Capital Structure Decisions and the Use of Factoring

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Abstract

This thesis analyzes three research questions that belong to the field of corporate finance. The first and the second parts of this thesis examine predictions of the trade-off theory of capital structure. This theory postulates that firms balance the benefits and costs of debt versus equity and as a result, choose target capital structures. The third research question analyzes the determinants of the decision of a firm to sell its accounts receivable to a factor.

According to the trade-off theory, the tax advantage of debt at the corporate level encourages firms with high marginal tax rates to bear more debt whereas the tax advantage of equity at the investor level leads to a lower debt ratio for firms with high personal tax rates. This thesis provides new evidence that taxes affect the capital structure choice of firms. Following the Graham methodology to simulate marginal tax rates, we find a statistically and economically significant positive relationship between the marginal tax benefit of debt (net and gross of investor taxes) and the debt ratio. A 10% increase in the net (gross) marginal tax benefit of debt causes a 1.5% (1.6%) increase in the debt ratio, ceteris paribus.

Firms that face transaction costs may not adjust to their target capital structures immediately but instead the adjustment takes a period of time. The speed of adjustment to target capital structure has important implications for the relevance of the target capital structure for the firms' choice of financing. Recent studies show that a standard partial adjustment model with the debt ratio as the dependent variable cannot distinguish between mechanical mean reversion and adjustment to target capital structure. We propose a new approach that uses the net increase of debt as the dependent variable and uses only ex-post information to estimate the target capital structure. Simulation

experiments show that this approach is mainly unaffected by mechanical mean reversion and hence able to provide a meaningful test for the target adjustment hypothesis. We estimate a speed of adjustment to target capital structure of 28% per year.

The third part of this thesis analyzes a firm's decision of whether to accounts receivable internally, use full-service factoring or enter into an in-house factoring contract. Our model is primarily based on a theory of the firm that stresses a supplier's need for financing, risk and financial flexibility. We find that high-risk firms with a strong need for short-term financing and restricted access to bank credit are more likely to use factoring. Larger firms typically prefer in-house factoring, whereas smaller firms tend to rely on full-service factoring. The firm's desire to attain independence from banks plays an important role in decisions regarding factoring.

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List of Abbreviations

AR(1)	Auto-regressive process of first order
CFO	Chief financial officer
CRSP	Center for Research in Security Prices
EBIT	Earnings before interest and taxes
EBT	Earnings before taxes
FE	Fixed effects
GDP	Gross domestic product
I	Interest
IT	Information technology
MTR	Marginal tax rate
OLS	Ordinary least squares
Perc.	Percentile
SIC	Standard industry classification
SMTR	Simulated marginal tax rate
SOA	Speed of adjustment to target capital structure
Std. Dev.	Standard Deviation
TDR	Target debt ratio
UK	United Kingdom
US	United States of America

List of Symbols and Variables

Assets (A)	Book Assets
α	Benefit from the deferral of capital gains
BEN_{EBIT}^{Net}	Marginal net tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3)
BEN_{EBIT}^{Gross}	Marginal gross tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3)
BEN^{Net}	Marginal net tax advantage of debt with the simulated marginal tax rate based on EBT (see Section 2.2.3)
BEN^{Gross}	Marginal gross tax advantage of debt with the simulated marginal tax rate based on EBT (see Section 2.2.3)
BEN	Represents both BEN^{Gross} and BEN^{Net}
Collateral	Net property, plant and equipment/*A*
d	Dividend payout ratio
Debt (D)	Short term financial debt + long term financial debt
Debt issues	Dummy variable that is equal to one if the firm has a positive deficit and issues more debt than book equity
Debt repurchases	Dummy variable that is equal to one if the firm has a negative deficit and repurchases more debt than book equity

Def	Financial deficit defined as *Nei* + *Ndi*
Def/Assets	*Def/A*
Δ	First difference operator
Dr	*D/A*
Dr*	Target debt ratio
Equity (E)	Book equity
ϵ	Normally distributed random variable with mean 0 and variance equal to the variance of historical ΔTI
k	*Def/(D+E)*
i	Firm *i*
Med	Industry median debt ratio
I(NEGEQ)	Dummy variable equal to 1 if the firm has negative equity
I(NODIV)	Dummy variable equal to 1 if the firm does not pay dividends
I(NOL)$_{EBIT}$	Dummy variable equal to 1 if the firm has a tax loss carry forward that is based on EBIT
I(Regulated)	Dummy variable equal to 1 if the firm belongs to a regulated industry
I(RND)	Dummy variable equal to 1 if the firm has missing *RND*
I(Sensitive)	Dummy variable equal to 1 if the firm belongs to a sensitive industry
h	Factor that accounts for the restricted deductability of taxable income at the municipality level
λ	Estimate of the speed of adjustment to target capital structure

MTB	(*A*-*E*+market equity/*A*)
MTR_{Graham}	Graham's marginal tax rate based on EBIT
μ	Moving average of historical ΔTI
Ndi	First difference of *Debt*
NDTS	Depreciation/*A*
Nei	First difference of book equity
Re/Assets	Retained Earnings/*A*
RND	Research and development expense/sales
ROA	EBIT/*A*
Size	Natural logarithm of sales, deflated by the implicit price deflator
t	Time t
τ_c	Corporate tax rate
τ_e	Personal tax rate on equity income
τ_{fed}	Federal corporate tax rate
$\tau_{fed,re}$	Top statutory tax rate for retained earnings
τ_{loc}	Local corporate tax rate
τ_i	Personal tax rate on interest income
θ	Imputation credit of taxes paid at the corporate level that is allowed by the tax system
TI	Taxable income
Z-score	(3.3·EBIT + sales+1.4·retained earnings + 1.2·(current assets - current liabilities))/*A*

Chapter 1

Introduction

Even after more than 50 years of research based on the irrelevance theorem of Modigliani and Miller (1958), basic questions of corporate finance remain unclear: How do firms choose the mixture of debt and equity? What are the determinants of alternative financing instruments, e.g. entering into a factoring contract versus usage of a bank credit?

Taking the Modigliani and Miller's irrelevance assumptions as a starting point, the capital structure research developed theories that state that a firm's decision between debt and equity has an influence on the value of the firm. The capital structure literature can be divided into two groups (1) theories that postulate that firms have target debt ratios and (2) theories that don't predict the existence of targets. The static trade-off theory of capital structure argues that firms balance the benefits of debt (e.g., tax benefits) against the costs of debt (e.g., costs of financial distress) and choose target capital structures. The pecking order theory predicts that firms follow a pecking order of financing, i.e. firms first use internal generated funds to finance investments and in case of a financing deficit or surplus, prefer debt over equity (see Myers and Majluf (1984)). The market timing theory states that firms issue and repurchase equity in times of opportunity, i.e. firms issue equity when the market valuation of equity is high and repurchase equity when the market valuation of equity is low (see Baker and Wurgler (2002)). Both, the pecking order theory and the market timing theory do not predict the existence of target debt ratios. Although some progress has been made there is still a need to test the empirical relevance of competing capital structure theories.[1]

The first part of this dissertation tests the static trade-off theory of capital structure. We examine if taxes, both at the corporate and the personal level, affect the debt ratios of German firms. We further analyze which other determinants are important for the financing choices of firms. The results of this analysis serve as a starting point for the subsequent examination of the speed of adjustment to target capital structure, as we use the determinants that are found to relate to the costs and benefits of debt as a proxy for the target debt ratio. The speed of adjustment to target capital structure measures how much of the gap between the initial debt ratio and the predicted target capital structure is offset each year. Simulation experiments show that previously estimated speeds of adjustment are largely biased by mechanical mean reversion. We provide an approach that can differentiate between mean reversion of debt ratios and real adjustment to a target capital structure.

The second part analyzes the firms' policy choice of the accounts receivable management. Firms must decide whether to vertically integrate the management functions that are associated with the trade credit extension or to employ a specialized intermediary like a factor. We differentiate between internal management of all trade credit functions, internal management of the debt collection but externalizing of the other functions to a factor (in-house factoring) and outsourcing of all trade credit functions to a factor (full-service factoring). In our model, we focus on the examination of determinants that relate to a theory of the firm that stresses a supplier's need for financing, risk and financial flexibility.

The basic research questions that are adressed in this dissertation can be summarized as:

1. Do corporate and personal taxes reliably influence capital structures of German firms? What other determinants affect the firms' financing choice?

2. Do firms adjust their capital structures towards targets? If yes, how important is the deviation

[1] For a comprehensive overview of the empirical capital structure research, see e.g., Graham and Leary (2011) and Parsons and Titman (2008).

from the target debt ratio for the firms' financing decisions?

3. What are the determinants of a firm's decision to sell its accounts receivables to a factor?

In the second and the third chapter of this thesis, we analyze a firm's choice between debt and equity financing. To model a firm's financing decisions we pursue the following approach (see e.g., Byoun (2008) and Chang and Dasgupta (2009)). The retained earnings and investments of a firm are assumed to be exogenous. As the primary source of financing the firm uses its internally generated earnings. If the internally generated funds do not suffice to finance the growth of the firm's assets, the firm must decide whether to issue equity or debt. If the retained earnings exceed the firm's financial needs, the remaining amount must be used to either repurchase equity or debt. We test if these decisions are made in accordance with the trade-off theory of capital structure.

Chapter 2 investigates the relationship between taxes and the capital structure of German firms.[2] The interest payments on the firm's debt are a tax-deductible expense at the corporate level whereas such a provision does not exist for equity. This unequal treatment of debt and equity by law provides a tax advantage of debt at the corporate level. However, investors who receive interest payments from debt pay higher personal taxes than investors who own shares of the firm. So at the investor level, the tax law favors payments that arise from a stake in the firm's equity. The overall effect remains unclear and depends on the country specific tax law. We test if firms with a high tax benefit of debt use high debt levels and issue more net debt to benefit from the tax advantage of debt.

We use Graham's expected marginal tax rate approach for the identification of tax effects on the capital structure decision (see Shevlin (1990), Graham (1996*a*) and Graham et al. (1998)). We simulate various paths of future taxable income along which marginal tax rates are calculated that account for the carry forward and backward rules. This procedure accounts for the fact that firms may report losses and in this case, the tax shield cannot be used immediately and will offset future positive taxable income. Furthermore, we circumvent the endogeneity problem due to the reverse causality between debt and taxes. Recent studies using dichotomous tax rates based on net operating

[2]See Graham (2003) for a detailed overview of the taxes and capital structure literature.

losses or effective tax rates arrive at a negative relation between tax rates and debt usage because they do not adequately take this issue into account (see e.g., Byoun (2008) and Antoniou et al. (2008)).

In Chapter 2, we provide the first empirical analysis that shows a significant positive relationship between the marginal tax benefit of debt and the debt ratio for German firms using the Graham methodology to estimate marginal tax rates. In the empirical model, we simultaneously examine the influence of various other determinants on a firm's capital structure which are motivated by the existence of information asymmetries, bankruptcy costs and transaction costs. A 10% increase in the marginal tax benefit of debt at the corporate level (investor level) causes a 1.5% (1.6%) increase in the debt ratio, ceteris paribus. This positive relationship can also be found in various other specifications of the dependent variable like changes in debt levels or net increase of debt. Overall, the findings of this chapter provide empirical support for the trade-off theory of capital structure as firms issue more debt and choose higher debt ratios if they have higher marginal tax rates and higher (lower) values for firm characteristics that relate to the benefits (costs) of debt .

Chapter 3 examines if and how fast firms adjust their capital structure toward their targets. In the presence of significant adjustment costs, firms may not adjust to their target capital structures immediately. For example, if the financial deficit is not high enough to close the gap between the initial debt ratio and the target debt ratio, the adjustment process takes more than one year. The magnitude of the speed of adjustment gives an insight how important the deviation from target is for the firms' financing decisions. However, the previous literature produces different speeds of adjustment that range from 7% in Fama and French (2002) to 34% in Flannery and Rangan (2006) per year. Simulation experiments show that these estimates are biased by mechanical mean reversion (see Chang and Dasgupta (2009)).

We provide an unbiased estimate of the speed of adjustment to target capital structure by using the following estimation technique. First, we rely on the net increase of debt instead of the debt ratio as the dependent variable. Second, we use only historical data to estimate the target debt ratio. Third, we separate the coefficients of the target debt proxy and the lagged debt ratio (debt ratio at time $t-1$) and interpret the coefficient of the predicted target as the speed of adjustment to target capital structure. This procedure produces low spurious speeds of adjustment in simulated samples where firms follow random financing. We find that firms close 28% of the gap between the debt ratio at the beginning of the year and the target debt ratio.[3] Thus, our results show that the deviation from the target debt ratio is important for the financing decision of a firm in accordance with the trade-off theory.

