax (on retained earnings) and the solidarity surcharge.[104] Since I deal with financially constrained firms, for which debt is the marginal source of finance, the financial costs θ_t, which do not vary between firms, is multiplied by (1- τ_t) to account for the tax benefit.[105] The second key variable

[104] In case firms make or carry forward losses, the use of the statutory tax might be not appropriate. However, there are a number of reasons why financial statements data may not be used to identify tax losses, for example due to rules on interest deduction or profit distribution (Auerbach and Poterba 1987, Hanlon 2003, Edgerton 2010). Further, since it has been shown that, even when using tax data, accounting for tax losses does not lead to statistically different point estimates (Dwenger and Walch 2011), I do not account for them but address whether this bias my results by excluding financially distressed firms in a sensitivity analysis as for these firms tax losses are most important.

[105] Although it is possible to use a weighted average of the different sources of finance, the simplification I use ensures that the financial costs are in line with the hierarchy of finance theory. Furthermore, the chosen financial costs do not influence the results as my estimated coefficients are similar to the one estimated in Dwenger (2012), who uses a weighted average as financial costs. This is also in line with the results of Buettner and Hoenig (2011) and Bond and Xing (2010), who showed that the source of finance is less crucial for the identification of the impact of the *ucc* on capital. To check nevertheless the sensitivity of my choice, I estimated the models with retained

for analysing the link between corporate income taxation and financial constraints is *EATR*, which is defined as tax payments divided by the replacement costs of the beginning-of-the-period capital stock. The identification of tax effects, both *EMTR* and *EATR*, is ensured as the statutory corporate income tax rate decreased remarkably between 1987 and 2008, from 56% to 15%, due to tax reforms (Table C-27, Appendix C). Additional explanatory variables are real sales (measured as firm-specific turnover deflated by an industry-specific output price deflator) and before-tax cash-flow (income before tax plus depreciation). Appendix B provides details about the construction of the variables.

Some descriptive statistics are reported in Table A-23 in Appendix A. The average capital stock in my sample amounts to 254 million Euros, while the median is about 40 million Euros. Thus, the data is strongly skewed. However, due to the normalization of investment, cash-flow and *EATR* with the replacement cost value of the beginning-of-the-period capital stock, it does not affect the estimation results. The firm-specific mean investment rate, calculated as net investment scaled by the replacement cost value of capital stock ($K_{i,t-1}$), amounts to 14%; the median is 8%. The average firm in my sample has a ratio of cash-flow to beginning-of-the period capital stock of 45% and pays 12% taxes, expresses as a percentage of the replacement cost value of capital stock ($K_{i,t-1}$). Further, there is substantial variation with respect to the Δucc and to Δsales.

4.3.3 MEASUREMENT OF FINANCIAL CONSTRAINTS

To assess whether corporate income taxation affects company investment decisions differently with respect to the degree of financial constraints, I identify firms facing external financial constraints. These are firms for which a wedge between the cost of internal and external finance exist. Most prominent explanations for cost wedges centre on information asymmetries and bankruptcy costs.[106]

earnings as marginal source of finance. The results are qualitatively the same. They are available upon request from the author.

[106] See, for example, Chirinko (1997), Hubbard (1998), and Schiantarelli (1996).

The first splitting criterion I use is firms' debt ratio in the last period.[107] A higher debt ratio is related to a higher interest rate firstly as the liquidation value is lower (Harris and Raviv 1990a) and secondly as the probability of default may increase with increased firm leverage (Cooley and Quadrini, 2001). Thus either bankruptcy costs increase or they are weighted at a higher rate (Barro 1976). Firms' debt ratio or related indicators are shown to be a valid splitting criterion (Whited 1992) or as an important factor for the likelihood of being constrained or not (Hovakimian and Titman 2006, Almeida and Campello 2007). For my analysis I assume that a firm is financially constraint if its debt ratio is above the median per year and industry.[108] If the debt ratio is below, then the firm is assumed to be unconstrained.

The second splitting criterion builds upon the first and exploits, in addition, the firms' asset structure. This is the ratio of the firms' tangibility to total liabilities, again in the last period. The impact of firms' tangibility on firms' external cost of finance is stressed by Bester (1985).[109] He shows that collateral attenuates asymmetric information problems in the credit market since banks might use collateral requirements as a signalling mechanism.[110] Calculation of firm tangibility follows, due to a lack of data for German firms, the work of Berger et al (1996), who analyse asset liquidation values for US companies. Firms' liquidation value is given by equation (2). Like Berger et al (1996) and Almeida and Campello (2007), I add cash-holding and scale it by total book assets. When a firm's tangibility value to liabilities is below (above) the median per year and industry, I assume that the firm is financially (un-)constrained.

$$Tangibility = 0.715 * Receivables + 0.547 * Inventory + 0.535*Capital \quad (4.2)$$

The characteristics of the split sample, according to debt ratio, differ noticeably (see Appendix A, Table A-24). Constrained firms are slightly larger (mean capital

[107] In prior studies, the most prominent splitting criterion used is firms' payout ratio. I do not rely on this criterion since up to 2001 the (marginal) corporate income tax rate depended upon whether a firm distributed profits or not. Further, it is argued that certain industries tend not to pay dividends (Fama and French 2001, Eije and Megginson 2008).

[108] The mean per year and industry is calculated before outliers were dropped; this explains why the size of the subsamples differs slightly.

[109] A similar argument was made by Hart and Moore (1994), who highlight that if creditors have no bargaining power, they will only lend up to the liquidation value of the firm.

[110] The problem of adverse selection in the credit market is emphasized by Stiglitz and Weiss (1981).

stock 268 million versus 240 million Euros), invest less (on average 13 % versus 16%) and have, on average, a lower cash flow (on average 40% versus 52% of the capital stock). Additionally, *EATR* is much lower for constrained firms (mean 10% to 15%). However, the distribution of the *UCC* is similar for both groups.

The characteristics of financially constrained firms, according to the splitting criterion liquidation value, are similar to those described above (see Appendix A, Table A-24). These firms are slightly larger (on average capital stock 281 million versus 227 million Euros), invest less (on average 13% versus 16% of the capital stock) and have a lower cash flow (on average 38% versus 53% of the capital stock). Furthermore, *EATR* is lower for constrained firms (mean 9% versus 16%).

4.4 MODEL AND METHODOLOGY

4.4.1 SWITCHING REGRESSION FRAMEWORK

As noted in the introduction, one of the main criticisms of previous studies addressing financial constraints is the lack of accounting for self-selection (Chatelain 2003), which might result in biased estimates if there are truly different regimes. This is also true in case for estimation in first differences, since firms may switch between the regimes and thus selection bias is not cancelled out. This study accounts for this problem by using a switching regression framework with known sample separation directly for the selection process. Theory on self-selection originates with Roy (1951) and is developed further by Maddala and Nelson (1974) and Maddala (1986). The starting point for the switching regression is the assumption that the number of regimes is known. Two different regimes are assumed, one for the financially constrained and one for unconstrained firms. For both regimes there is a structural equation (equation (4.3) resp. (4.4)), which could, but does not have to, include the same variables. Furthermore, there is a selection equation (2.5) that determines a firm's propensity of being in regime 1 or 2.

$$I_{i,t} = X_{i,t}\beta_1 + u_{1,i,t} \qquad if \qquad Y^*_{i,t} \geq 0 \tag{4.3}$$

$$I_{i,t} = X_{i,t}\beta_2 + u_{2,i,t} \qquad if \qquad Y^*_{i,t} < 0 \tag{4.4}$$

$$Y_{i,t}^{*} = Z_{i,t}\gamma + \varepsilon_{i,t} \tag{4.5}$$

In the structural equations (4.3) and (4.4), $X_{i,t}$ are the determinants of corporate investment and $Z_{i,t}$ are the determinants of a firm's likelihood of being in the first or the second regime. β_1, β_2 and γ are parameter vectors, $Y_{i,t}^{*}$ is a latent variable measuring whether a firm is financially constrained or not. A switch between the two regimes is possible and occurs when $Y_{i,t}^{*}$ reaches a certain (unobserved) threshold value. The error terms of equation (4.3), (4.4), and (4.5) are assumed to be normally distributed with mean 0. In case of estimating the structural equations separately without accounting for the self-selection into the two regimes, the estimated coefficients will only be unbiased if the error terms of the structural equation, $u_{1,i,t}$ and $u_{2,i,t}$, are uncorrelated with the error term of the selection equation $\varepsilon_{i,t}$. Otherwise the estimation suffers from a selection bias, which can be interpreted as an omitted variable bias.[111]

However, in contrast to unknown sample separation in case of known sample separation, the latent variable $Y_{i,t}^{*}$ is observed. This makes estimation much easier since the system of equations does not have to be estimated simultaneously, but can instead be estimated as two two-stage standard Heckman-type self-selection models (Heckman 1979).

Following Heckman (1979), in the first step, I estimate the selection equation, a probit-model, using maximum likelihood to calculate the selection term, the inverse Mills ratio, which is the ratio of the probability density and the cumulative density function. In the second step, the inverse Mills ratio is included in the structural equations and the investment equations are estimated.