In Chapter 4, we analyze the determinants of a firm's account receivable management policy choices. The majority of the inter-firm trade is not paid directly; instead the seller commonly offers the buyer a certain period of time for the payments of the delivered services or goods. Firms that offer trade credit to customers must decide how to operate and finance the accounts receivable, i.e. which of the trade credit functions are managed within the firm and which of the functions are externalized to an intermediary like a factor. We emphasize that it is important to account for the included services in the factoring contract. Despite of the fact that most of the firms use in-house factoring, the previous literature models the firms accounts receivable management choice as a decision between internal management and the use of full-service factoring (see Smith and Schnucker (1994) and Summers and Wilson (2000)). In our model, the firm decides between internal management of all trade credit functions, use of in-house factoring and entering into a full-service contract. Furthermore, we investigate the influence of variables that relate to theories that stress the supplier's need for financing, risk and financial flexibility on the factoring decision. We find that firms rely either on in-house or full-service factoring to meet short term financing needs and to diversify their financial portfolio. The full insurance of potential bad debts and the potential increase of the equity ratio are also important reasons for the firm's decision to use factoring. Large firms prefer in-house factoring, whereas small, growing firms appreciate the relief of accounting requirements that is provided by

[3] Hovakimian and Li (2011) use a similar technique but rely on the debt ratio as the dependent variable. By additionally deleting high debt ratios in the simulated samples and the real sample, they come to an unbiased estimate of the speed of adjustment of 5-8%.

full-service factoring.

The structure of this dissertation is the following:

Chapter 2 investigates the relationship between taxes, both at the corporate and the personal level, and the debt-equity choice. Furthermore, we analyze the influence of other determinants that are motivated by the trade-off theory on the capital structure of firms. We find that firms with a higher tax benefit of debt issue more net debt and choose higher debt ratios. The coefficients of the control variables are statistically significant and have the correct signs as predicted by the trade-off theory.

Chapter 3 examines the speed of adjustment to target capital structure. We construct random samples in which firms do not follow target behavior to test which specification of the partial adjustment model produces a low spurious speed of adjustment in these samples. We show that partial adjustment models that rely on debt ratios as the dependent variable are largely biased by mechanical mean reversion. In a specification that uses the net increase of debt as the dependent variable, we find that it takes a firm two years on average to offset 50% of the deviation from the target debt ratio.

Chapter 4 analyzes the firm's choice of whether to vertically integrate the management of the accounts receivable or externalize the trade credit functions to a factor. In a multinomial model, we test which firm characteristics increase the probability to use in-house factoring or full-service factoring. We find that firms with a large customer base that are in need of short-term financing are more likely to employ a factor. Furthermore, firms who seek to increase their equity ratio and want to gain independence from a house bank prefer to use in-house factoring or full-service factoring. Firms that use in-house factoring differ from firms that rely on full-service factoring mainly in size.

Chapter 2

Tax Incentives and Capital Structure Choice: Evidence from Germany

2.1 Motivation

It is widely held that the interest deductability of debt at the corporate level encourages firms to use debt financing, whereas personal income taxation provides a tax advantage of equity at the investor level leading firms to use less debt. The overall effect remains unclear and depends on the country-specific tax law. In this chapter, we examine the relationship between taxes, at both the corporate and the personal level, and the capital structure decision of a firm. We use a unique panel data set of firms resident in Germany.

Researchers face two general problems when they want to examine the effect of taxes on a firm's capital structure choice. First, the lack of variation of statutory tax rates over time as well as in the cross-section of firms makes it difficult to identify tax effects. Second, a simultaneity bias might occur because firms that exhibit a high debt ratio have high interest payments which in turn lower the tax base and hence decrease the marginal tax rate. Thus, a regression model that uses a tax rate that is based on income *after* interest deduction leads to a spurious negative estimate of the coefficient of the tax variable (see Graham et al. (1998)). Despite this endogeneity problem, recent studies still use marginal tax rates based on income after interest payments and thus arrive at a negative relation between tax rates and debt usage (see e.g., Byoun (2008) and Antoniou et al. (2008)).

It is widely accepted in the theory of finance that the marginal tax rate is the relevant tax variable for the analysis of tax effects on the financing decision of a firm (see King and Fullerton (1984)). The marginal tax rate is defined as the present value of taxes that are paid on one additional unit of income earned today (see Scholes and Wolfson (1992)). As long as the unit of income is sufficiently small, the marginal tax rate can be viewed as the present value of taxes that is shielded by one additional unit of income paid out as interest.

Our identification strategy relies on Graham's methodology to simulate marginal tax rates (see Shevlin (1990), Graham (1996*a*) and Graham et al. (1998)). The simulated marginal tax rate that is used in this chapter incorporates an important feature of the German tax code, namely the asymmetric treatment of gains and losses. Firms only pay taxes at the statutory rate as long as the taxable income is positive. In Germany, losses are allowed to be carried forward and backward in time. When the tax base of a firm is fully exhausted (e.g., because of high existing depreciation and interest payments) an additional unit of interest paid today does not shield taxes today; instead it shields taxes at the time in the future when the firm first generates positive taxable income again. Despite the fact that a considerable proportion of firms report losses and hence cannot exploit the full amount of potential tax deductions (marginal tax rates are below statutory tax rates in 30% of our sample), researchers often neglect the dynamic features of the tax code (e.g., Booth et al. (2001)). We simulate various paths of future taxable income along which marginal tax rates are calculated that account for the carry forward and backward rules. Averaging these marginal tax rates should mimic the managers' expectations of the marginal tax rate. Plesko (2003) and Graham (1996*b*) show that the marginal tax rate that is based on simulations is the best available approximation of the 'true' marginal tax rate. In particular, it is superior to just using variables that are assumed to be highly correlated with the marginal tax rates, such as statutory tax rates, dummies which indicate whether a firm is reporting losses or trichotomus variables, as used, for example, in Byoun (2008) or Gropp (2002).

We circumvent the endogeneity problem as our measure of the marginal tax rate is based on income *before* the relevant financing decision. In the debt ratio analysis, we use marginal tax rates that are based on earnings *before interest* and taxes. Since the debt ratio represents debt issued in the current and in the past period, we add all interest back to taxable income. In the analysis of changes in debt, where we examine only the amount of debt that is issued (or repurchased) in the current period, we rely on marginal tax rates that are based on the earnings before taxes and after interest payments at the beginning of the period.

Although there is increasing evidence of tax effects on capital structure choices for US firms (see MacKie-Mason (1990), Graham (1996*a*), Graham (1999)), evidence outside the US is rare. Alworth and Arachi (2001) simulate marginal tax rates following the Graham methodology for a panel of Italian firms and find evidence that corporate and personal taxes affect the debt usage of Italian firms. However they focus on the net increase of debt as the explanatory variable and do not show if taxes also influence debt ratios. Since the marginal tax benefit of debt depends heavily on country-specific tax laws, existing results from other countries cannot be directly transferred to Germany. Using the variation of top local tax rates across municipalities, Gropp (2002) shows that local taxes influence the capital structure choice of German firms. However, he neglects the dynamic features of the tax code and the effect of federal and personal taxes. We incorporate the dynamic local and federal German tax code to accurately estimate marginal tax rates and show that the marginal tax benefit of debt has a statistically and economically significant and positive effect on the debt ratio of firms resident in Germany, both at the corporate level and the investor level (i.e., including personal income taxes). A significantly positive effect of taxes on the change in debt ratio and the net increase of debt is also identified. Recent empirical capital structure studies argue that transaction costs deter firms from adjusting to their optimal capital structures immediately (see e.g., Flannery and Rangan (2006)). For instance, firms could be reluctant to exploit the full marginal tax advantage of debt in a scenario in which they face issuing costs of debt that outweigh the additional tax advantage of debt. As a robustness check, we use a partial adjustment model to account for transaction costs and to rule out dynamic endogeneity concerns. We still find a significantly positive effect of taxes on the debt ratio. Several additional robustness checks are performed, such as alternative specifications of the dependent variable.

The rest of the chapter is organized as follows. We present our identification strategy in Section 2.2. Section 2.3 shows some summary statistics and investigates the variation of the simulated marginal tax rates. In Section 2.4, we discuss the main results of the chapter, which are tested for robustness in Section 2.5. Section 2.6 presents the conclusions of this chapter.

2.2 Measuring Tax Effects on Debt Usage

In this section, we explain the identification strategy for measuring tax effects on the debt-equity choice. First, we describe the theoretical background for the empirical analysis, then we explain the simulation procedure for the marginal tax rates, which is crucial for the empirical model that is illustrated in the last part of this section.

2.2.1 The Theoretical Model

In Germany (as in most other countries), interest payments are deductible from taxable income, whereas such a deduction is not allowed for equity. This provides a tax advantage of debt at the corporate level (Modigliani and Miller (1963)). However, if interest income is taxed at a higher personal tax rate than income in the form of dividends or capital gains, investors will demand a higher pre-tax return for debt investments than for equity investments. This leads to a tax advantage of equity at the investor level. Miller (1977) states that, at the margin, the tax disadvantage of debt at the investor level completely offsets the tax advantage at the corporate level; that is, tax-induced optimal capital structures do not exist in equilibrium. Neutrality with respect to different finance instruments played a central role in past major German tax reforms. Thus, Germany is an excellent country to test Miller's hypothesis. We measure the marginal tax advantage of debt, net of personal taxes, as the difference between the after-tax value of a dollar invested in debt and a dollar invested in equity (see Miller (1977)):

$$(1-\tau_i)-(1-\tau_c)(1-\tau_e), \tag{2.1}$$

where τ_i is the personal tax rate on interest income, τ_c is the corporate tax rate and τ_e is the personal tax rate on equity income. The tax rate on equity income covers the tax systems that were inherent in Germany during the observation period. To separate the effect of corporate taxes and personal taxes, the above equation can be transformed to

$$\tau_c-[\tau_i-(1-\tau_c)\tau_e]. \tag{2.2}$$

So the net tax advantage of debt equals the tax advantage of debt at the corporate level τ_c (gross tax advantage of debt) minus the tax disadvantage of debt at the personal level. As long as the term in the square brackets is positive, the net tax advantage of debt is smaller than the tax advantage of debt at the corporate level. The next section deals with the empirical measurement of the corporate tax rate τ_c.

2.2.2 The Simulated Marginal Tax Rate

It is often implicitly assumed that firms are profitable in every state of nature and hence, the corporate tax rate τ_c is equal to the top statutory tax rate. However, this disregards the possibility that firms report losses or that tax loss carry forwards exceed taxable income. In that case the carry back and carry forward provisions of the German tax code must be considered and τ_c can vary between 0 and the top statutory tax rate. For instance, consider a firm with a tax loss carry forward in t and positive taxable income in $t+1$ exceeding tax loss carry forward in the time t. For this firm, an additional unit of income in t lowers the tax loss carry forward provision in t and thus leads to additional tax payments in $t+1$. Discounting the (additional) tax payments in $t+1$ yields a marginal tax rate below the top statutory tax rate. This view is consistent with the marginal tax rate (MTR) defined as the present value of current and future taxes to be paid on an extra unit of time t income. Our measure of the MTR has two essential properties. First, it incorporates important features of the German tax code, such as the treatment of net operating losses and non-debt tax shields. Second, it reflects managers' expectations of the MTR at time t when the debt decision is made. To account for the ability to carry losses forward in time we derive a forecasted stream of taxable income. Following Shevlin (1990) and Graham (1996*a*) we use a random walk with drift model to forecast taxable income:

$$\Delta TI_{i,t} = \mu_{i,t} + \epsilon_{i,t}, \tag{2.3}$$

where ΔTI is the first difference of taxable income, μ is the (at least 3 and at most 7-year) moving average of historical ΔTI, with the moving average restricted to being non-negative, and ϵ is a normally distributed random variable with mean 0 and variance equal to the variance of historical ΔTI.[1] Blouin et al. (2010) argue that the random walk approach is flawed because it does not account for mean reversion in taxable income, thus leading to extreme paths of future taxable income. Instead, they propose a nonparametric approach where future income is forecasted by draws from bins of firms that are grouped by profitability and assets size. However, Graham and Kim (2009) argue that using firm-specific information is important and show that the nonparametric approach produces too centralized distributions of marginal tax rates within the bins. Comparing the distribution of marginal tax rates using the random walk approach with the distribution of perfect-foresight marginal tax rates, Graham and Kim (2009) find that the random walk approach performs very well in predicting marginal tax rates. They further develop an AR(1) process which outperforms the bin and the random walk model. However, as using an AR(1) process would markedly reduce our sample size and the performance differences are small, we rely on the random walk approach to forecast taxable income.