Determinants of a firm's likelihood to be in regime 1 or 2 (summarized by $Z_{i,t}$ in Equation (4.5)) contain, on the one hand, variables that are related to firms' financial situation. These are chosen following the existing literature.[112] On the

[111] If a firm in regime 1 is observed, the expected value of the dependent variable is given by $E\left[I_{i,t} \mid Y_{i,t}^{*} > 0\right] = X_{i,t}\beta_1 + E\left[u_{1,i,t} \mid Y_{i,t}^{*} > 0\right]$, with $E\left[u_{1,i,t} \mid Y_{i,t}^{*} > 0\right] = E\left[\sigma_{1,\varepsilon}\varepsilon_{i,t} \mid \varepsilon_{i,t} < Z_{i,t}\gamma\right] = \sigma_{1,\varepsilon} * \frac{\phi(Z_{i,t} * \gamma)}{\Theta(Z_{i,t}\gamma)}$. Where $\frac{\phi(Z_{i,t} * \gamma)}{\Theta(Z_{i,t}\gamma)}$ is the inverse Mills ratio, which is the ratio of probability density function to the cumulative distribution function.

[112] See, for example, Hovakimian and Titman (2006) or Almeida and Campello (2007).

other hand, I include the main variables of the structural equation in order to account for potential differences between the two regimes with respect to these variables.[113] For both splitting criteria the following variables related to firms' financial situation are included:

Firm size: Smaller firms are more likely to be financially constrained for several reasons. Firstly, transaction costs are mostly fixed, which make external finance relatively more expensive for smaller firms. Secondly, small firms are less often rated and, thus, suffer from greater informational asymmetries between lender and borrower. Furthermore, a third reason for a greater likelihood is the greater risk of bankruptcy for smaller firms due to less diversification than larger firms. However, since the descriptive statistics suggest that constrained firms are larger and since the results of Audretsch and Elston (2002) contradict these considerations for Germany as they find middle sized firms are more likely to be financially constrained, I also include firm size squared in order to capture the possible non-linear relationship. I measure firm size as the natural logarithm of the book value of total assets.

Financial Slack: Financial slack may indicate a greater or a lesser likelihood of being financial constrained. Some argued that firms with large cash reserves are not financially constrained as their investment is not constrained by a lack of finance (Kaplan and Zingales 1997). However, on the other hand, it is stated that constrained firms have a bigger incentive to accumulate cash (Fazzari et al 2000). Since both arguments are plausible, I have no clear expectation about the relationship of financial slack and the likelihood of being financially constrained. I define the variable as cash plus liquid securities scaled by the beginning-of-the-period capital stock. Again, to capture a possible non-linear relationship I include as well the squared value of this variable.

Dummy for Publicly Traded Firms: I include a dummy variable for publicly traded firms as these firms have easier access to equity capital and, consequently, are expected to be less likely financially constrained.

[113] These are growth rate in the *UCC*, growth rate of sales, and after-tax cash-flow (sum of before-tax cash-flow and EATR), scaled by replacement costs value of the capital stock ($K_{i,t-1}$).

Dummy for Dividends: Lastly, I include a dummy variable that is one if a firm pays out dividends. This is motivated by firms' cash-flow identity, which states that investment plus dividends must be financed by cash-flow, new shares and new debt. Thus, if a firm pays out dividends, it is unlikely that the firm is constrained, as one would expect that no dividends are paid out by constrained firms.

In addition, industry and time dummies are included in both selection equations. Further, all the variables enter the equation with lagged values. The exclusion restriction for identification of the inverse Mills ratios is ensured since the structural approach of the outcome equation determines which variables are included in the investment equation. Thus, for example, *Firm size* and *Financial Slack* do not affect investment but rather the likelihood whether a firm is constrained or not.

4.4.2 INVESTMENT MODEL AND SPECIFICATION

The determinants of the structural equations (captured by $X_{i,t-1}$ in equation (4.3) resp. (4.4)) for both regimes are based on the neoclassical approach (Arrow et al 1961, Jorgenson 1963, Eisner and Nadiri 1968). In a frictionless world, the optimal capital stock depends on firm's level of output (S), the *UCC*, a firm-specific distribution parameter (A_i), and on the technology (T_t) (equation (4.6)). Noteworthy, the optimal capital stock in this partial analysis does not depend on the wage level, which means that firms are assumed to be price-takes on perfectly competitive product and factor markets.[114] The parameter of interest in this analysis is $-\sigma$, the elasticity of capital to its user costs.

$$K^*_{i,t} = A_i T_t S_{i,t}{}^{\beta} UCC_{i,t}{}^{-\sigma} \tag{4.6}$$

Since I am interested in the short run dynamics and to allow a comparison of my results with the prior literature, I estimate a commonly used distributed lag specification (DL, Chirinko et al 1999, Dwenger 2012).[115] It is given by equation

[114] In the empirical analysis, differences in the wage rate of time and between firms are captured by the time trend and firm specific effects.

[115] Dwenger (2012) shows that using a distributed lag specification provides a smaller impact of the user costs of capital on capital accumulation. She finds an elasticity of capital to its user costs of around -0.5 in the distributed lag model and around -1 in the error correction framework. She argues that the diverging results are due to the fact that distributed lag models suffer from short

(4.7). The left-hand side variable is the rate of new investment[116], b_i a firm-specific constant, $\Delta s_{i,t}$ the growth rate of sales, $\Delta ucc_{i,t}$ the growth rate of the *UCC*, d_t captures technological progress, a deterministic trend, and $\xi_{i,t}$ is an i.i.d. error term.[117] The error term has the same properties as the error term equation (4.3) resp. (4.4). The inclusion of the lagged explanatory variables accounts for the presence of uncertainty and adjustment costs (Dwenger 2012).

$$\frac{I_{i,t}}{K_{i,t-1}} = b_i - \sum_{h=0}^{H} \sigma_h \Delta ucc_{i,t-h} + \sum_{h=0}^{H} \beta_h \Delta s_{i,t-h} + \sum_{t}^{T-1} \eta d_t + \zeta_{i,t} \qquad (4.7)$$

For analysing the effects of corporate income taxation, before tax cash flow and *EATR* are included as shown in equation (4.8). As discussed in Section 4.2.1, the sum of the short term coefficients for the *UCC* should be lower for financially constrained firms than for unconstrained firms. Moreover, I expect that the opposite should be true for the coefficient of *EATR*, since only financially constrained firms are affected by liquidity outflow through tax payments.

$$\frac{I_{i,t}}{K_{i,t-1}} = b_i - \sum_{h=0}^{H} \sigma_h \Delta ucc_{i,t-h} + \sum_{h=0}^{H} \beta_h \Delta s_{i,t-h} + \theta_{cf} \frac{(CF_{i,t}^{before-tax})}{K_{i,t-1}} + \theta_{eatr} EATR + \sum_{t}^{T-1} \eta d_t + \tilde{\zeta}_{i,t} \qquad (4.8)$$

Estimation is done using a heteroscedasticity robust two-step system GMM (Blundell and Bond 1998). This is motivated because system GMM estimation is done using first differences and, consequently, the firm-specific constant does not bias the results. Second, there are several reasons why the *UCC* should be instrumented. First, measurement error is likely to occur, which biases the coefficient of the user costs of capital in an OLS regression toward zero, as shown by Goolsbee (2000).[118] Second, the user costs of capital might be endogenous since a firm's asset structure used as weighting of the *UCC* is probably correlated with investment. Third, with an upward sloping curve for capital supply, a reduction in

run frictions. In error correction model this is not the case, as the long run relationship between capital and its user costs is explicitly modeled. Since I am interested in short run frictions, I rely on the distributed lag specification. I am therefore also able to test her explanation regarding the diverging results.

[116] $\Delta k = I_{i,t}/K_{i,t-1} + b_i$ with b_i as replacement investment.

[117] A more flexible version of the model would also include the lagged dependent variable. In a robustness check I include the dependent variable lagged one to three years. Since the results do not change, but the Arellano-Bond Test for second order correlation of the error term cannot be rejected at the 5% level, I stick to the modeling without dependent variable.

[118] Measurement error is likely to occur because, for example, economic depreciation is not firm but industry specifically considered in the construction of the user costs of capital.

the tax rate raises prices in the short run and thus might attenuate the increase in investment through reduced taxes (Goolsbee 1998b, 2004). This simultaneity bias also distorts the user costs elasticity toward zero. Further, the simultaneity of investment shocks and interest rates might bias the user costs of capital coefficient, as suggested by Chirinko et al (1999). In addition, I instrument *EATR*, sales, and before tax cash flow since all variables are very likely to be contemporaneously correlated with investment and measurement error is likely to occur.

The instruments, which are used by system GMM, are the lagged levels for the difference equation and the lagged differences variables for the level equation. Since standard errors in the usual two-step GMM estimator are downward biased in finite samples, I also apply the Windmeijer (2005) correction. To check whether the estimator provides consistent coefficients, which is only the case in the absence of higher-order serial correlation in the error term, I present the Arellano-Bond (1991) test-statistics. I also report the Sargan test of over-identifying restrictions.

4.5 RESULTS

4.5.1 SELECTION EQUATION

The results of the estimated selection equation, according to firms' debt ratio as sample splitting criterion, are reported in Table 21. They reveal that firms with a debt ratio above the median per year and industry, thus classified as financially constrained, are - as expected - less likely to be publicly traded and less likely to pay dividends. This highlights the importance of including non-quoted firms in the analysis of financial constraints. With regard to firm size and financial slack, the coefficients cannot directly be interpreted as the relationship is nonlinear. The graphical analysis (Figure A-5, Appendix A) points out that only for firm size there is indeed a quadratic relationship. This supports the results by Audretsch and Elston (2002). They show that middle sized firms have a greater likelihood of being financially constrained. Concerning financial slack, the relationship is monotone. Firms with a low amount of financial slack have the greatest likelihood of being financially constrained. This contrasts the results of Hovakimian and Titman (2006) and Almeida and Campello (2007), who show that a higher amount

of financial slack is related to a higher likelihood of being financially constrained.[119] It is, however, in line with the view by Kaplan and Zingales (1997) that firms with large cash-reserves are not constrained by a lack of finance.