[1]Graham (1996*b*) shows that setting the mean μ to 0 if it would be negative yields a better estimate of the 'true' marginal tax rate. To model potential differences between trade balance sheets and tax balance sheets, taxable income is adjusted for latent taxes. The precise definition of taxable income depends on the choice of the dependent variable and is provided in the next section.

When estimating the MTR for firm i at time t, we first use the random walk with drift model to forecast a path of taxable income for the years $t + 1, ..., t + 20$ (the allowed carry forward period at time t is assumed to be unlimited in this example).[2] Along this path we calculate the present value of the tax bill from $t - 1$ through $t + 20$ (the allowed carry back period is assumed to be one year in this example). Then we add 1000 euro (the smallest unit of income in our database) to time t income and calculate the present value of the tax bill again. The difference between the two tax bills yields a single MTR for the specific path of taxable income. We run this procedure for 50 different paths of taxable income and compute the average of these single MTRs.[3] The output is the (expected) simulated MTR for firm i at time t. Averaging the marginal tax rates over the 50 different scenarios of future taxable income should reflect the managers' expectations about the marginal tax rate. In the following, we call this tax rate the simulated marginal tax rate (SMTR).

2.2.3 The Empirical Model

The SMTR is not only the best available approximation for the 'true' marginal tax rate (see Graham (1996*b*) and Plesko (2003)), it also contains enough variation to identify tax effects. Furthermore, as our identification strategy does not solely rely on tax rate or tax system changes over time, other overlapping time effects should not induce a major bias. However, since the SMTR relies on pre-tax income, an endogeneity bias may occur. Consider a firm with a high initial marginal tax rate. The high tax advantage of debt encourages the firm to use interest payments to shield taxes. Since interest payments are deductible from taxable income, the pre-tax income decreases. Thus the probability increases that the firm does not pay taxes in every state of nature, which leads to a low marginal tax rate. Hence, a firm with a high tax advantage of debt has low (after financing) marginal tax rates but use a high level of debt. This phenomenon leads to a spurious negative relation in regressions of tax variables on the usage of debt.

We use two strategies to avoid this endogeneity problem. First, we examine debt ratios (book

[2]We restrict the carry forward period to 20 years; loss carry forwards at $t + 21, ...$ are negligible due to discounting.
[3]Using more than 50 paths does not significantly alter the estimates of the average marginal tax rates.

financial debt, both short term and long term, divided by total book assets) and use SMTRs based on earnings after non-debt tax shields *before* interest deductions (EBIT). Given that debt ratios reflect cumulative historical financing decisions, all interest (I) has to be added back to pre-tax income (EBT) to eliminate the simultaneity bias. Second, we investigate incremental financing choices, mostly used in past tax research, measured by the change in debt ratio (the first difference of debt divided by total book assets) as one specification and the net increase of debt (the first difference of debt, the difference divided by lagged total book assets) as another specification.[4] To circumvent simultaneity in these specifications we use *lagged* SMTRs based on earnings after non-debt tax shields and *after* interest payments (EBT), so that the tax variable is calculated before the time t financing decision is made but after historical financing choices.

Studying debt ratios has two drawbacks with respect to the incremental debt analysis. First, tests based on current financing decisions should have greater power since debt ratios contain aggregate past financing decisions. Second, no (implicit) assumption of an optimal capital structure is needed (more on that in Section 2.5.2). However, balance sheet data contain no information about actual security issues. The difference of book debt in consecutive years can be 0 or even negative (if the firm is paying down debt) for a high marginal tax rate firm, but this does not mean for sure that tax incentives are irrelevant for this firm. Instead, it could be the case that this firm is simply not in need of external funds (see Graham (1999)). Additionally, statistical and economic significance of taxes for the incremental financing choice cannot be carried over to debt ratios. Since most of the empirical capital structure research tries to explain existing debt ratios rather than incremental financing decisions, we focus on the debt ratio analysis. We address the above caveats as we also use incremental debt as the dependent variable in Section 2.4 and a partial adjustment model to cover dynamic effects in Section 2.5.

[4]See Appendix A for details on the variable construction.

The Gross Tax Advantage of Debt

German firms pay corporate taxes at the federal level and local taxes at the municipality level, which were deductible from taxable income at the federal level until 2007. The local tax rate is calculated as the product of a base rate, which is constant through municipalities and changed once in the observation period, and a multiplicative coefficient, which differs among municipalities. Since we have no information about the locations of the firms in our sample and the key to which taxes are allocated among different locations, we use the average multiplicative coefficient of the Federal Statistical Office (Statistisches Bundesamt).[5] Interest payments are fully deductible at the federal level, but only partially deductible (most of the sample years, 50%) at municipality level. We therefore implement a multiplicative factor h which corrects for this special feature of the German tax code and the fact that local taxes have not been deductible at the federal level since 2008. Thus, the corporate tax rate τ_c can be written as

$$\tau_c = \tau_{fed} + h \cdot \tau_{loc} \cdot (1 - \tau_{fed}), \tag{2.4}$$

where τ_{fed} is the federal corporate tax rate and τ_{loc} is the local corporate tax rate. Before 2001, corporate profits in form of retained earnings were taxed at a higher rate than dividends, which provided partial relief from the double taxation of dividends at the corporate and personal level. We use the corporate tax rate for retained earnings in our simulation method.[6] To account for uncertainty of income and the asymmetries in the local tax code, we multiply the local tax rate τ_{loc} by the SMTR divided by the top tax rate for retained earnings.[7] In a nutshell, the tax advantage of debt at the corporate level BEN^{Gross} (gross of personal taxes) is calculated by

$$BEN^{Gross} = SMTR + h \cdot \tau_{loc} \cdot \frac{SMTR}{\tau_{fed,re}} (1 - SMTR), \tag{2.5}$$

[5] See Gropp (2002) for an approach using cross-sectional variation in the multiplicative coefficient to identify tax effects.

[6] The results remain essentially the same if we use a tax rate weighted by the dividend payout ratio.

[7] In Germany, it is permitted to carry local tax losses forward in time (with the duration and volume being equal to that of federal tax losses), but not backward in time (see section 10a of the German Trade Tax Act (*Gewerbesteuergesetz*)).

where $\tau_{fed,re}$ is the top statutory tax rate for retained earnings.

The Net Tax Advantage of Debt

To derive BEN^{Net}, the tax advantage of debt net of personal taxes, we insert the gross tax advantage of debt into Equation (2.1):

$$BEN^{Net} = (1 - \tau_i) - \left(1 - BEN^{Gross}\right)(1 - \tau_e)\,. \tag{2.6}$$

The tax rate on interest income τ_i equals the personal income tax rate during the period under review. The taxes paid on equity income depend on the tax system and on the fraction of income paid out as dividends. Let d denote the dividend payout ratio, α the benefit from the deferral of capital gains and θ the imputation credit of taxes paid at the corporate level that is allowed by the tax system (see King (1977)).[8] We assume that the 'marginal investor' is in the highest tax bracket and that capital gains are taxable.[9] Since dividends and capital gains are taxed at the same rate τ_d in Germany, we can write

$$(1 - \tau_e) = d\theta\,(1 - \tau_d) + (1 - d)\,(1 - \alpha\tau_d)\,. \tag{2.7}$$

From 1971 to 2008, the period under review, there existed three different tax systems. From 1971 to 1976, a classical tax system similar to that in the US with different corporate tax rates for dividends and retained earnings was in place. This tax system was followed by a full imputation system, again with a split rate of corporate tax. In 2001, the government introduced a shareholder relief system, under which only half of the equity income was taxed at the personal level. These different tax systems are reflected in the parameter θ and in the tax rate τ_d.

In our capital structure analysis throughout this chapter, we run each regression model, first, by using the BEN^{Gross} variable as one specification, which only represents the tax advantage of

[8] In the empirical analysis the dividend payout ratio is lagged one year to avoid a simultaneity bias.

[9] We run the analysis with tax-free capital gains, but the results are qualitatively the same.

debt at the corporate level, and second, by using the BEN^{Net} variable as another specification, which also incorporates investor taxes. Hereafter, we refer to BEN^{Gross} and BEN^{Net} as the BEN variables.

Control Variables

We control for various other factors beside the tax advantage of debt that influence financing decisions. DeAngelo and Masulis (1980) argue that the tax shield that is produced by interest deductions competes with non-debt tax shields like depreciation allowances. However, the BEN variables already incorporate non-debt tax shields, since the taxable income used for the tax rate calculations is based on pre-tax income after depreciation. Within the simulation of the marginal tax rate, non-debt tax shields are modeled according to the random walk with drift model described in Section 2.2.2.[10]

The trade-off theory postulates that managers balance the benefits and costs of debt when they make financing decisions. However, the costs of debt are difficult to measure directly. For example, financial distress costs are difficult to separate from economic distress costs (which occur due to other reasons than high debt ratios and thus are irrelevant for the financing decision) and researchers are still searching for accurate estimates of financial distress costs for single firms (see Graham and Kim (2009), Korteweg (2010) and Van Binsbergen et al. (2010)). Following Graham et al. (1998), we use two variables for the ex post financial distress costs of debt depending on firm characteristics. First, we include the modified Altman's Z-score, which is measured as (see Altman (1968) and MacKie-Mason (1990)):

$$\text{Z-score} = \frac{3.3\text{EBIT} + \text{Sales} + 1.4\text{Retained Earnings} + 1.2\text{Working Capital}}{\text{Total Assets}}. \tag{2.8}$$

[10]See Graham et al. (2004) for other non-debt tax shields such as employee stock options that relate to the capital structure decisions of US firms.

We expect the corresponding coefficient to have a negative sign. The lower the *Z-score*, other things being equal, the more likely the firm is in financial distress, leading to deterioration of equity. Second, we use *I(NEGEQ)*, a dummy variable which is equal to 1 if equity is negative. For the same reason as noted above, *I(NEGEQ)* should be positively related to debt usage. Another variable indicates whether an industry is likely to suffer from ex ante financial distress costs. When firms that produce unique products enter into liquidation, they impose large costs on suppliers and customers (e.g., lack of repair service and spare parts). A high proportion of debt in the capital structure induces a high probability of liquidation, leading to high (expected) financial distress costs, e.g. because customers may be reluctant to buy products of these firms. Consequently, these firms should use less debt than other firms, ceteris paribus. To gauge product uniqueness, we follow Titman (1984) and use a dummy variable *I(Sensitive)* which is equal to one if the firm is in a industry with high assumed financial distress costs. These industries are identified by the SIC codes between 3400 and 4000.

The effects of profitability on usage of debt are ambiguous. On the one hand, from the perspective of the trade-off theory, profitable firms should use a high amount of debt to shield taxes since they are unlikely to go bankrupt. An additional argument for profitable firms using higher debt ratios than unprofitable firms is given by the free cash flow hypothesis stated by Jensen (1986). This theory claims that interest payments discipline managers to not divert funds into their own pockets (e.g., through empire building) and thus, large interest payments mitigate the moral hazard problems between managers and stockholders. On the other hand, according to the pecking order theory (see Myers and Majluf (1984)), firms use first internal equity and when internal funds do not suffice, debt financing is preferred over equity financing. Thus, this theory implies that profitable firms use less debt in their capital structure since they are more likely to be not in need of external funds. We measure profitability by the variable ROA, which is defined as operating cash flow divided by total assets.

Amihud and Murgia (1997) show that dividends are informative about values of listed German companies (although dividends are not tax-disadvantaged by German tax law). Thus, it could be argued that dividend-paying firms do not suffer from a large ‘lemons’ premium when issuing new equity. Vice versa, firms that do not pay dividends may be subject to large informational asymmetries, perhaps causing them to prefer debt over equity financing (see Sharpe and Nguyen (1995)). To capture the amount of information asymmetries with respect to the information content of dividends, a no dividend dummy *I(NODIV)* is included into the regression. We expect the sign of *I(NODIV)* to be positively related to the use of debt. Moreover, regulated firms are likely to be less levered because the regulatory agency may provide investors with relevant information and thus reduce signaling costs (see MacKie-Mason (1990)). We therefore include the industry dummy variable *I(Regulated)* for the energy and water supply industry and the railroad industry.

Large firms are likely to be well diversified and should therefore face low ex ante costs of financial distress. In addition, large firms often have lower informational costs and lower transaction costs when issuing securities. Therefore, larger firms are more likely to have a high debt ratio, other things being equal. We measure *Size* by the natural logarithm of sales, where sales, expressed in million euro, are deflated by the implicit price deflator.[11] Firms with a high proportion of *Collateral* should borrow on favorable terms and are expected to issue more debt. *Collateral* is defined as net property, plant and equipment divided by total assets. Year dummies are also included to control for unobserved time effects such as macroeconomic effects.

2.3 Data and Summary Statistics

Our empirical analysis is based on the balance sheet database *Unternehmensbilanzstatistik* of the Deutsche Bundesbank; it is one of the most comprehensive databases for German non-financial firms. The database was established for the Deutsche Bundesbank’s rediscount business in 1971. The Bundesbank was required to purchase bills that were backed by parties known to be solvent (see Stöss (2001)). German firms used as collateral in this business had to submit their complete

[11] As a robustness check, we replace sales by total assets; the results are qualitatively unchanged.

Table 2.1: The Structure of Panel Data

The sample consists of all non-financial corporations in the *Unternehmensbilanzstatistik* of the Deutsche Bundesbank with at least three consecutive observations. The listed variables are winsorized at the 1st percentile and the 99th percentile. *Total assets* and *Sales* are expressed in million euro and are deflated by the implicit price deflator. *Z-score* is the modified Altman's (1968) Z-score. *I(NEGEQ)* is a dummy variable that is equal to 1 if the firm has negative equity. *I(NOL)*$_{EBIT}$ is a dummy variable that is equal to 1 if the firm has an EBIT based tax loss carry forward (calculated within the simulation of the marginal tax rate based on EBIT).

	Year	Mean	Std. Dev.	25th Perc.	Median	75th Perc.
Employees	1975	567.80	2056.54	15.00	75.00	300.00
	1985	229.47	1399.85	4.00	21.00	75.00
	1995	236.46	1231.90	12.00	32.00	93.00
	2005	322.82	1338.26	17.00	51.00	169.00
Total assets	1975	19.20	68.27	0.57	1.80	6.67
	1985	9.10	47.60	0.25	0.61	2.00
	1995	10.32	48.88	0.33	0.78	2.50
	2005	31.81	89.11	1.06	3.34	14.42
Sales	1975	23.06	75.10	1.09	3.23	10.80
	1985	12.79	56.79	0.55	1.38	4.18
	1995	13.27	55.92	0.70	1.72	4.81
	2005	35.75	94.25	2.04	6.03	20.93
Z-score	1975	2.54	1.73	1.52	2.20	3.07
	1985	2.89	1.82	1.75	2.56	3.59
	1995	2.73	1.75	1.57	2.43	3.51
	2005	2.79	1.79	1.60	2.57	3.66
I(NEGEQ)	1975	0.25	0.43	0.00	0.00	1.00
	1985	0.29	0.45	0.00	0.00	1.00
	1995	0.12	0.33	0.00	0.00	0.00
	2005	0.04	0.19	0.00	0.00	0.00
I(NOL)$_{EBIT}$	1975	0.16	0.37	0.00	0.00	0.00
	1985	0.08	0.27	0.00	0.00	0.00
	1995	0.13	0.34	0.00	0.00	0.00
	2005	0.13	0.34	0.00	0.00	0.00

financial statements to the Bundesbank to check their creditworthiness; these financial statements are collected in the *Unternehmensbilanzstatistik*. Thus, missing data are not a big issue for the database.

The database consists of annual data for over 100,000 corporations (mostly limited liability companies) over the period from 1971 to 2008. The simulation method of the marginal tax rate requires at least three consecutive observations. This requirement leads to 623,780 observations (86,173 firms) for the years 1973 to 2008.

Table 2.2: Summary Statistics

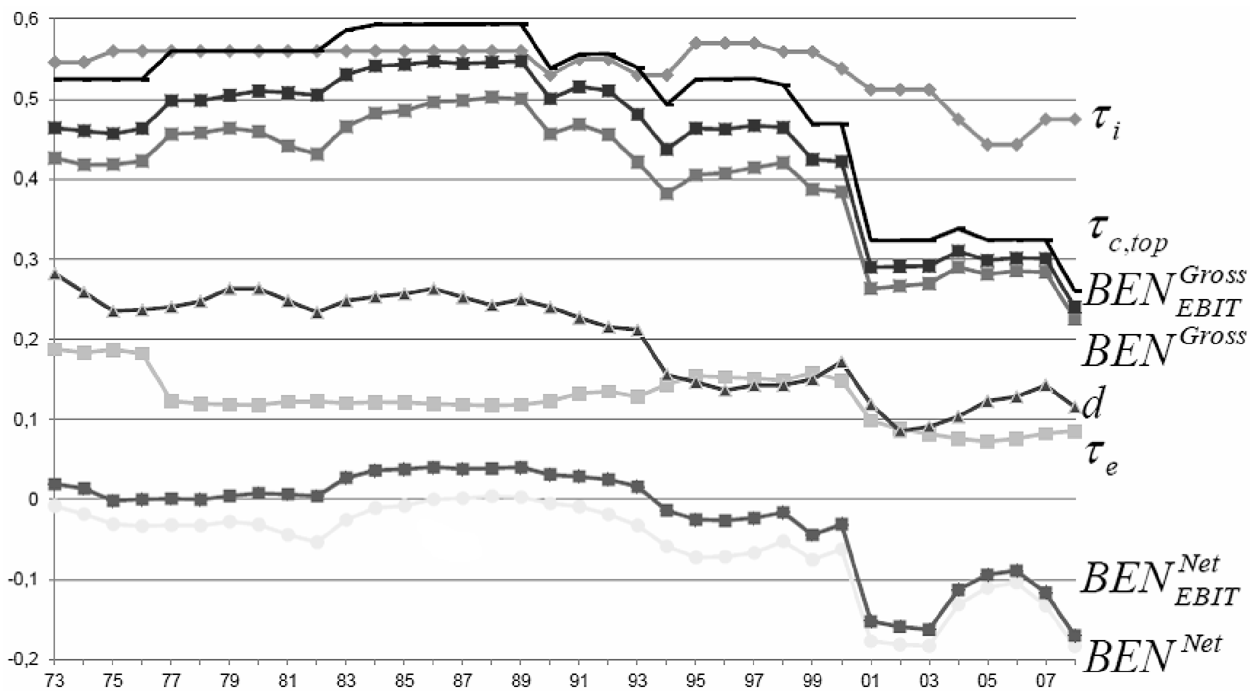
The sample consists of all non-financial corporations in the *Unternehmensbilanzstatistik* of the Deutsche Bundesbank from the years 1973 to 2008 with at least three consecutive observations. Debt is short term financial debt plus long term financial debt. BEN_{EBIT}^{Net} is the marginal net tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). BEN_{EBIT}^{Gross} is the marginal gross tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). BEN^{Net} is the marginal net tax advantage of debt with the simulated marginal tax rate based on EBT. BEN^{Gross} is the marginal gross tax advantage of debt with the simulated marginal tax rate based on EBT. *ROA* is defined as operating income after depreciation divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. *Collateral* is net property, plant and equipment divided by total assets. *Z-score* is Altman's (1968) modified Z-score. *I(NEGEQ)* is a dummy variable that is equal to 1 if the firm has negative equity. *I(NODIV)* is a dummy variable that is equal to 1 if the firm does not pay dividends. *I(Regulated)* is a dummy variable that indicates if the firm belongs to a regulated industry. *I(Sensitive)* is a dummy variable that indicates if the firm belongs to a sensitive industry. The listed variables are winsorized at the 1st percentile and the 99th percentile.

	Observations	Mean	Std. Dev.	Median	Minimum	Maximum
Debt/Assets	623780	0.3059	0.2359	0.2776	0.0000	0.8804
BEN_{EBIT}^{Net}	623780	-0.0100	0.1078	0.0290	-0.4477	0.1064
BEN_{EBIT}^{Gross}	623780	0.4691	0.1351	0.5253	0.0000	0.5937
BEN_{t-1}^{Net}	536139	-0.0404	0.1287	0.0158	-0.4477	0.1064
BEN_{t-1}^{Gross}	536139	0.4316	0.1578	0.4931	0.0000	0.5937
ROA	623780	0.0738	0.1125	0.0585	-0.3277	0.5020
Size	623780	0.9656	1.8135	0.7739	-3.5870	6.1868
Collateral	623780	0.2043	0.2074	0.1349	0.0000	0.8871
Z-score	623780	2.7872	1.7907	2.4791	-0.3969	10.3764
I(NEGEQ)	623780	0.1415	0.3485	0.0000	0.0000	1.0000
I(NODIV)	623780	0.7520	0.4319	1.0000	0.0000	1.0000
I(Regulated)	623780	0.0135	0.1153	0.0000	0.0000	1.0000
I(Sensitive)	623780	0.2313	0.4217	0.0000	0.0000	1.0000

Since 1998, the number of balance sheets per year in the sample has decreased by about two-thirds, reaching a level of approximately 20,000 in 2008. This drop is connected to the fact that the discount credit facility in the context of bill-based lending was not included in the European Central Bank's set of monetary policy instruments (see Bundesbank (2001)). This implies that, since 1999, the requirements with respect to the creditworthiness of the companies to be included in the database were strengthened (Article 18.1 of the Statute of the European System of Central Banks). The reduced sample size leads to a reduction of the statistical power of the data set. Moreover, due to the collection mechanism, a certain quality bias may occur.

Table 2.1 presents statistics of selected variables that describe the structure and quality of the data

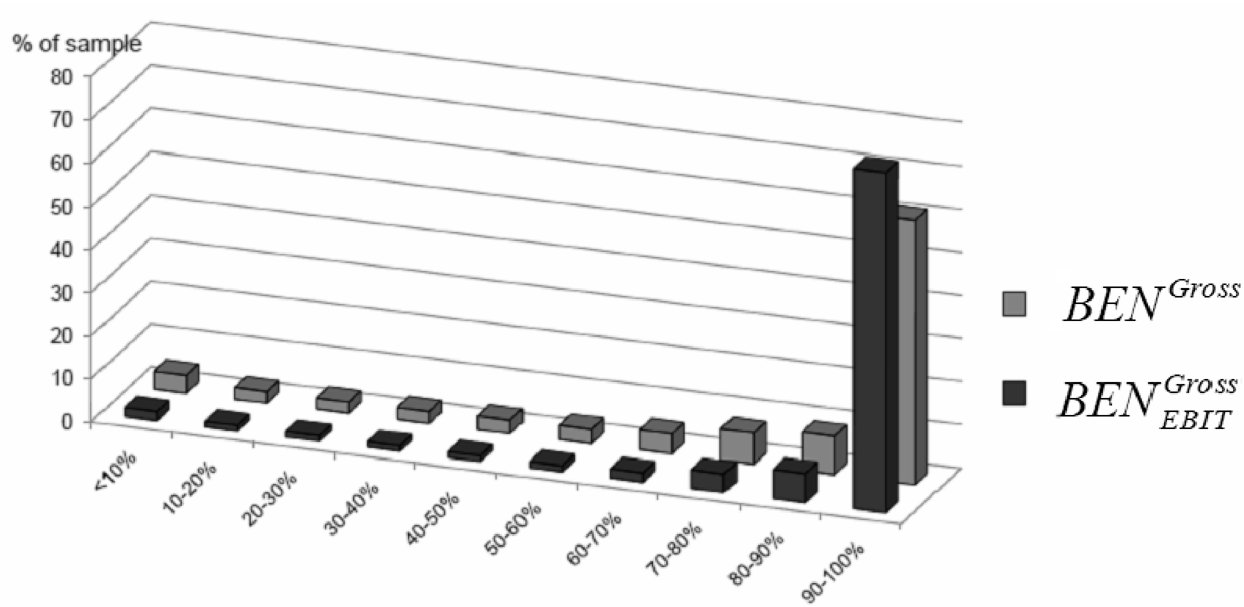
Figure 2.1: Mean Values of Tax Variables Over Time



This figure shows the mean annual values for several tax variables and the dividend payout ratio d over the years 1973$-$2008. τ_i is the personal tax rate on interest income, which is equal to the top personal income tax rate. $\tau_{c,top}$ is a combination of the top statutory federal and local tax rate (see Equation (2.4)). For details of the construction of t_e, the personal tax rate on equity income, and BEN^{Net} (BEN^{Gross}), the tax benefit of debt net (gross) of investor taxes, see Section 2.2.3.

set used in this study. The statistics of *Employees*, *Sales* and *Total assets* show that the data set contains small, medium sized and large companies. Our analysis may be favored with respect to the identification and the magnitude of tax affects if financially distressed firms are underrepresented in the data set. We therefore provide statistics for the variables *Z-score* and *I(NEGEQ)* which indicate if firms suffer from (ex post) financial distress. The distribution of the *Z-score* variable suggests that the main part of the firms in the data set are financially healthy (75% of the *Z-score* values are higher than 1.5). However, the mean values of *I(NEGEQ)* show that firms report negative equity in a substantial part of the observations, which indicates that the data set contains also financially distressed firms. The increase in the statistics of the *Z-score* and the variables that measure the firms' size and the decrease of the mean value of *I(NEGEQ)* from 1995 to 2005 reflect the change in the collection mechanism after the beginning of the monetary union.