Table 21: Results of the selection equation for both splitting criteria

Selection Criterion	Debt Ratio	Liquidation Value /Debt
Firm Size	0.241***	0.210***
	(0.072)	(0.073)
Firm Size, squared	-0.007***	-0.006***
	(0.002)	(0.002)
Financial Slack	-2.278***	-3.451***
	(0.080)	(0.087)
Financial Slack, squared	0.719***	1.043***
	(0.053)	(0.055)
Dividends (Dummy)	-0.241***	-0.225***
	(0.018)	(0.018)
Publicly Traded (Dummy)	-0.225***	-0.182***
	(0.022)	(0.022)
Δsales	0.164***	0.189***
	(0.024)	(0.024)
Δucc	-0.029	-0.030
	(0.034)	(0.034)
Cash-flow/$K_{i,t-1}$	-0.035***	-0.050***
	(0.008)	(0.008)
Number of Observations	25,646	25,646

Notes: Dependent variable is coded as 1 for investment regime 1 and 0 for investment regime 2. Firms assigned into regime 1 are classified as financially constrained; regime 2 covers the financially unconstrained firms. (Un-) constrained firms according to the splitting criterion debt ratio are firms that have a debt ratio above (below) the median per year and industry. (Un-) constrained firms according to the splitting criterion liquidation value are firms that have a ratio below (above) the median per year and industry. All variables enter in lagged form and are defined as described in the text. Standard errors are in parenthesis. *, **, *** indicate significance at the 10, 5 and 1 percentage two-tail test levels, respectively.
Source: *Hoppenstedt* firm database and own calculations, 1987-2008.

With respect to the variable in the investment equation, it is noteworthy that the change in the *UCC* does not differ between constrained and unconstrained firms. However, with respect to change in sales and cash-flow there are differences. Constrained firms have a lower cash-flow and face higher growth rates, which is in

[119] One reason for the diverging results may be that the two mentioned studies use publicly traded firms.

line with previous research for the US (Hovakimian 2009, Almeida and Campello 2007).

The results for the second splitting criterion are very similar to the one described above, I will thus review them only briefly. According to the selection equation financially constrained firms are middle sized, are less likely to be publicly traded and less likely to pay dividends. Further, they have only a small amount of financial slack (Table 21). In addition, they have lower cash-flows and better growth opportunities.

Using the estimated coefficients of the selection question, the inverse Mills ratios are calculated for both financial regimes and included in the structural equations in order to account for self-selection.

4.5.2 STRUCTURAL EQUATION

The results of the investment equation for the debt ratio as splitting criterion using the *DL* framework for the whole and the two subsamples are reported in Table 22. The long run coefficient of the *UCC* for all firms (-0.42) is similar to previously documented results using a *DL* model using German data (Harhoff and Ramb 2001, Dwenger 2012) and double the size using US data (Chirinko et al 1999). Furthermore, the coefficient for *EATR* is similar to what is estimated for the after-tax cash flow both in US (Rauh 2006) and for Germany (Chirinko and van Kalckreuth 2003, Harhoff and Ramb 2001).

If I now account for the two investment regimes and the self-selection process, the long term coefficient for the *UCC* for unconstrained firms increases to -0.81, significant at the 1% level, and decreases for constrained firms to -0.32, while becoming insignificant. The difference between the two coefficients amounting to -0.488 is statistically significant (one-sided t-test, p-value= 0.09). This result is in line with my theoretical prediction and suggests that firms facing financial constraints react less to tax incentives because they are constrained by their financial situation. My results confirm, thus, the findings by Edgerton (2010).

Table 22: Results: Effect of taxes on investment

Splitting Criterion		Debt Ratio		Liquidation Value	
Sample	**All firms**	**Un-constrained**	**Constrained**	**Un-constrained**	**Constrained**
$\Delta ucc_{i,t}$	-0.231***	-0.457***	-0.167*	-0.448***	-0.133
	(0.060)	(0.167)	(0.090)	(0.149)	(0.090)
$\Delta ucc_{i,t-1}$	-0.118***	-0.234**	-0.088	-0.223***	-0.072
	(0.035)	(0.095)	(0.058)	(0.085)	(0.059)
$\Delta ucc_{i,t-2}$	-0.062***	-0.104**	-0.058	-0.102**	-0.050
	(0.023)	(0.048)	(0.040)	(0.046)	(0.038)
$\Delta ucc_{i,t-3}$	-0.012	-0.014	-0.007	-0.022	-0.005
	(0.014)	(0.021)	(0.022)	(0.024)	(0.022)
(SUM $\Delta ucc_{i,t}$)	**-0.423*** **	**-0.808*** **	**-0.320**	**-0.795*** **	**-0.259**
	(0.119)	**(0.307)**	**(0.197)**	**(0.283)**	**(0.195)**
$\Delta s_{i,t}$	0.179***	0.055	0.090*	0.094*	0.056
	(0.048)	(0.045)	(0.053)	(0.053)	(0.061)
$\Delta s_{i,t-1}$	0.059***	0.042*	0.038**	0.038	0.055
	(0.014)	(0.022)	(0.032)	(0.021)	(0.034)
$\Delta s_{i,t-2}$	0.024**	0.011	0.031	0.010	0.035
	(0.012)	(0.017)	(0.033)	(0.016)	(0.033)
$\Delta s_{i,t-3}$	0.003	-0.001	-0.018	-0.006	-0.007
	(0.010)	(0.016)	(0.018)	(0.016)	(0.018)
(SUM $\Delta s_{i,t}$)	0.265***	0.107*	0.141	0.136**	0.139
	(0.061)	(0.059)	(0.099)	(0.067)	(0.116)
$CF_{i,t}/K_{i,t-1}$	0.062**	0.042	0.118**	0.045*	0.128**
	(0.026)	(0.029)	(0.046)	(0.023)	(0.053)
$EATR_{i,t}$	**-0.079**	**0.036**	**-0.166** **	**0.021**	**-0.164** **
	(0.050)	**(0.069)**	**(0.070)**	**(0.069)**	**(0.069)**
Inverse Mills ratio		0.123	-0.281	0.086	-0.106
		(0.227)	(0.226)	(0.178)	(0.201)
Number of firms	25,646	12,651	12,995	12,665	12,981
Sargan-Test (p-value)	0.911	0.995	0.501	0.975	0.150
Arellano-Bond-Test (p-value), order 1	0.000	0.000	0.004	0.000	0.003
Arellano-Bond-Test (p-value), order 2	0.441	0.819	0.398	0.984	0.440

Notes: The dependent variable is investment scaled by the replacement costs of the beginning-of-the-period capital stock. (Un-)Constrained firms according to the splitting criterion debt ratio are firms that have a debt ratio above (below) the median per year and industry. (Un-)Constrained firms according to the splitting criterion liquidation value are firms that have a ratio below (above) the median per year and industry. Estimation is done with system-GMM. A full set of time dummies is included. The instruments for the first-differenced regression are the values (in levels) of $\Delta ucc_{i,t}$, $\Delta s_{i,t}$ and $CF_{i,t}/K_{i,t-1}$, lagged two through seven years. Robust standard errors are reported. *, **, *** indicate significance at the 10, 5 and 1 percentage two-tail test levels, respectively. T-statistic and significance are based on robust standard errors. The standard errors for the long-term coefficient of the user costs of capital and sales are calculated using the delta method.

Source: *Hoppenstedt* firm database and own calculations, 1987 to 2008.

In addition, the estimated long term coefficient of the *UCC* for financially unconstrained firms is statistically not different from -1, the neoclassical benchmark (two-sided Chi-square test: *p*-value: 0.52). This indicates that the elasticity of capital to its user costs in a *DL* model is underestimated in case of neglecting the presence of financial constraints, which is in line with the results of Chirinko and Van Kalckreuth (2003). Further, my results confirm the explanation proposed by Dwenger (2012), why distributed lag models provide smaller estimates for the user costs of capital compared to the ones in error-correction frameworks: *DL* models suffer from the presence of short run frictions.

The long-term coefficient for sales is greater for constrained firms, but for both subsamples smaller than for the whole sample, which is surprising but might be explained due to the large standard errors. As a last point, it is worth noting that the inverse Mills ratios are not significant, which indicate that the error term of the selection equation is uncorrelated with the error terms of the structural equation. Thus, there seems to be no self-selection by firms into the two different regimes.

I now turn to the results for the second splitting criterion, the liquidation value. They are, as indicated by the results of the selection equation, very similar. The elasticity of capital to the *UCC* incorporating the *EMTR*, is almost three times larger for unconstrained than for constrained firms (- 0.80 vs. -0.26). The difference is statistically significant (one-sided t-test: p-value: 0.06). Furthermore, the coefficient of the *UCC* for unconstrained firms is not statistically different from -1 (two-sided Chi-squared test: p = 0.64).