Figure 2.2: Cross-Sectional Distribution of the Marginal Tax Benefit of Debt

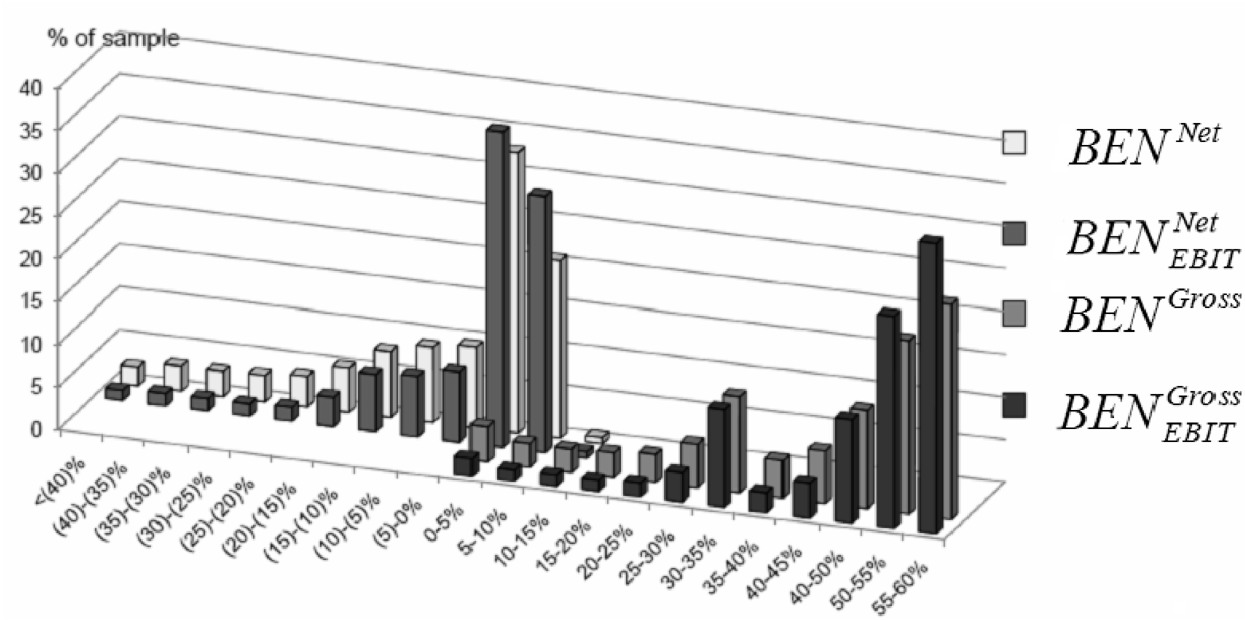


This figure presents the cross-sectional distribution of the variables of the marginal tax benefit of debt, gross of investor taxes. The BEN^{Gross} variables are divided by the top statutory tax rate to fade out time-series changes. The construction of the BEN^{Gross} variables is described in Section 2.2.3.

Central to the identification strategy in this chapter is that the sample contains enough firms with pre-tax losses. Table 2.1 reports statistics of *I(NOL)*$_{EBIT}$, a dummy variable which is equal to one if the firm has accumulated a tax loss carry forward based on EBIT. As our main analysis studies the effect of taxes on debt ratios that cover all debt issues in the past that result in interest payments today, tax losses that are based on *EBIT* are accumulated within the simulation of the marginal tax rate to circumvent endogeneity problems. The amount of firms with tax loss carry forwards that are based on EBIT (13%) remains unchanged from 1995 to 2005. To examine a possible selection bias, we run additional robustness checks (see Section 2.5.1).

Table 2.2 reports some summary statistics for the dependent and explanatory variables. To remove outliers from the sample, variables are winsorized at the 1st percentile and the 99th percentile, respectively. The debt ratio has a sample mean (median) of 30.59% (27.76%) with a standard deviation of 23.59%. All variables exhibit substantial variation. In the following, we analyze the variation in the BEN variables in more detail, which is crucial for the identification of tax effects.

Figure 2.3: Panel Distribution of the Marginal Tax Benefit of Debt



This figure shoes the panel distribution of variables of the marginal tax benefit of debt. The construction of the BEN variables, net and gross of investor taxes, can be found in Section 2.2.3.

Figure 2.1 shows the time variation in the mean values of the tax variables. The mean values of the BEN variables exhibit some time-series variation. Most of the time-series variation stems from tax reforms which changed the top statutory corporate tax rates and personal tax rates. The remaining variation in the BEN^{Gross} variables over time can be mainly explained by the change in the treatment of tax losses with regard to carry forward and carry back provisions. The BEN^{Net} variables additionally vary with the dividend payout ratio. The tax advantage of debt slightly increases 1983 due to the fact that interest payments were the first time deductible from the local tax base. The two larger declines in 2001 and 2008 can be mainly explained by the decrease in top federal corporate tax rates.

The fact that the tax rate for equity payments is markedly smaller than the tax rate for interest payments explains the wide spread between the gross tax advantage of debt and the net tax advantage of debt. Since we use the top statutory tax rate for the marginal personal income tax rate, the net tax advantage of debt can be interpreted as a lower bound.

Figure 2.2 presents the cross-sectional variation in the BEN^{Gross} variables. BEN^{Gross} values are divided by the top statutory tax rate to blank out time-series changes in the top statutory tax rates. The *BEN* variables based on EBIT measure the tax advantage of the first euro of interest payments, whereas the *BEN* variables based on EBT measure the tax advantage of the last euro of interest payments. Since interest payments lower taxable income, the values for the tax benefit of debt based on EBIT exhibit less variation than the tax rates based on EBT and a higher percentage of EBIT based tax benefits are equal to the top statutory tax rate (70% versus 60%).[12]

Figure 2.3 shows that our measure of the tax benefit of debt exhibits substantial variation when both the time-series and cross-sectional dimension are considered. Once personal taxes are taken into account, the sample distribution of the gross tax benefit of debt moves to the left. Thus, the higher personal tax rate on interest income with respect to equity income reduces the tax benefit of debt at the corporate level. Comparing the tax benefit of debt before and after interest, the Figures $1-3$ reflect the endogenous relation between debt and the marginal tax rate.

2.4 Taxes and Static Capital Structure

Table 2.3 presents the main results of our estimations. Throughout this chapter (unreported) year dummies are included to control for any unmodeled time effects. Standard errors are robust to within firm correlation, as we cluster the standard errors by firm, and are robust to heteroscedasticity by using the technique of White (1980).[13] Columns (1) and (2) of Table 2.3 show the estimates for the dependent variables using pooled OLS, with Column (1) including the net tax benefit of debt and Column (2) covering the gross tax benefit of debt.[14] The tax benefit of debt has a statistically and economically significant and positive effect on the debt ratio, both gross and net of personal taxes. A 10% increase in the marginal tax benefit of debt follows a 1.5-1.6% increase in the debt

[12] The cross-sectional variation shown in Figure 2.2 changes only slightly over time.

[13] See Petersen (2009) for a detailed analysis which estimation technique for the standard errors should be used in finance panel data.

[14] Since the debt ratio is winsorized we also run a Tobit regression. The results essentially remain the same.

Table 2.3: Static Debt Ratio Regressions

This table shows the coefficients of panel regressions with the debt ratio as the dependent variable. The sample consists of all non-financial corporations in the *Unternehmensbilanzstatistik* of the Deutsche Bundesbank from the years 1973 to 2008 with at least three consecutive observations. The dependent variable is debt divided by total assets. *Debt* is short term financial debt plus long term financial debt. BEN^{Net}_{EBIT} is the marginal net tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). BEN^{Gross}_{EBIT} is the marginal gross tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). *ROA* is defined as operating income after depreciation divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. *Collateral* is net property, plant and equipment divided by total assets. *Z-score* is Altman's (1968) modified Z-score. *I(NEGEQ)* is a dummy variable that is equal to 1 if the firm has negative equity. *I(NODIV)* is a dummy variable that is equal to 1 if the firm does not pay dividends. *I(Regulated)* is a dummy variable that indicates if the firm belongs to a regulated industry. *I(Sensitive)* is a dummy variable that indicates if the firm belongs to a sensitive industry. The listed variables are winsorized at the 1st percentile and the 99th percentile. All regressions include (unreported) year dummies. The standard errors are corrected for heteroscedasticity and within firm correlation. Coefficients that are significant at the 5%, 1% and 0.1% levels are marked with ^{c}, ^{b} and ^{a}, respectively. Reported R^2 numbers for models including firm fixed effects (Firm FE) are 'within' R^2 statistics.

	(1)	(2)	(3)	(4)
BEN^{Net}_{EBIT}	0.1478^a		-0.0086^c	
BEN^{Gross}_{EBIT}		0.1607^a		-0.0006
ROA	-0.1652^a	-0.1811^a	-0.1408^a	-0.1435^a
Size	-0.0063^a	-0.0064^a	0.0194^a	0.0193^a
Collateral	0.2145^a	0.2141^a	0.2136^a	0.2135^a
Z-score	-0.0105^a	-0.0104^a	-0.0271^a	-0.0270^a
I(NEGEQ)	0.1201^a	0.1232^a	0.0491^a	0.0495^a
I(NODIV)	0.0554^a	0.0563^a	0.0316^a	0.0316^a
I(Regulated)	-0.1645^a	-0.1640^a		
I(Sensitive)	-0.0395^a	-0.0391^a		
Firm FE	No	No	Yes	Yes
Observations	623780	623780	623780	623780
Adjusted R^2	0.1930	0.1944	0.1494	0.1494

ratio, ceteris paribus. The coefficients of the control variables are statistically significant and have the expected signs, except *Size*. The negative relation between *Size* and the debt ratio is, however, a common finding in the literature about the capital structure in Germany (see e.g., the cross-country analysis of Rajan and Zingales (1995)).

The panel structure of our data allows us to control for unobserved time constant heterogeneity by including firm fixed effects. This means that we solely rely on the within firm variation to estimate the coefficients of the regression model. Column (3) and (4) present the regression results of the firm fixed effects specifications. The industry control variables *I(Regulated)* and *I(Sensitive)* are not included since firms often remain in the same industry during their sample life. The other control variables exhibit enough within firm variation. Their coefficients are statistically significant and have the same signs as in Columns (1) and (2), except *Size*. Under the firm fixed effects specification the coefficients of the BEN variables are no longer significant (and even become slightly negative). Our identification strategy for the tax advantage of debt is heavily based on the cross-sectional variation of marginal tax rates (see Section 2.3). Including firm dummies removes the cross-sectional variation and hence it is no longer possible to identify tax effects on the debt ratio (see Griliches and Mairesse (1995) and Lemmon et al. (2008) for a critical discussion of firm fixed effects estimations). Moreover, the simulated marginal tax rates are highly correlated over time. Graham (1999) obtains similar results in his debt ratio analysis, which implies that the simulated marginal tax rate approach does not provide enough within firm variation in the tax rates to identify tax effects on the debt ratio in a firm fixed effects model. Rather, the cross-sectional variation of the SMTRs helps to identify tax effects on the capital structure. We estimate the (unreported) coefficients for each cross-section of the years 1973$-$2008. Almost all of the tax benefit of debt coefficients are positive and significant.

We run additional (unreported) regressions to check for any unmodeled time-series effects. First, we calculate the time-series means for each firm and hence solely rely on between firm variation. The coefficients of the BEN variables in this specification are positive and significant with coefficients being slightly higher than in the pooled OLS model. Second, we interact the BEN variables with year dummies to allow for time changes of the tax effects. Again, most of the coefficients are positive and significant.

To further investigate if the shown relationship between the tax advantage of debt and the debt ratio might be spurious due to omitted time constant variable bias, we use the change in debt ratio (the first difference of *Debt/Assets*) and the net increase of debt (($Debt_t$-$Debt_{t-1}$)/$Assets_{t-1}$) as other specifications. As mentioned in Section 2.2.3, using the lagged SMTR based on EBT solves the endogeneity problem. However, when we use the lagged SMTR in the incremental financing analysis, an increase in the usage of debt could also be caused by an increase in non-debt tax shields. We therefore include the variable Δ*NDTS*, which is defined as the first difference of book depreciation divided by total assets. When examining incremental debt financing we use the first difference of *Size* and *Collateral* to be consistent with the dependent variable and to be comparable with earlier studies (e.g., MacKie-Mason (1990), Graham (1996*a*), Alworth and Arachi (2001)). Columns (1)$-$(4) of Table 2.4 present the results for the change in debt ratio analysis and Columns (5)$-$(8) for the net increase of debt analysis. The BEN variables are positive and significant for both specifications, even if firm fixed effects are included. Firms with a high marginal tax benefit issue significantly more debt and increase (lower) their debt ratio significantly more (less) than firms with low marginal tax rates. A 10$\%$ increase in the BEN variables produces a 0.7-0.9$\%$ (0.13-0.18$\%$) increase in the use of net debt (change in debt ratio), other things being equal. The non-debt tax shield variable Δ*NDTS* and the other control variables, except Δ*Size*, have the expected signs and are significant. Overall, the incremental debt analysis shows that unobserved time constant heterogeneity does not drive the results.

2.5 Robustness Checks

We carry out several additional robustness checks. First, we address the statistical issue of selection bias and reduced sample size. Second, we analyze the effect of taxes on the debt ratio in a dynamic setting. The third part of this section deals with different specifications of the dependent variable.

2.5.1 Issues Related to Data Selection

In this section, we investigate whether the reduced sample size, the collection mechanism or the higher requirements of the creditworthiness after 1999 induce a bias (see Section 2.3). We pursue two strategies to illustrate that our results are not biased by selection or reduced sample size. First, we separate our data into two subsets, with one part covering the years until 1999 and the

Table 2.4: Changes in Debt Regressions

This table shows coefficients of panel regressions of changes in debt. The sample consists of all non-financial corporations in the *Unternehmensbilanzstatistik* of the Deutsche Bundesbank from the years 1973 to 2008 with at least three consecutive observations. *Debt* is defined as short term financial debt plus long term financial debt. BEN^{Net} is the marginal net tax advantage of debt with the simulated marginal tax rate based on EBT (see Section 2.2.3). BEN^{Gross} is the marginal gross tax advantage of debt with the simulated marginal tax rate based on EBT (see Section 2.2.3). Δ*NDTS* is the first difference of depreciation divided by total assets. *ROA* is defined as operating income after depreciation divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. Δ*Size* is the first difference of *Size*. *Collateral* is net property, plant and equipment divided by total assets. Δ*Collateral* is the first difference of *Collateral*. *Z-score* is Altman's (1968) modified Z-score. *I(NEGEQ)* is a dummy variable that is equal to 1 if the firm has negative equity. *I(NODIV)* is a dummy variable that is equal to 1 if the firm does not pay dividends. The listed variables are winsorized at the 1st percentile and the 99th percentile. The listed variables are winsorized at the 1st percentile and the 99th percentile, respectively. All regressions include (unreported) year dummies. The (unreported) variables *I(Regulated)* and *I(Sensitive)* are estimated in the models without firm fixed effects (Firm FE). The standard errors are corrected for heteroscedasticity and within firm correlation. Coefficients that are significant at the 5%, 1% and 0.1% levels are marked with ^{c}, ^{b} and ^{a}, respectively. Reported R^2 numbers for models that include firm fixed effects are 'within' R^2 statistics.

	Δ(*Debt/Assets*)				Δ*Debt/Assets*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BEN^{Net}_{t-1}	0.0775^a		0.0897^a		0.1505^a		0.1750^a	
BEN^{Gross}_{t-1}		0.0681^a		0.0801^a		0.1323^a		0.1570^a
Δ*NDTS*	-0.0597^a	-0.0606^a	-0.0502^a	-0.0514^a	-0.6004^a	-0.6024^a	-0.5292^a	-0.5317^a
ROA	-0.1132^a	-0.1148^a	-0.1475^a	-0.1484^a	-0.1587^a	-0.1618^a	-0.1419^a	-0.1437^a
Δ*Size*	-0.0110^a	-0.0108^a	-0.0049^a	-0.0046^a	0.1047^a	0.1049^a	0.1085^a	0.1091^a
Δ*Collateral*	0.2135^a	0.2132^a	0.2045^a	0.2040^a	0.2326^a	0.2320^a	0.2024^a	0.2014^a
Z-score	-0.0021^a	-0.0021^a	-0.0108^a	-0.0109^a	-0.0093^a	-0.0093^a	-0.0437^a	-0.0438^a
I(NEGEQ)	0.0124^a	0.0131^a	0.0084^a	0.0091^a	0.0178^a	0.0192^a	-0.0001	0.0015
I(NODIV)	0.0029^a	0.0032^a	0.0044^a	0.0051^a	0.0059^a	0.0064^a	0.0027^a	0.0040^a
Firm FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	536139	536139	536139	536139	536139	536139	536139	536139
Adjusted R^2	0.0378	0.0382	0.0451	0.0455	0.0643	0.0649	0.0927	0.0937

other part covering the years after 1999. We rerun the regressions based on these two data sets and compare the results. The (unreported) coefficients of the BEN variables of both subsets are positive and significant, with the coefficients being in the same magnitude. Second, we use the data set *Jahresabschlussdatenpool* of the Deutsche Bundesbank, which was created due to the decrease in observations of the *Unternehmensbilanzstatistik*. The *Jahresabschlussdatenpool* contains over 100,000 observations starting in the year 1997. This data set is not based on the collection method of the *Unternehmensbilanzstatistik* used in this chapter. The (unreported) results using the *Jahresabschlussdatenpool* are essentially the same. This implies that the presented results are not biased by selection or reduced sample size.

2.5.2 Taxes and Dynamic Capital Structure

In this section we perform additional tests to address dynamic endogeneity concerns. If adjustment to target capital structure is costly, firms may not shift to their optimal capital structure immediately. Hence, recent studies in the field of capital structure research focus on partial adjustment models (see Flannery and Rangan (2006), Lemmon et al. (2008) and Rongbing and Ritter (2009)). A standard partial adjustment model can be written as:

$$Dr_{i,t+1} - Dr_{i,t} = \lambda \left(Dr^*_{i,t+1} - Dr_{i,t} \right) + \epsilon_{i,t}. \tag{2.9}$$

We model the target debt ratio Dr^* by $\beta X_{i,t}$, where $X_{i,t}$ is a vector including the tax variables and control variables introduced in Section 2.2. Hence, Equation (2.9) can be estimated by

$$Dr_{i,t} - Dr_{i,t-1} = (\lambda\beta) X_{i,t} - \lambda Dr_{i,t-1} + \epsilon_{i,t}. \tag{2.10}$$

By adding the lagged debt ratio on both sides of Equation (2.10), one can see that this estimation technique is identical to including the lagged dependent variable in the static regression model estimated in Section 2.4 with the coefficient of the lagged dependent variable changing to $1 - \lambda$.

Table 2.5: Dynamic Debt Ratio Regressions

This table shows the regression coefficients of a partial adjustment model that is estimated by using pooled OLS. The sample consists of all non-financial corporations in the *Unternehmensbilanzstatistik* of the Deutsche Bundesbank from the years 1973 to 2008 with at least three consecutive observations. The dependent variable is the first difference of debt divided by total assets. *Debt* is short term financial debt plus long term financial debt. BEN^{Net}_{EBIT} is the marginal net tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). BEN^{Gross}_{EBIT} is the marginal gross tax advantage of debt with the simulated marginal tax rate based on EBIT (see Section 2.2.3). *ROA* is defined as operating income after depreciation divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. *Collateral* is net property, plant and equipment divided by total assets. *Z-score* is Altman's (1968) modified Z-score. *I(NEGEQ)* is a dummy variable that is equal to 1 if the firm has negative equity. *I(NODIV)* is a dummy variable that is equal to 1 if the firm does not pay dividends. The listed variables are winsorized at the 1st percentile and the 99th percentile. All regressions include (unreported) year dummies. The (unreported) variables *I(Regulated)* and *I(Sensitive)* are estimated in the models without firm fixed effects (Firm FE). The standard errors are corrected for heteroscedasticity and within firm correlation. Coefficients that are significant at the 5%, 1% and 0.1% levels are marked with ^{c}, ^{b} and ^{a}, respectively. Reported R^2 numbers for models including firm fixed effects are 'within' R^2 statistics.

	(1)	(2)	(3)	(4)
BEN^{Net}_{EBIT}	0.0224^a		-0.0041	
BEN^{Gross}_{EBIT}		0.0188^a		-0.0056^c
$(Debt/Assets)_{t-1}$	-0.1961^a	-0.1962^a	-0.5120^a	-0.5122^a
ROA	-0.1183^a	-0.1185^a	-0.1480^a	-0.1470^a
Size	-0.0011^a	-0.0011^a	0.0162^a	0.0162^a
Collateral	0.0444^a	0.0444^a	0.1400^a	0.1400^a
Z-score	-0.0036^a	-0.0036^a	-0.0199^a	-0.0199^a
I(NEGEQ)	0.0251^a	0.0252^a	0.0251^a	0.0250^a
I(NODIV)	0.0113^a	0.0114^a	0.0178^a	0.0178^a
Firm FE	No	No	Yes	Yes
Observations	623739	623739	623739	623739
Adjusted R^2	0.7185	0.7184	0.3674	0.3674

Table 2.5 shows that including the lagged dependent variable does not alter our main results. The long run coefficient of BEN^{Net}_{EBIT} is equal to 0.1142 ($= 0.0224/0.1961$) and significant. This number is slightly smaller than 0.1478, the estimated coefficient of Table 2.3 in the static setting. Again, when firm fixed effects are included, tax effects can no longer be identified. However, these results have to be used with caution. Whereas the dynamic OLS estimations do not account for unobserved time constant heterogeneity, the results of the dynamic fixed effects estimations may also be biased (see Arellano and Bond (1991)). In the fixed effects model, the time demeaned lagged dependent variable is correlated with the error term and thus endogenous. The bias declines with

the length of the observed time period, but increases with the persistence of the dependent variable (see Wooldridge (2010)). Although our sample period covers over 30 years, the debt ratio is highly correlated over time. Rongbing and Ritter (2009) conduct several Monte Carlo simulations to show that dynamic panel estimators relying on first differences of the debt ratio are also flawed due to the weak instruments problem. Moreover, Chang and Dasgupta (2009) find that parameter estimates of λ in partial adjustment models suffer from mechanical mean reversion. Overall, further research needs to be done to obtain an adequate estimator in the dynamic setting. In the main part of this chapter, we therefore rely on the well established static estimation techniques. The next chapter provides a solution to the issue regarding mechanical mean reversion of debt ratios.

2.5.3 Alternative Debt Ratio Definitions

Some researchers argue that firms rather optimize their long term financial structure and use short term funds to meet current financial needs (see e.g., Graham (1996*a*)). We therefore restrict the numerator of our dependent variable to include only long term financial debt. The (unreported) results do not qualitatively alter.

Welch (2010) argues that the denominator total assets leads to wrong results. Total assets reflect several other simultaneous decisions that are not related to the financial debt-equity choice. For instance, an increase in accounts payable causes an increase in total assets but is likely to be unrelated to the decision between financial debt and equity. Since right-hand-side variables are also divided by total assets, using a left-hand-side variable which is divided by total assets may lead to wrong results. In the context of our tax advantage of debt analysis, consider a firm with a high BEN variable that has high accounts payable due to non-tax related reasons. In this scenario, estimations of tax effects on a debt variable that is divided by total assets may be biased. To rule out this concern we use financial debt divided by capital (financial debt plus equity) as the dependent variable (results are not reported due to space limitations) and compare the results with the specification that uses financial debt divided by *total* assets. Sign and significance of the BEN variables remain the same, although the coefficients double up. Overall, the results therefore become clearer when using debt to capital ratios.