The *EATR,* in contrast, only matters for financially constrained firms and has the same size as for the first splitting criterion (around 0.16). The difference between the coefficient of the two different regimes is statistically significant (one-sided t-test: p-value: 0.03). Moreover, the inverse Mills ratios are insignificant and, thus, suggesting that the error terms of structural and selection equation are uncorrelated.

Overall, the results are robust and support my hypothesis. The effect of corporate taxation in the short run differs depending on the degree of financial constraints that a firm faces. If the wedge between internal and external cost of finance is

small, taxes affect investment only by changing the rate of return. In case of liquidity constraints, however, the impact due to the cost channel vanishes and the liquidity aspect of taxes becomes more important.

4.5.3 SENSITIVITY ANALYSIS: DISTRESSED FIRMS.

To account whether a possible non-monotone but inversely u-shaped cash-flow sensitivity bias my results, I conduct two sensitivity checks. Cleary et al (2007) explained the inversely u-shaped cash-flow sensitivity by the presence of two different types of financial constrained firms, internal and external. Only externally constrained firms show the expected positive relationship between cash-flow and investment, as for them an additional unit of debt finances increases bankruptcy risk. They named this the cost effect. Investment by internally constrained firms, in contrast, increases when cash-flow sinks. The authors explain this by the fact that for internal constrained firms the revenue effects outweighs the cost effect, which presents the channel that investment raises expected revenue that improves firms' ability to repay debt and, thus, reduces the marginal cost of debt finance. A similar argument is also made by Fazzari et al (2000), who name internally constrained distressed firms.

To check the sensitivity of my results, I estimate a specification used by Cleary et al (2007) with a quadratic cash-flow term using the whole sample. Further, I estimate the same equation as above for the two subsamples but exclude internally constrained or, as they are also called, financial distressed firms. Following Asquith et al (1994), I classify firms as financially distressed if they exhibit a ratio of earnings before interest, taxes, depreciation and amortization (EBITDA) to interest expenses of less than 80% in one year or if EBITDA is less than the interest expenses for two consecutive years.

Since *EATR* is insignificant for the whole sample, I only use after taxes cash flow in the estimation and include a squared term as well. The results are shown in Table A-25 in the Appendix A. The squared cash-flow term is insignificant and even negative. The results of the second sensitivity analysis (Table A-26 in Appendix A), where I exclude financially distressed firms, point in the same direction. The estimated coefficient for the *EATR* does not change significantly, only the level of

significance decreases slightly. The other variables of interest remain basically unchanged.

Thus, internally constraints firms seem not present in my data such that my results are not biased. This is in line with my *a-priori* expectation based on the findings by Hovakimian (2009) who showed that internally constrained firms are even younger and smaller than externally constrained firms.

4.6 CONCLUSION

To the best of my knowledge, this study is the first that examines the different effects of corporate income taxation on investment for firms with and without binding financial constraints. From a theoretical point of view I expect that the investment decision of financially unconstrained firms to depend on *EMTR*, which captures the normally assumed cost channel of corporate taxation. *EATR*, which measure liquidity outflow through taxation, should, in contrast, not matter for these firms, since external and internal capital are perfect substitutes. For constrained firms instead, I expect the opposite in the short run: their investment decision should depend to a strong degree on internal finance and, thus, on *EATR* and only to a small extent on the *EMTR*.

To analyse my research questions I use the neoclassical investment approach where the *EMTR* is included in the *UCC* and *EATR* is explicitly included as one important determinant of internal finance. Two different sample splitting criteria are employed. One the one hand, firms are classified as financially constrained if their debt ratio in the last period is above the mean per year and industry and, on the other, if their liquidation value in the last period is below the median per year and industry. To overcome the critique of prior studies, I firstly control for the self-selection of the firms into one of the two financial regimes by employing a switching regression with known sample separation. Secondly, I check whether the presence of internally constrained or distressed firms biases my results. The latter seems not to be the case. This is what I expected since my data base contains mostly medium and large sized companies, while internally constrained firms are young, small and fast growing (Hovakimian 2009). Thirdly, the critique on the use of cash-flow sensitivity of investment to analyse financial constraints is of minor

important as I rely on the *EATR,* which is to some extent exogenous to the firms as taxes have to be paid and, in the period of my analysis, several tax reforms changed the amount of tax payments.

The results of the chapter are threefold. First it turns out that selection bias due to the self-selection of firms into the two different financial regimes seems negligible. The selection terms are not significant in all cases of the structural equation. This is comparable to the finding by Dwenger (2012) who account for sample attrition, which also does not seem to bias the results. Thus, although there are arguments from a methodological point of view to account for selection, the bias seems quite small, at least in the data set used in this study.

Secondly, my results show that the elasticity of capital to its *UCC* in a *DL* model is underestimated in case of neglecting the presence of financial constraints. If one accounts for the presence of financial constraints, however, the estimated long-term coefficient of the *UCC* for unconstrained firms is close to -1. This is also the result of prior literature using an error correction framework (Dwenger 2012, Bond and Xing 2010) or a partial adjustment model (Buettner and Hoenig 2011). This indicates that models in which the long run relationship is explicitly modelled do not suffer from the presence of financially constrained firms. This has been suggested by Dwenger (2012). She argues that the estimated coefficient in *DL* models may be biased due to short run friction as finance constraints. My results confirm their explanation.

Thirdly, I present evidence that the effect of corporate income taxation in the short run depends strongly on the degree of financial constraints that the firm faces. In the case of an unconstrained firm, only the cost channel of corporate income taxation matters, which represent the usual assumed impact of corporate income taxation on firms' investment. If, however, a firms' investment is constrained by its financial situation due to a wedge between its internal and external cost of finance, the cost channel of taxation is of minor importance in the short run. Instead, how taxes affect firms' liquidity come into play. Thus, when evaluating corporate income taxation regimes, the liquidity aspect of taxation should be considered as entrepreneurs or small sized firms might be especially affected by this channel.

4.7 APPENDIX A: SUPPLEMENTARY TABLES AND ESTIMATION RESULTS.

Table A-23: Descriptive statistics for the whole sample

	Mean	P25	P50	P75	SD
Ki,t (in 1,000 Euros)	254.544	10.990	40.127	139.717	1.628.821
Ii,t/Ki,t-1	0.141	0.032	0.083	0.159	0.519
UCCi,t	0.121	0.096	0.118	0.141	0.039
Δucci,t	-0.007	-0.077	-0.001	0.066	0.252
Si,t (in 1,000 Euros)	475.514	28.690	72.865	228.746	2.271.173
Δsi,t	-0.021	-0.072	0.002	0.074	0.369
CFi,t/Ki,t-1	0.459	0.071	0.166	0.351	1.17
EATRi,t	0.128	0.000	0.007	0.066	0.701

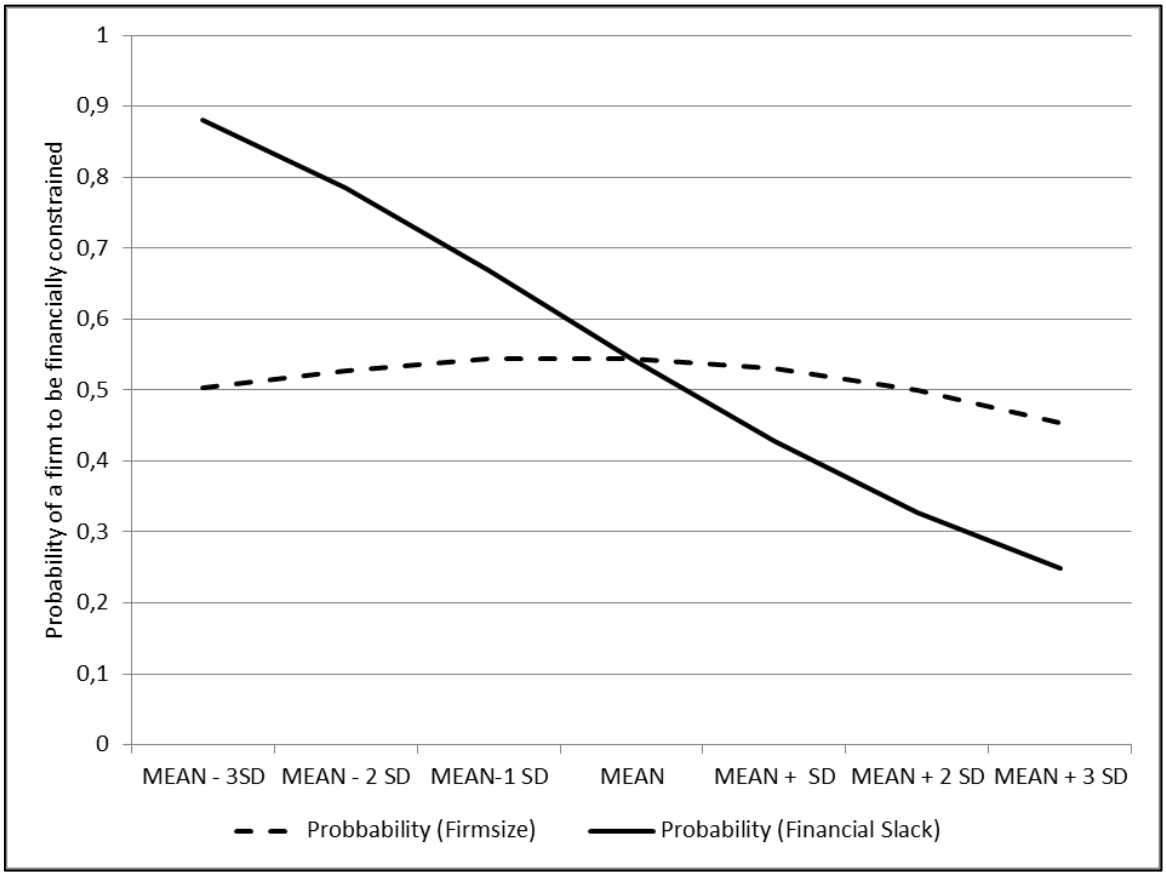
Notes: $\Delta ucc_{i,t}$ ($\Delta s_{i,t}$) is the growth rate of the UCC (sales).
Source: *Hoppenstedt* firm database and own calculations, 1987-2008.

Table A-24: Descriptive statistics for the two subsamples

Splitting Criterion	Debt Ratio		Liquidation Value	
Mean	**Unconstrained**	**Constrained**	**Unconstrained**	**Constrained**
$K_{i,t}$ (in 1,000 Euros)	240.465	268.250	227.090	281.329
$I_{i,t}/K_{i,t-1}$	0.156	0.127	0.156	0.126
$UCC_{i,t}$	0.125	0.116	0.126	0.117
$\Delta ucc_{i,t}$	-0.007	-0.006	-0.007	-0.006
$S_{i,t}$ (in 1,000 Euros)	558.194	395.023	556.399	396.589
$\Delta s_{i,t}$	-0.030	-0.011	-0.030	-0.011
$CF_{i,t}/K_{i,t-1}$	0.515	0.404	0.532	0.388
$EATR_{i,t}$	0.151	0.106	0.157	0.099

Notes: $\Delta ucc_{i,t}$ ($\Delta s_{i,t}$) is the growth rate of the UCC (sales). Un-) constrained firms according to the splitting criterion debt ratio are firms that have a debt ratio above (below) the median per year and industry. (Un-) constrained firms according to the splitting criterion liquidation value are firms that have a ratio below (above) the median per year and industry.
Source: *Hoppenstedt* firm database and own calculations, 1987-2008.

Figure A-5: Probability of a firm to be financially constrained: Firm size and Financial Slack



Notes: Predicted probabilities of a manufacturing firm in 1989 to be financially constrained in dependence of its size and financial slack. The firm is not publicly traded, does not payout dividends and has a mean cash flow and mean sales and ucc growth. The prediction is based on the probit results shown in Table 21 for the debt ratio as splitting criterion.
Source: *Hoppenstedt* firm database and own calculations, 1987 to 2008.

Table A-25: Results: Effect of taxes on investment (with squared cash-flow)

Sample	**Full**
$\Delta ucc_{i,t}$	-0.308***
	(0.103)
$\Delta ucc_{i,t-1}$	-0.161***
	(0.059)
$\Delta ucc_{i,t-2}$	-0.080*
	(0.033)
$\Delta ucc_{i,t-3}$	-0.019
	(0.017)
(SUM $\Delta ucc_{i,t}$)	**-0.568*** **
	(0.201)
$\Delta s_{i,t}$	0.125***
	(0.043)
$\Delta s_{i,t-1}$	0.055***
	(0.014)
$\Delta s_{i,t-2}$	0.028**
	(0.018)
$\Delta s_{i,t-3}$	-0.004
	(0.010)
(SUM $\Delta s_{i,t}$)	**0.204**
	(0.055)
$CF_{i,t}/K_{i,t-1}$	0.096**
	(0.040)
$(Cf_{i,t}/K_{i,t-1})^2$	-0.004
	(0.005)
Number of firms	25,646
Sargan-Test (p-value)	0.587
Arellano-Bond-Test (p-value), order 1	0.000
Arellano-Bond-Test (p-value), order 2	0.390

Notes: The dependent variable is investment scaled by the replacement costs of the beginning-of-the-period capital stock. Estimation is done with system-GMM. A full set of time dummies is included. The instruments for the first-differenced regression are the values (in levels) of $\Delta ucc_{i,t}$, $\Delta s_{i,t}$ and $CF_{i,t}/K_{i,t-1}$, lagged two through seven years. Robust standard errors are reported. *, **, *** indicate significance at the 10, 5 and 1 percentage two-tail test levels, respectively. T-statistic and significance are based on robust standard errors. The standard errors for the long-term coefficient of the user costs of capital and sales are calculated using the delta method.
Source: *Hoppenstedt* firm database and own calculations, 1987 to 2008.

Table A-26: Results: Effect of taxes on investment (without distressed firms)

Splitting Criterion	**Debt Ratio**		**Liquidation Value**	
Sample	**Unconstrained**	**Constrained**	**Unconstrained**	**Constrained**
$\Delta ucc_{i,t}$	-0.546***	-0.109	-0.448***	-0.133
	(0.155)	(0.137)	(0.149)	(0.090)
$\Delta ucc_{i,t-1}$	-0.235***	-0.059	-0.223***	-0.072
	(0.080)	(0.086)	(0.085)	(0.059)
$\Delta ucc_{i,t-2}$	-0.085*	-0.043	-0.102**	-0.050
	(0.045)	(0.075)	(0.046)	(0.038)
$\Delta ucc_{i,t-3}$	-0.009	0.010	-0.022	-0.005
	(0.025)	(0.046)	(0.024)	(0.022)
(SUM $\Delta ucc_{i,t}$)	**-0.880*** **	**-0.194**	**-0.795*** **	**-0.259**
	(0.272)	**(0.322)**	**(0.283)**	**(0.195)**
$\Delta s_{i,t}$	0.083	0.012	0.094*	0.056
	(0.056)	(0.108)	(0.053)	(0.061)
$\Delta s_{i,t-1}$	0.029	0.032	0.038	0.055
	(0.044)	(0.047)	(0.021)	(0.034)
$\Delta s_{i,t-2}$	0.009	0.014	0.010	0.035
	(0.018)	(0.059)	(0.016)	(0.033)
$\Delta s_{i,t-3}$	-0.011	-0.027	-0.006	-0.007
	(0.016)	(0.049)	(0.016)	(0.018)
(SUM $\Delta s_{i,t}$)	**0.109**	**0.022**	**0.136** **	**0.139**
	(0.075)	**(0.215)**	**(0.067)**	**(0.116)**
$CF_{i,t}/K_{i,t-1}$	0.036	0.119*	0.045*	0.128**
	(0.025)	(0.064)	(0.023)	(0.053)
$EATR_{i,t}$	**0.046**	**-0.164***	**0.021**	**-0.164** **
	(0.076)	**(0.093)**	**(0.069)**	**(0.069)**
Inverse Mills Ratio	0.012	0.072	0.086	-0.106
	(0.313)	(0.171)	(0.178)	(0.201)
Number of firms	10,670	7,388	12,665	12,981
Sargan-Test (p-value)	0.998	0.376	0.975	0.150
Arellano-Bond-Test (p-value), order 1	0.000	0.061	0.000	0.003
Arellano-Bond-Test (p-value), order 2	0.984	0.030	0.984	0.440

Notes: The dependent variable is investment scaled by the replacement costs of the beginning-of-the-period capital stock. (Un-)Constrained firms according to the splitting criterion debt ratio are firms that have a debt ratio above (below) the median per year and industry. (Un-)Constrained firms according to the splitting criterion liquidation value are firms that have a ratio below (above) the median per year and industry. Estimation is done with system-GMM. A full set of time dummies is included. The instruments for the first-differenced regression are the values (in levels) of $\Delta ucc_{i,t}$, $\Delta s_{i,t}$ and $CF_{i,t}/K_{i,t-1}$, lagged two through seven years. Robust standard errors are reported. *, **, *** indicate significance at the 10, 5 and 1 percentage two-tail test levels, respectively. T-statistic and significance are based on robust standard errors. The standard errors for the long-term coefficient of the user costs of capital and sales are calculated using the delta method.

Source: Hoppenstedt firm database and own calculations, 1987 to 2008.

4.8 APPENDIX B: CONSTRUCTION OF THE VARIABLES

This appendix describes the calculation of the variables used in the model and their data source.

Gross Investment $I_{i,t}$

Gross investment is defined as investment in fixed tangible assets and structures plus reposting, less disposals from fixed tangible assets and structures at book values.

Sales $S_{i,t}$

Sales are measured by turnover, deflated by an industry-specific output price index, provided by the German Statistical Office.

Cash flow $CF_{i,t}$

Cash flow is income before taxes plus depreciation. The difference between depreciation for firms who create their profit and loss statement according to the whole expenditure method and firms who apply the cost of sales method is neglected.

Effective average tax rate $EATR_{i,t}$

The *EATR* is defined as tax payments $etp_{i,t}$ scaled by the replacement costs of the beginning-of-the-period capital stock .

Capital stock $K_{i,t}$

Gross investment is scaled by the real replacement costs of equipment and structure. This cost of capital is not available in the data and must thus be estimated from historic cost data. The replacement costs of the capital stock are assumed to equal their historic costs in the first year a firm is observed in the data set, adjusted for previous years' inflation. Thereafter, the replacement costs are updated using the perpetual inventory method:

$$P_t^I * K_{i,t} = (1-\delta) * P_{t-1}^I * K_{i,t-1} \frac{P_t^I}{P_{t-1}^I} + P_t^I * I_t$$

where t = 1987,...,2008, $K_{i,t}$ = capital stock, $I_{i,t}$ = gross investment, P_t^I= price of investment goods, and δ = depreciation rate. I assume a depreciation rate of 12.25 percentages per year for fixed tangible assets and 3.61 percentages per year for buildings as in Dwenger (2012).