2.6 Conclusions

We show in this chapter that our measure of the marginal tax benefit of debt has a significant and positive influence on the capital structure of German firms, both net and gross of personal taxes. A 10% increase in the marginal net (gross) tax benefit of debt increases the debt ratio by about 1.5% (1.6%), ceteris paribus.

This result has an important implication for studies that investigate tax effects on debt policy and for researchers that need to control for tax effects in studies in which taxes may have an influence on the dependent variable. Moreover, with respect to recent tax policy debates about the deductability allowance of interest payments in Germany, the findings in this chapter provide evidence that this tax incentive encourages German firms to use more debt in their capital structures, other things being equal. However, the recent introduction of an upper-bound deduction of interest after 2008 reduces the tax advantage of debt in some cases. It would be interesting to use this tax rule to yield a new approach for the identification of tax effects on the financing policy of firms. Furthermore, to what extent German firms exploit the tax benefits of debt in consideration of the costs of debt and how much the tax benefits contribute to the value of the firm is beyond the scope of this thesis. These tasks may be a valuable area for future research.

The results that are presented in this chapter are robust to different definitions of the dependent variables, such as changes in debt, and various other specifications. We also find a significantly positive relation between taxes and debt usage in a partial adjustment model. As static and dynamic debt ratio regressions that include firm dummies show, the simulated marginal tax rate approach does not provide enough within firm variation to prove the effects of taxes on the debt ratios in a firm fixed effect model. The results in this chapter imply that the cross-sectional variation of marginal tax rates is crucial for identifying tax effects on debt ratios in a single-country analysis.

Chapter 3

How to Yield an Unbiased Estimate of the Speed of Adjustment to Target Capital Structure

3.1 Motivation

The trade-off theory is one of the leading branches in the capital structure literature. This theory postulates that firms weigh the advantages and disadvantages of debt versus equity and as a result, choose target capital structures. There are two different approaches to provide empirical support for the trade-off theory. First, debt ratios are regressed on variables that relate to the benefits and costs of debt. The coefficients of these variable are found to be statistically significant and to have the signs that are predicted by the trade-off theory (see e.g., Rajan and Zingales (1995) and Graham et al. (1998)). Second, in the presence of adjustment costs, firms only occasionally move to their target capital structures when the costs of deviation from the targets exceed the adjustment costs. Here, models in which firms partially move to their target capital structure are used to analyze if and how fast firms adjust their capital structures toward targets. In this chapter, we compare different specifications of partial adjustment models to assess their capability to produce unbiased estimates of the speed of adjustment to target capital structure.

Two major issues arise when researchers try to estimate the SOA. First, because the target capital structure is a latent variable studies have to rely on an approximation. Recent studies regress explanatory variables on debt ratios in the first stage and use the fitted values from this regression as the target debt ratios in the second stage (see e.g., Fama and French (2002)). In an alternative approach, the variables that relate to the benefits and costs of debt are inserted for the target debt ratio and the SOA is estimated in a single step (see e.g., Flannery and Rangan (2006)). Depending on the pursued estimation method, the estimated speeds of adjustments range from 7% in Fama and French (2002) to 34% in Flannery and Rangan (2006). At the low end, a SOA of 7% indicates that firms move to their target capital structure very slowly and thereby, adjustment to target capital structure is not of first order importance. At the high end, a SOA of 34% means that firms close 34% of the gap between the debt ratio at the beginning of the year and the target debt ratio each year, which indicates that target adjustment has a strong importance for the firms' choice of debt versus equity.

In previous studies, the SOA is found to be statistically and economically significantly greater than zero (see Fama and French (2002), Kayhan and Titman (2007) and Flannery and Rangan (2006)). However, Shyam-Sunder and Myers (1999) and Chang and Dasgupta (2009) question if these findings can be conclusively interpreted as adjustment behavior toward target capital structures. They compare the empirical findings of previous studies that support the trade-off theory with simulated samples in which firms randomly issue debt and equity and do not follow a target behavior. The magnitudes of the results of the simulated samples are found to be similar to the estimates of the real sample. This finding indicates that previous studies are not able to distinguish between actual adjustment to the target capital structure and a mean reversion of debt ratios that is independent of target debt ratios (called mechanical mean reversion).

Although Chang and Dasgupta (2009), Iliev and Ivo (2010) and Flannery and Hankins (2012) point out that there may be problems with the interpretation of estimates of SOAs, they do not provide a solution to the issue regarding the mechanical mean reversion of debt ratios. However, some progress has been made to yield an approach which can separate target behavior from mechanical mean reversion. Elsas and Florysiak (2010) try to reveal this problem statistically and use an estimator that accounts for the fractional nature of the debt ratio. Using their estimator for fractional dependent variables they estimate an average unbiased SOA of 26%. Hovakimian and Li (2011) suggest three combined techniques to yield an estimate of the SOA that is significantly different from the SOA that is produced in simulated samples in which firm choose random financing. First, they find that target debt ratio regressions that are based on future information about debt ratios produce biased estimates of the SOA due to a look ahead bias. Therefore, they rely only on historical observations to infer target debt ratios. Second, they argue that the coefficient of the lagged dependent variable captures the mechanical mean reversion effects and interpret the coefficient of the target leverage prediction as the true estimate of the SOA. Thirdly, they delete the upper tail of the debt ratio of the real and simulated samples and come to a relatively low unbiased average SOA in the range from $5-8\%$ per year. Both studies rely on debt ratios as the dependent variables.

We pursue an approach that addresses the different kinds of mechanical mean reversion more directly. We identify four types of potential mechanical mean reversion, 1) mechanical mean reversion due to the use of debt ratios as dependent variables, 2) mechanical mean reversion caused through the deficit, 3) mechanical mean reversion due to a look ahead bias in the estimation of target capital structure and 4) mechanical mean reversion because debt ratios are bounded between 0 and 1.

We test various specifications of partial adjustment models regarding to the target approximation and the choice of the dependent variable to assess whether these specifications produce low spurious SOA in the simulated samples. Supported by the empirical findings, we suggest to use the net increase of debt defined as the first difference of debt divided by total assets as the dependent variable ($(D_t - D_{t-1})/A_t$). On the one hand, unlike debt ratios, this variable is not centered at the lower or upper bound (12% of the sampled firms have zero leverage). Therefore using the net increase of debt reduces the statistical bias introduced by using fractional dependent variables like debt ratios. On the other hand, this variable is unaffected from the mechanical mean reversion which is caused by the financial deficit. We follow Hovakimian and Li (2011) and use historical data to estimate the target debt ratios and rely on the coefficient of the target approximation as the estimate for the true SOA. This specification produces low spurious SOAs in the simulated sample (0-5% per year) but high SOAs in the real sample. We incorporate firm fixed effects into the target estimation and find that firms close 28% of the gap between the initial debt ratio and the target debt ratio each year. Deleting observations where the decision between equity and debt would produce debt ratios that lie outside the (0,1) interval does not essentially alter the estimated SOA. Partial adjustment models that use the debt ratio as the dependent variable or rely on future observations to asses target approximations are found to be unable to distinguish between mechanical mean reversion and adjustment toward targets.

The rest of this chapter is organized as follows. In Section 3.2, we present the theoretical model that is used to estimate the SOA to target capital structure and discuss the different types of mechanical mean reversion. Section 3.3 describes the target debt ratio approximation. In Section 3.4, we present the results of the partial adjustment regressions for the simulated samples and the actual data. Section 3.5 presents the conclusions of this chapter.

3.2 Measuring the Speed of Adjustment to Target Debt Ratios

We follow Byoun (2008) and start to model partial adjustment to target capital structure with

$$\Delta D_{i,t} = \lambda \left(D^*_{i,t} - D_{i,t-1} \right) , \tag{3.1}$$

where $\Delta D_{i,t} = D_{i,t} - D_{i,t-1}$, $D_{i,t}$ is the debt of firm i at time t and $D^*_{i,t}$ is the target debt for firm i at time t. $D^*_{i,t} - D_{i,t-1}$ is the amount of net debt firm i has to issue in period t to be at its optimum and $\Delta D_{i,t}$ is the actual amount of net debt issued in period t. To account for adjustment costs that may prevent the firm to shift to target debt immediately, we incorporate the parameter λ which is assumed to be the same for all firms. The target amount of debt $D^*_{i,t}$ depends on the target capital structure $\left[\frac{D}{A}\right]^*_{i,t}$, where $A_{i,t}$ is total assets for firm i at time t. So we divide both sides of Equation (3.1) by $A_{i,t}$ and obtain

$$\frac{\Delta D_{i,t}}{A_{i,t}} = \lambda \left(\left[\frac{D}{A}\right]^*_{i,t} - \frac{D_{i,t-1}}{A_{i,t}} \right). \tag{3.2}$$

The parameter λ measures the average speed of adjustment to target capital structure, which is less than one in the presence of significant adjustment costs.

However, an empirical model that estimates the above equation would be biased due to a mechanical relationship caused by the financial deficit at time t. Both sides of Equation (3.2) have the same denominator $A_{i,t}$ which can be written as

$$A_{i,t} = A_{i,t-1} + \Delta \mathit{Re}_{i,t} + \mathit{Def}_{i,t} = A_{i,t-1} + \Delta \mathit{Re}_{i,t} + \mathit{Nei}_{i,t} + \mathit{Ndi}_{i,t}, \tag{3.3}$$

where $\Delta \mathit{Re}_{i,t}$ is the change in retained earnings, $\mathit{Nei}_{i,t}$ the net equity issued and $\mathit{Ndi}_{i,t}$ the net debt issued for firm i in period t. So a high deficit leads to high total assets which imply a low value of $\frac{D_{i,t-1}}{A_{i,t}}$. If the deficit is financed by debt the connection between the deficit and total assets produces a mechanical negative relation between $\frac{D_{i,t-1}}{A_{i,t}}$ on the right-hand side and $\frac{\Delta D_{i,t}}{A_{i,t}}$ on the left-hand side of Equation 3.2. To eliminate this potential mechanical relation caused by the deficit, we use total assets at time $t-1$ as the denominator on the right hand side of Equation 3.2 and obtain the following empirical model:

$$\frac{\Delta D_{i,t}}{A_{i,t}} = \lambda \left(\left[\frac{D}{A}\right]^*_{i,t} - \frac{D_{i,t-1}}{A_{i,t-1}} \right) + \epsilon_{i,t}.\text{[1]} \tag{3.4}$$

[1]Unreported simulation experiments show that there is indeed a mechanical relation if we use total assets at time t in the denominator.

The target capital structure is indirectly measured by firm characteristics $X_{i,t}$ that model the costs and benefits of debt.[2]:

$$\left[\frac{D}{A}\right]^*_{i,t} = \beta X_{i,t}. \tag{3.5}$$

Researchers empirically estimate partial adjustment models in two different ways. In the two step model, the target capital structure is obtained by a regression of the observed debt ratio on the firm characteristics X. The predicted values from this regression are then used as the target debt ratio in Equation (3.4). In the single step model, the vector $\beta X_{i,t}$ is inserted for the target capital structure in Equation (3.4) and the parameter λ is estimated in a single step. The two step model is more flexible with respect to different estimation techniques of the target capital structure, whereas only the one step model allows to estimate the long run impact β of the firm characteristics X. Since we are interested in accurate estimates of the SOA, we favor the two step model in this chapter and use the one step model as a robustness check, where possible.

The parameter estimate of λ is used to test the trade-off theory. If firms have a target capital structure, deviation from target would be costly and λ would be greater than 0. If firms totally move to their target capital structure each period, then the SOA would be equal to 1. A high magnitude of λ can be interpreted as a high importance of the target capital structure for the firms' financing choices, whereas a low value of λ means that adjustment to target capital structure is of second order importance. Several economic situations are possible in which the observed SOA could be smaller than 1.

First, transaction costs of issuing debt and equity could outweigh the benefits from adjusting to target.

Secondly, Baker and Wurgler (2002) find that firms time the market and issue equity during windows of opportunity, i.e. firms issue equity when market values are high and repurchase equity when

[2]Some studies use lagged firm characteristics due to endogeneity concerns (see e.g., Kayhan and Titman (2007) and Chang and Dasgupta (2009)) We use lagged values for the independent variables as a robustness check but the results remain unchanged. Using contemporary variables allows us to include more observations.

market values are low.