Price indices P_t^I and P_t^S

The index P_t^I (*Investitionsgueterindex*) is constructed at the country level and the price index P_t^S (*Erzeugerpreisindex*) on a disaggregated level for manufactures by the German Statistical Office. I use this information at the four digit industry level.

Rate of economic depreciation $\delta_{a,j,t}$

The rate of economic depreciation $\delta_{a,j,t}$ can be derived from the national accounts capital stock (*Kapitalstockrechnung*), provided by the German Statistical Office. The rate is asset (fixed assets and structures), industry (four-digit-level) and time-specific. The rate of economic depreciation is calculated in prices of 2000.

Depreciation allowances $z_{a,j,t}$

In Germany, allowances for fixed assets and structures follow different methods. Structures are depreciated on a straight line basis, whereas fixed assets could also be depreciated according to the declining-balance method until 2007. The rates of depreciation are set by the Federal Ministry of Finance. Due to data restrictions, only regular depreciation allowances are considered. Until 2000, the relevant lifetime of structures for tax purposes was 25 years, since 2001 this lifetime is 33 1/3 years. Until 2000 the yearly rate for the declining balance method was 0.3 for fixed assets, since 2001 the rate is 0.2. Because of missing information about the relevant lifetime for different fixed assets, I assumed a relevant lifetime of 10 years until 1997, 13 years between 1998 and 2002 and 16.9 years from 2001 on based on the investigation of depreciation allowances in Germany from Oestreicher and Spengel (2002).

Interest rate r_t

I used the overall yield on corporate bonds r_t provided by the German Central Bank in its series "Yields on debt securities outstanding issued by residents/corporate bonds/monthly average".

4.9 APPENDIX C: STATUTORY TAX RATES

Table C-27: Statutory tax rates over time

Year	Corporate Income Tax On Retained Earnings	Corporate Income Tax On Distributed Profits	Solidarity Surcharge
1987	56%	36%	-
1988	56%	36%	-
1989	56%	36%	-
1990	50%	36%	-
1991	50%	36%	3.75%
1992	50%	36%	3.75%
1993	50%	36%	-
1994	45%	30%	7.5%
1995	45%	30%	7.5%
1996	45%	30%	7.5%
1997	45%	30%	7.5%
1998	45%	30%	5.5%
1999	45%	30%	5.5%
2000	45%	30%	5.5%
2001	25%	25%	5.5%
2002	25%	25%	5.5%
2003	26.5%	26.5%	5.5%
2004	25%	25%	5.5%
2005	25%	25%	5.5%
2006	25%	25%	5.5%
2007	25%	25%	5.5%
2008	15%	15%	5.5%

Source: Own representation, corporate income tax law, 1987 to 2008, solidarity surcharge law 1991 to 2008.

CHAPTER 5: GENERAL CONCLUSION

5.1 MAIN RESULTS

There are two key empirical results derived in this doctoral thesis. Firstly, my findings show that beyond the previously analysed corporate income taxation, shareholder taxation matters for firms' cost of finance (Chapter two). Secondly, my results highlight that the effect of taxes on the cost of capital, and thus on investment, differs remarkably between firms, depending on other aspects of capital market frictions firms may face (all chapters).

Miller (1977) pointed out the potential impact of differential taxation of debt and equity returns on firms' leverage, however, empirical evidence is still rare (Graham 1999, Alworth and Arachi 1999, Overesch and Voeller 2010). Chapter two narrows this gap by presenting evidence on the impact of interest income taxation on firms' capital structure choice. My results suggest that on average, a ten percentage point increase in the interest income tax rate will decrease leverage by about 1 percentage point during the first year. In the long run, however, this effect is likely to be much larger as my results uncover that the adjustment of firms' finance structure is mainly achieved through new investment. It may also partially be delayed due to the financial frictions that firms face. I further highlight that smaller firms react more strongly to changes in interest income taxation, which may be caused by a greater influence of shareholders on firms' finance decisions. This substantial heterogeneity of the impact of taxes on firms' cost of capital and its dependence from other market friction is confirmed in the two other studies of this doctoral thesis.

In chapter three, the importance of the tax advantage of debt is assessed. In contrast to prior studies (e.g. Dwenger and Steiner 2009, Graham 1999), which use reforms of corporate income taxation for the identification, I rely on a quasi-experimental setting: the introduction of the interest barrier in Germany. This regulation aims to prevent excessive debt financing by restricting the amount of deductible interest expenses to a certain share of taxable profits. Due to several

escape clauses within the regulation it mostly affects large firms. By exploiting the escape clauses using a difference-in-difference approach, I show that firms for which the tax advantage of debt was partly abolished exhibit a strong decline in their leverage ratio. This highlights the importance of the tax advantage of debt and confirms the results of prior literature.

My study further contributes to the understanding of the relationship between the cost of capital and investment by showing that investment spending was not negatively affected by the interest barrier. Two main reasons may explain this result. Firstly, only firms with net interest expenses above 1 million euro are affected by the regulation. Since these firms are likely to be in the mature stage of their life cycle, their investment is not constrained by retained earnings, as is the case for young firms that are in a growing stage (chapter four). This is in line with prior research that shows that the capital structure of large firms is more sensitive to corporate income taxation (Dwenger and Steiner 2009). Secondly, the non-negative investment effect suggests that the marginal source of finance for these firms is retained earnings. Thus, the abolishment of the tax advantage of debt does not affect the marginal cost of finance. This explanation is in line with prior research (Bond and Xing 2010); however, the results may also be explained by fixed investment in the short term or by firms' expectations to circumvent the regulation in the long term.

Another important finding is that there is a bunching of firms at the exemption limit as some firms shift part of their assets into subsidiaries in order to exploit the exemption limit multiple times. Thus, by reducing their absolute interest payments they are still able to finance their investment with a large fraction of debt but nevertheless avoid the application of the interest barrier. This highlights the most important caveat of the regulation.

In the fourth chapter of this dissertation I show that taxes affect investment through two different channels and that the importance of the channels is determined by firms' financial situation. If debt and equity are almost perfect substitutes, firms' investment decision is only affected by the taxation of the marginal investment. This is the most commonly analysed cost channel of taxation. (e.g. Chirinko et al 1999, Buettner and Hoenig 2011, Dwenger 2012). This channel

is captured by the effective marginal tax rate (*EMTR*). However, the investment decision for financially constrained firms is only marginally influenced by the *EMTR* while the liquidity impact of taxation is significant. Since constrained firms face a cost wedge between their internal and external cost of finance, the reduction of internal cash increases the amount of external finance for a given investment budget. Thus, the cost of capital increases and investment decreases.

In addition to these main results, important determinants that influence the impact of taxes on firms' investment are identified. In particular, firms in a growing stage of their life cycle are especially likely to face financial constraints. These are firms with good growth opportunities, with low cash flows and firms that are often not publicly traded. Further, these firms are not necessarily small but middle sized, respectively more capital intensive.

5.2 POLICY IMPLICATIONS

The policy implications that can be derived from this doctoral thesis depend on the goal of tax policy. If this is only to eliminate tax-induced distortion, my results suggest a need for equal taxation of debt and equity returns as otherwise firms' financial decision is distorted. Thus, the recent trend in Europe to introduce flat withholding taxes on interest but not on equity income should be revisited. In Germany, for instance, where a final withholding tax on interest income was introduced in 2009, the gap between the tax rate in equity income and interest income amounts to almost 20%. Thus, an entrepreneur is less likely to invest equity in his or her business but will use debt instead.

My results call further for a change of the corporate income tax. On the one hand, the debt advantage of debt has to be abolished, either by abolishing the corporate income tax or by treating debt and equity return in the same way on the firm level. The latter was intended by the introduction of the thin capitalization rule in Germany. However, it applies only to a subset of firms as it is designed against profit shifting activities of multinationals. On the other hand, changes in the corporate income tax are necessary as the corporate income tax in the current form affects investment spending by reducing internal liquidity (Keuschnigg and Ribi 2010, chapter four) even if it does not affect the marginal investment. Thus,

recent tax reforms in Europe which followed the principle "tax cut cum base broadening," are likely to change the way how taxes affect investment. In principle, economists are in favour of lower tax rates and a broader tax base as the disincentives are weaker. However, the broadening of the tax base causes tax payments especially for firms with low retained earnings that are often affected by financial constraints. Recent reforms introducing less generous depreciation allowance and/or tighter loss-off set rules may thus reduce the disincentive to invest, however, affect firms' investment spending by reducing firms' internal liquidity. To avoid this impact one can either abolish corporate income taxation or include tax credits such that tax payments are postponed to the future if companies invest.

If the goal of tax policy is, however, to mitigate capital market frictions the impact of taxes has to be seen in the light of firms' life cycle stages and the varying intensity of capital market frictions they face. This changes some of the implications and strengthens for other the arguments.

The first implication states that taxation should not disfavour equity financing of firms by taxing shareholders' interest income at a lower rate than equity returns. Small firms react stronger to the differential taxation of debt and equity returns than large firms (chapter two). However, small firms already rely on debt to finance their investment since their retained earnings are not sufficient. The disadvantage of equity financing by taxing the returns at a higher rate amplifies firms' dependence on debt and does not mitigate it, although this would be beneficial from a welfare perspective (Fuest et al 2002). However, it is beyond the explanatory power of my analyses to judge whether this speaks for a favoured treatment of equity returns or not. This depends on the access to the equity market, which may especially be limited for small firms due to their low publication requirements for instance.

Regarding the implication of my studies for corporate income taxation, my results show that for small firms this is a double edge sword. On the one hand corporate income taxation reduces internal liquidity, which decreases investment spending if firms face financial constraints (chapter four). On the other hand, however, small firms use debt as their marginal source of finance due to their low retained

earnings and their limited access to the equity market. Furthermore, small firms face stronger capital market frictions because they have, for example, less collateral (Bester 1985). Corporate income taxation mitigates these distortions by enabling them to bear higher interest rates, given they pay taxes. Therefore, the optimal design for small firms should keep the corporate income tax in place while limiting the impact of taxation on cash flow. This may be achieved by the introduction of generous exemption limits such that small and middle sized firms are less affected or by the introduction of tax credits for companies which invest.

The implications for the optimal design of corporate income taxation for large firms are different. These firms suffer less from asymmetric information in the debt market as they must fulfil tighter publication requirements. In addition, larger firms' excess to the equity market is, in general, not limited. Thus, the impact on the marginal cost of finance seems small even if the tax advantage of debt affects their capital structure. Moreover, since larger firms are able to substitute between equity and debt financing easily, the liquidity aspect of taxation does not matter. If firms use debt to reduce their tax payments either via excessive debt financing or via debt-shifting, it seems thus reasonable to at least partly abolish the tax advantage of debt. This has been achieved through the thin-capitalization rule in Germany and other countries, in order to broaden the tax base.

However, to avoid negative investment effects the regulation should only be applied to firms which can easily substitute between debt and equity financing, because only for these firms debt is not the marginal source of finance. This was intended by the inclusion of the firm-based exemption limit in Germany. My analysis yet highlight that the design of the regulation should be more carefully done. Since some firms may exploit the exemption limit by dividing firms' assets, the effectiveness of the whole regulation is severely hampered by a firm-based exemption limit. Thus, the increase of the exemption limit in Germany from 1 to 3 million euro in 2009 is likely to decrease the effectiveness of the regulation. Firstly, fewer firms are affected by the regulation and secondly, splitting up firms' assets is a more realistic option for more firms. It seems thus recommendable to revisit the regulation of the exemption limit. One promising way to increase the effectiveness of the interest barrier may be the introduction of a group based exemption limit.

With regard to the optimal design of a thin-capitalization rule, my results indicate that thin capitalization rules of the new type, as introduced in Germany, seem more effective. Under the new type of regulation all interest payments are subject to the regulation, whereas the old type considers only interest payments to shareholders. Therefore, the latter suffers from the substitution between internal and external debt (Buettner et al 2012). Since profit shifting is also done via external debt (Moen et al 2011), only the new type of thin-capitalization rules effectively prevents profit-shifting and excessive debt financing.

5.3 FURTHER RESEARCH

The results derived in this doctoral thesis point to several directions for future research. On the one hand, I will describe future research, which is linked to the limitations of my studies. On the other hand, I will discuss future directions that are derived out of my findings.

Firstly, I could not analyse the long run impact of differential taxation on firms' leverage decision due to data limitations. Firms adjust their finance structure particularly through new investment, and might only have a delayed reaction due to adjustment costs. My findings present thus a lower bound of the behavioural response. Accordingly, they should be complemented by studies determining the long run effect. Secondly, the thin capitalization rule was changed retroactively. Thus, the long run impact and in particular, how the regulation affects multinational firms' choice of location should be addressed by future research. Thirdly, it remained unsolved whether firms are able to use the basic rule of the regulation, the EBITDA escape clause, or not. Firms with a ratio of interest expenses to EBITDA below 30% did not behave differently from firms with a higher ratio. This suggests that the EBITDA escape clause cannot be used by firms as otherwise both groups should behave differently. However, another explanation for this finding could be measurement error that occurred due to the classification of firms according to the tax-adjusted EBITDA which I calculated based on financial statements data.[120] A promising way to address this measurement error may be

[120] Another way to address the measurement error is to use an instrumental variable approach. Commonly used in this regard are lagged values of the variable. In the case of the tax-adjusted EBITDA this however

using tax data. Finally, future research should address whether international groups choose the so-called equity escape. According to this clause, the interest barrier is not applied if the debt ratio is similar in all firms of the group. To test whether this escape clause is used, the whole group structure must be known. As I use only data for German firms I am not able to do so. Future research may address the use of the escape clause as in principle data on group structures are available.

The most important direction for future research is to provide direct evidence on the dependence between taxation on the one hand and firms' (marginal) costs of capital, firms' life cycle stage and capital market frictions on the other hand. Although, this doctoral thesis presents strong evidence of the dependence, it is mainly based on an indirect analysis. In chapter four, for example, I uncover the characteristics of firms that are likely to face financial constraints. Further, chapter three adds that larger firms do not reduce their investment spending in the event that the debt advantage of debt is abolished. My results should therefore be validated with direct evidence. One way to do so would be to assess the elasticity of firms' leverage to the corporate income tax based on firms' age. Another way could be to account directly for firms' bankruptcy costs. According to the trade-off theory the marginal tax advantage of debt equals firms' marginal bankruptcy costs in the optimum. Accordingly, the marginal bankruptcy costs should strongly influence the impact of taxes on firm's capital structure choice. From my point of view special attention should be paid to different shareholder types, since firms belonging to a group of firms are probably different from firms with natural persons as shareholders (Krämer 2012).

Finally, an important insight into firms' cost of finance and investment may be gained by analysing this dependence in the setting of multinational firms. So far, it has been shown that multinationals shift profits abroad, either via debt financing (Huizinga et al 2008, Buettner and Wamser 2012) or transfer pricing (Clausing 2003, Huizinga and Laeven 2008). Further, it is documented that the investment spending of the subsidiary depends on the tax rate of the parent company (Overesch 2009). However, direct evidence on the causal relationship is limited (Egger et al 2012).

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is questionable as the measurement error is likely to be correlated over time. The lagged values of the variable are therefore not valid instruments.

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LIST OF ABBREVIATIONS

CIT	Corporate Income Tax
DL	Distributed Lag
DIT	Dual Income Tax
EBITDA	Earnings Before Interest, Taxes and Depreciation Allowances
ECM	Error Correction Model
EATR	Effective Average Tax Rate
EMTR	Effective Marginal Tax Rate
GMM	Generalized Method of Moments
IV	Instrumental Variable
Inc.	Income
PIT	Personal Income Tax
S	Sales
TCR	Thin-Capitalization Rule
UCC	User Cost of Capital

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ENGLISH SUMMARY

The focus of this work is to shed light on the impact of taxation on firms' cost of capital and investment. The importance of this topic is highlighted by Modigliani and Miller (1958), who show that it is only in a world with frictionless markets that firms' finance and investment decision are independent. Thus, to encourage capital accumulation and, therefore, society's welfare, the impact of market frictions on investment has to be understood.

Taxes are one reason for market frictions. This doctoral thesis contributes to the literature on public and corporate finance by presenting empirical evidence on the relative importance of taxes on firms' finance decision and on their investment spending. Furthermore, this doctoral thesis adds to the political debate on taxation by evaluating the dominant changes in taxation in Germany and Europe. These are the introduction of flat withholding taxes on interest income (chapter two), the introduction of thin-capitalization rules to prevent profit shifting and excessive debt financing (chapter three), and the trend to cut tax rates while broadening the tax base (chapter four).

The first part of this thesis is concerned with the impact of differential taxation of debt and equity returns of shareholders on firms' finance decision (chapter two). Two different methods are used to reveal the causal impact. The first is a semi-parametric difference-in-difference matching strategy. This method accounts for potential unobserved time-invariant as well as observed time varying differences between the treatment and control group. The second, a more structural method is used to compare my results to the prior literature and to validate the first method. Both methods provide consistent results. They show that a preferential taxation of debt on the shareholder levels leads to more debt financing. Although the estimated one year impact is small, results indicate that the long run impact is likely to be larger as firms adjust their finance structure mainly through new investment.

The third chapter highlights the importance of the tax advantage of debt for firms' finance decision. I identify the causal effect of the tax advantage by exploiting the introduction of the German interest barrier as a quasi-natural experiment. This regulation aims to prevent profit shifting and excessive debt financing by denying the deductibility of interest expenses if they exceed a certain share of profits. My study accounts for the fact that the true impact of the regulation is not the restricted deductibility of interest expenses but rather the behavioural response of firms to use more equity financing. My results indicate that the interest barrier is quite effective in reducing firms' debt usage. Furthermore, firms that reduce their debt ratio are found to exhibit a strong increase in reported profits. Firms' investment spending is not negatively affected. A possible explanation for this finding is that the regulation target mostly large firms that do not use debt as the marginal source of finance. It is further shown that some firms exploit the exemption limit multiple times by shifting part of their assets into subsidiaries. Thus, the exemption limit, which was included in the regulation to avoid the application of the regulation for small and middle sized firms, appears to be the regulation's shortcoming. Firms that divide their assets, still significantly finance their investment with debt, but avoid the application of the rule as their interest expenses are below the exemption limit.

In chapter four of this doctoral thesis the impact of taxes on investment in case of binding and non-binding financial constraints is assessed. In line with my theoretical predictions, I show that the channel how taxes affect investment depends on firms' financial situation. While firms facing high external costs of finance react less to marginal incentives, which are captured by the effective marginal tax rate (*EMTR*), they react stronger to the effective average tax rate (*EATR*), which captures the impact of taxes on firms' internal finance. Instead, the investment of firms for which debt and equity are perfect substitutes depends solely on the taxation of the marginal investment.

To uncover the causal relationship I address the endogeneity of the user cost of capital, which incorporate the taxation of the marginal investment, and the effective average tax rate by using system *Generalized Method of Moments* estimator (GMM). A further innovation is related to the critique passed on prior

studies analysing the impact of finance constraints on investment spending: the possible self-selection of firms that might bias the results. I address the self-selection by applying a switching regression. Although it turned out that self-selection does not bias the results, the framework provides fruitful insight on the type of firms that face financial constraints. These are firms with good growth opportunities, a low cash flow and firms that are neither publicly traded nor paying out dividends. Furthermore, they are middle sized.

Overall the results derived in this doctoral thesis highlight that, firstly, it is not just corporate income taxation but also shareholder taxation that matters for firms' finance decision. Secondly, the impact of taxation on firms' finance structure and investment is strongly influenced by other market frictions. Thus, there is a substantial heterogeneity between firms that should be taken into account when designing an optimal tax policy.

GERMAN SUMMARY

Hauptaugenmerk dieser Arbeit liegt auf dem Einfluss der Besteuerung auf die Finanzierungsstruktur und Investitionen von Unternehmen. Die Relevanz dieser Thematik wurde als erstes von Modigliani und Miller (1958) herausgestellt. Sie haben gezeigt, dass Investitions- und Finanzierungsentscheidungen von Unternehmen nur bei vollkommenen Märkten voneinander unabhängig sind. Es ist daher von großem Interesse, den Einfluss von unvollkommenen Kapitalmärkten auf Investitionsentscheidungen zu verstehen, um die optimale Kapitalakkumulation zu erreichen und damit die gesamtwirtschaftliche Wohlfahrt zu steigern.

Ein Grund für unvollständige Kapitalmärke ist Besteuerung. Die vorliegende Doktorarbeit trägt daher zur Literatur der Finanzwissenschaft und Unternehmensfinanzierung bei, indem sie empirische Evidenz zum Einfluss der Besteuerung auf Finanzierung- und Investitionsscheidung von Unternehmen präsentiert. Zudem bereichert sie die öffentliche Debatte zur Steuerpolitik in Deutschland und Europa, da wesentliche Änderungen in der Besteuerung analysiert werden. Diese sind die Einführung der Abgeltungsteuer auf Zinserträge (Kapitel zwei), die Einführung der Zinsschranke um Gewinnverlagerungen und übermäßige Fremdfinanzierung zu beschränken (Kapitel drei), sowie der Trend nominale Steuersätze zu senken bei gleichzeitiger Verbreiterung der Bemessungsgrundlage (Kapitel vier).

Der erste Teil dieser Arbeit beschäftigt sich mit dem Einfluss der unterschiedlichen Besteuerung von Zinsen und Eigenkapitalrückflüssen (z.B. Dividenden) von Anteilseignern auf die Finanzierungsentscheidung von Unternehmen. Um den kausalen Effekt zu identifizieren verwende ich zwei unterschiedliche Methoden. Die erste Methode ist ein semiparametrischer difference-in-differences Matching Ansatz. Diese Methode berücksichtigt mögliche unbeobachtete zeitkonstante und beobachtete zeitvariierende Unterschiede zwischen der Treatment- und Kontrollgruppe. Die zweite Methode ist ein eher struktureller Ansatz. Diesen verwende ich um die Ergebnisse mit der bisherigen Literatur zu vergleichen sowie

um den ersten Ansatz zu validieren. Beide Methoden kommen zu dem gleichen Ergebnis. Sie stellen heraus, dass die begünstigte Besteuerung von Zinsen für Anteilseigner zu mehr Fremdkapitalnutzung in Unternehmen führt. Obwohl der geschätzte Effekt im ersten Jahr sehr klein ist, zeige ich, dass der langfristige Effekt sehr wahrscheinlich größer sein wird. Dies ist insbesondere darauf zurückzuführen, dass Unternehmen ihre Finanzierungsstruktur über Investitionen anpassen.

Die zweite Studie dieser Dissertation befasst sich mit der Bedeutung der steuerlichen Begünstigung von Fremdkapital in Unternehmen. Der kausale Effekt des Steuervorteils wird durch die Einführung der Zinsschranke in Deutschland als quasi-natürliches Experiment identifiziert. Die analysierte Regelung begrenzt die Abziehbarkeit von Schuldzinsen auf einen Anteil am Gewinn (vor Steuern und Abschreibungen) und soll damit Gewinnverlagerungsaktivitäten von multinationalen Unternehmen und überdurchschnittliche Fremdfinanzierung nationaler Unternehmen verhindern. In meiner Studie berücksichtigte ich dabei explizit, dass der wahre Einfluss der Regelung nicht in deren Anwendung besteht, sondern in dem geänderten Verhalten von Unternehmen, mehr Eigenkapitalfinanzierung zu nutzen. Meine Ergebnisse deuten auf eine effektive Regelung hin. Unternehmen, die von der Zinsschranke betroffen sind, haben ihre Verschuldungsquote erheblich gesenkt. Ich zeige in der Studie des Weiteren, dass Unternehmen die ihr Fremdkapital reduziert haben, einen starken Anstieg in den ausgewiesenen Gewinnen aufzeigen. Zudem stellen die Ergebnisse heraus, dass die Investitionstätigkeit von Unternehmen nicht beeinträchtigt wurde. Ein wesentlicher Grund hierfür ist, dass nur große Unternehmen von der Regelung betroffen sind und diese mit einbehaltenen Gewinnen ihre Grenzinvestition finanzieren. Auch wird in der Studie deutlich, dass manche Unternehmen die Freigrenze mehrfach nutzen, indem sie sich in rechtlich selbständige Unternehmen aufspalten. Die Freigrenze, die in die Regelung aufgenommen wurde um die Anwendung für kleine und mittlere Unternehmen zu vermeiden, stellt damit die Achillesferse der Regelung dar. Unternehmen, die sich aufspalten, finanzieren sich weiterhin zu einem großen Anteil mit Fremdkapital. Sie vermeiden jedoch die

Anwendung der Zinsschranke, da ihre Zinsaufwendungen unter der Freigrenze liegen.

Im vierten Kapitel der Arbeit wird der Einfluss von Steuern auf die Investitionsentscheidung von Unternehmen analysiert, wenn diese Finanzierungsbeschränkungen unterliegen. In Übereinstimmung mit meinen theoretischen Überlegungen zeige ich, dass der Wirkungskanal, durch den Steuern die Investitionsentscheidung von Unternehmen beeinflussen, von der finanziellen Situation des Unternehmens abhängt. Wenn ein Unternehmen hohe externe Finanzierungskosten hat, reagiert es nur in geringfügig auf marginale Steueranreize; es ist jedoch in hohem Maße vom durchschnittlichen Steuersatz beeinflusst. Dieser misst den Einfluss der Besteuerung auf die internen Finanzierungsmittel des Unternehmens. Die Investitionsentscheidung von Unternehmen, für die Eigen- und Fremdkapital nahezu perfekte Substitute sind, wird im Gegensatz dazu einzig von der Besteuerung der marginalen Investition beeinflusst.

Zur Identifikation des kausalen Zusammenhangs verwende ich einen *System GMM* Ansatz. Dieser vermeidet die Verzerrung der Ergebnisse aufgrund der Endogenität der Kapitalkosten (*User Cost of Capital*), die die Besteuerung der marginalen Investition beinhalten, sowie des effektiven durchschnittlichen Steuersatzes. Eine weitere Innovation der Studie besteht in der Verwendung eines *Switching Regression* Ansatzes. Damit begegne ich einer Kritik an früheren Studien, die den Einfluss von Kreditmarktbeschränkungen auf Investitionsentscheidungen analysiert haben, dass eine mögliche Selbstselektion von Firmen in die verschiedenen Finanzierungsregimes die geschätzten Koeffizienten verzerrt. Obwohl die Ergebnisse darauf hindeuten, dass Selbstselektion nicht zu verzerrten Koeffizienten führt, bietet dieser Ansatz interessante Einblicke in die Art von Unternehmen, die Finanzierungsbeschränkungen unterliegen. Dies sind Firmen mit guten Wachstumsmöglichkeiten, mit geringem Cashflow, und Firmen, die weder börsennotiert sind noch Dividenden auszahlen. Zudem sind sie von mittlerer Größe.

Insgesamt stellen die Ergebnisse in dieser Doktorarbeit heraus, dass nicht nur die Körperschaftsteuer, sondern auch die Besteuerung der Anteilseigner die

Finanzierungsentscheidung von Unternehmen beeinflusst. Des Weiteren wird deutlich, dass der Einfluss der Besteuerung auf die Finanzierungsstruktur und Investitionsentscheidung von Unternehmen stark von anderen Kapitalmarktbeschränkungen abhängt. Unternehmen sind daher sehr unterschiedlich von Steuern betroffen. Dies sollte bei der Festlegung der zukünftigen Steuerpolitik berücksichtigt werden.

Erklärung gem. §9(4) der Promotionsordnung der Freien Universität Berlin

Hiermit erkläre ich, dass ich meine Dissertation selbstständig verfasst habe.

Martin Simmler