Thirdly, Myers and Majluf (1984) postulate the hypothesis that firms follow a pecking order of financing due to adverse selection costs; i.e. they prefer internal funds over external funds and if they need external financing firms prefer external debt over external equity. Then, in combination with transaction costs, firms are more likely to close the gap between the current and the target capital structure if they have a financing deficit/surplus.[3]

Fourthly, if important variables that relate to the costs and benefits of debt are excluded in the debt ratio regressions (e.g., indicated by a low adjusted R^2) the approximations of the target capital structures may be unprecise, which may in turn be reflected in low adjustment speeds.

Fifthly, Graham and Harvey (2001) find that 34% of the surveyed firms have a somewhat tight target or range. This result indicates that these firms only adjust their capital structure if their debt ratio lies outside their target range. Furthermore, Graham and Harvey (2001) show that 19% of the firms in the sample have a no target debt ratio or range at all. Again, this fact produces speeds of adjustment that are smaller than one.

Recent studies of target capital structure produce largely different results of the speed of adjustment. For example, Flannery and Rangan (2006) find a relatively rapid speed of adjustment of about 34%, while Lemmon et al. (2008) and Rongbing and Ritter (2009) estimate a speed of adjustment between 17% and 25%, and Fama and French (2002) and Kayhan and Titman (2007) come to a relatively low speed of adjustment between 7% and 18% per year.

Although the aforementioned studies apply different estimation techniques and thus come to different speeds of adjustment, they all suffer from mechanical mean reversion. Mechanical mean reversion means that there is a mechanical relation between the deviation from target capital structure and

[3] Byoun (2008) shows that there are differences in the SOAs depending on whether the firm is above/below target and faces a financial surplus/deficit. Moreover, he finds that the speed of adjustment is near one if the firm has a financial surplus and is above target and about 80% if the firm has a financial deficit and is below target.

the observed adjustment that treats existing studies in favor of finding adjustment to target. One reason for mechanical mean reversion stems from the use of the debt ratio as the dependent variable. Shyam-Sunder and Myers (1999) and Chang and Dasgupta (2009) show that in simulated samples in which firms follow pecking order or random financing estimated speeds of adjustment are of a similar magnitude than those estimated in the actual sample. Most of the previous studies that examine the SOA use the following model

$$Dr_{i,t+1} - Dr_{i,t} = \lambda \left(Dr^*_{i,t+1} - Dr_{i,t} \right), \tag{3.6}$$

where $Dr_{i,t}$ is the debt ratio of firm i at time t and $Dr^*_{i,t}$ is the target debt ratio of firm i at time t. However, estimates of λ within this model are flawed due to various types of mechanical mean reversion.

To illustrate this, Chang and Dasgupta (2009) develop a model in which firms that face a financial deficit (surplus) decide with probability p to issue (repurchase) debt and with probability $1-p$ to issue (repurchase) equity. Let E_t denote the book value of equity at time t. With no newly retained earnings, the first difference of the debt ratio emerges to

$$Dr_{t+1} - Dr_t = \begin{cases} \frac{D_t + Def_t}{D_t + E_t + Def_t} - \frac{D_t}{D_t + E_t} & \text{with probability } p \\ \frac{D_t}{D_t + E_t + Def_t} - \frac{D_t}{D_t + E_t} & \text{with probability } 1-p, \end{cases} \tag{3.7}$$

which simplifies to

$$Dr_{t+1} - Dr_t = \begin{cases} k_t \cdot \frac{1 - Dr_t}{1 + k_t} & \text{with probability } p \\ -k_t \cdot \frac{Dr_t}{1 + k_t} & \text{with probability } 1-p, \end{cases} \tag{3.8}$$

where k_t is equal to $Def_t/(D_t + E_t)$. As can be seen from Equation (3.8) there exists a mechanical relation between the change in debt ratio and the lagged debt ratio.

First, the effect of a decision between debt and equity on the change in the debt ratio from time t to $t+1$ depends on the magnitude of the debt ratio at time t. Consider a firm with a debt ratio near 1 which faces a financial deficit. If this firm finances the deficit with debt the debt ratio will increase little, however, when the deficit is financed by equity the debt ratio will markedly decrease. The opposite is true for a firm with a debt ratio near 0. So low debt ratios tend to increase over time and high debt ratios tend to decrease over time, leading to a mechanical mean reversion of the debt ratio, regardless of any target capital structure.

Second, even if firms follow a pecking order of financing, i.e. they finance deficits solely with debt, the first term on the right-hand side of Equation (3.8) implies a mechanical negative relation between the change in debt ratios and the debt ratio. Thus estimating a model with debt ratios as the dependent variables would result in an estimated SOA between 0 and 1. Furthermore, Shyam-Sunder and Myers (1999) argue that the time series patterns of capital expenditures and retained earnings create mean-reverting debt ratios. By construction, the model that is based on the net increase of debt as the dependent variable does not suffer from the above described mechanical relation.

Another possible type of mechanical mean reversion may stem from the bounded nature of the debt ratio. On the one hand, a debt ratio that is near one cannot go down since a firms that reaches the upper bound cannot issue debt when it faces a deficit and its debt ratio has to decrease. On the other hand, a firm with a debt ratio that is near the lower bound 0 cannot repurchase debt in the case of a financial surplus, so its debt ratio will increase in this scenario. Again, the influence of this type of mechanical mean reversion on a partial adjustment model that relies on the net increase of debt should be smaller than on a specification that uses the debt ratio as the dependent variable.

3.3 Target Debt Ratio

3.3.1 Data and Summary Statistics

For the empirical analysis, we cover data from the annual Compustat data base over the years 1971 to 2009. Market values of equity are gathered from CRSP. Like in previous studies, we restrict the sample to non-financial and non-regulated listed US firms with at least 5 consecutive years in the sample.[4] Our measure of leverage is the book debt ratio, which is defined as short-term debt (DLC) plus long term debt (DLTT), divided by total book assets (AT). We require total assets, sales, book and market equity to be positive and book debt not to exceed total assets. As we rely on lagged variables the first firm year can not be used for the empirical analysis. After deleting missing values for the dependent and independent variables the sample consists of 115,550 observations. The dependent variables and the explanatory variables except the variable of the marginal tax rate are winsorized at the 1st and 99th percentile to mitigate the effect of outliers.

We use several variables to determine the target capital structure that have been shown in the previous literature to reliably influence debt ratios (see Rajan and Zingales (1995), Graham et al. (1998) and Frank and Goyal (2009)):

MTR_{Graham}	=	Graham's marginal tax rate based on EBIT if available, otherwise we use the marginal tax rate before interest of Blouin et al. (2010) who assume a different random process for the simulation of future taxable income. If values are still missing we use the statutory tax rate if the firm reports positive EBIT (EBIT) and 0 otherwise. The tax deductability of interest payments leads to a tax advantage of debt at the corporate level. So firms with higher marginal tax rates are expected to have higher target debt ratios.

[4]Financial and regulated firms are identified by the SIC codes 6000-6999 and 4800-4999, respectively.

ROA = operating earnings after depreciation (EBIT) divided by total assets (AT). The target capital structure and the pecking order related theory differ in the prediction of the use of debt for profitable firms. According to the static trade-off theory, firms with high earnings use a high leverage since they are less likely to go bankrupt and more likely to benefit from the tax advantage of debt. On the other side, the pecking order theory explains that the lesser need of external financing for profitable firms leads to mechanical low leverage.

Size = natural logarithm of sales (SALE), deflated by the implicit price deflator. Larger firms are less likely to get into financial trouble since they are probably well diversified. Moreover, larger firms have a better access to capital markets and are less exposed to fixed issuing costs. Hence, larger firms are predicted to have higher target debt ratios.

Collateral = net property, plant and equipment (PPENT) divided by total assets. Firms with more *Collateral* can borrow on favorable terms and are more likely to have a high debt ratio.

Z-score = modified Altman's Z-score (see Altman (1968) and MacKie-Mason (1990)): (3.3· EBIT (EBIT) + sales (SALE) +1.4· retained earnings (RE)+ 1.2· (current assets - current liabilities) (WCAP)/book assets. Firms with a low *Z-score* suffer from (ex post) financial distress and hence have higher debt ratios due to the deterioration of equity.

I(NODIV) = dummy variable equal to 1 if the firm does not pay dividends (DV). Dividends convey information to investors and hence mitigate the adverse selection costs that arise from the information asymmetry between managers and investors. Firms that do not pay dividends are thus expected to have higher debt ratios.

MTB	=	(total assets-book equity+market equity/total assets). Book equity is stockholders' equity (SEQ) minus preferred stock plus deferred taxes and investment tax credit (TXITC) (if available). Preferred stock is the liquidation value of preferred stock (PSTKL), if missing we use the redemption value (PSTKRV) or the par value (PSTK). The market value of equity is the price (PRCC) times the shares outstanding (CSHO). Firms with a high *MTB* are likely to have high growth opportunities, so they may maintain financial slack to invest in the future. Additionally, their equity may be undervalued which increases the probability for equity issues. So firms with high *MTB* are likely to have high target debt ratios.
RND	=	research and development expense (XRD) divided by sales. *RND* controls for investment opportunities and non-debt tax shields. High *RND* is expected to lead to high debt ratios. We set missing values for this variable equal to zero.
I(RND)	=	dummy variable equal to 1 if the firm has missing *RND*. We include this variable to control for the effect of missing values of the *RND* variable
Med	=	industry median debt ratio according to the 2-digit SIC code. The median industry leverage accounts for several factors that relate to target capital structure, including competition and product uniqueness.

Table 3.1 presents various summary statistics for the dependent variables, the explanatory variables and the variables that are used to simulate random samples. After winsorizing, the debt ratio lies in the interval from zero to 69% with a median of 20%. Firms that have no debt in their capital structures represent 12% of the sampled firms. Moreover, these low leverages are seldom temporary and often persistent over a long period of time. This fact is one of the puzzles in the capital structure literature since zero leverages can hardly be explained by the trade-off theory (see Graham (2000) and Korteweg (2010)).[5] Almost two third of the sampled firms face a financial deficit which is

[5]See e.g., Agrawal and Nagarajan (1990), Strebulaev and Yang (2012) and Devos et al. (2012) for explanations why firms choose zero leverage policies.

Table 3.1: Summary Statistics

This table shows summary statistics of the dependent and independent variables. *Debt* is defined as short-term debt plus long term debt. MTR_{Graham} is Graham's simulated marginal tax rate. *ROA* is defined as earnings before interest and taxes divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. *Collateral* is net property, plant and equipment divided by total assets. *Z-score* is the modified Altman's (1968) Z-score. *I(NODIV)* is a dummy variable that is equal to one if the firm does not pay dividends. *MTB* is (total assets minus book equity plus market equity)/total assets. *RND* is the research and development expense divided by sales. *I(RND)* is a dummy variable that is equal to one if the firm has missing *RND*. *Med* is the median industry debt ratio according to the 2-digit SIC code. *Re/Assets* is retained earnings divided by total assets. *Def/Assets* is the first difference of debt plus the first difference of equity divided by total assets. *Debt issues* is a dummy variable that is equal to one if the firm has a positive deficit and issues more debt than book equity. *Debt repurchases* is a dummy variable that is equal to one if the firm has a negative deficit and repurchases more debt than book equity. The listed variables are winsorized at the 1st and 99th percentiles.

	Observations	Mean	Std. Dev.	Median	Minimum	Maximum
Δ*Debt/Assets*	115,550	0.0157	0.1026	0.0000	-0.3249	0.3808
Debt/Assets	115,550	0.2167	0.1770	0.1993	0.0000	0.6924
MTR_{Graham}	115,550	0.3268	0.1398	0.3500	0.0000	0.5100
ROA	115,550	0.0509	0.1660	0.0816	-0.7409	0.3438
Size	115,550	4.6118	2.1192	4.6313	-1.1644	9.5107
Collateral	115,550	0.3001	0.2143	0.2518	0.0127	0.8829
Z-score	115,550	1.8345	2.1468	2.1907	-8.8097	5.9030
I(NODIV)	115,550	0.5450	0.4980	1.0000	0.0000	1.0000
MTB	115,550	1.6888	1.3327	1.2414	0.5342	8.6615
RND	115,550	0.0960	0.4240	0.0000	0.0000	3.6252
I(RND)	115,550	0.4056	0.4910	0.0000	0.0000	1.0000
Med	115,550	0.1945	0.0760	0.1861	0.0632	0.3791
Re/Assets	115,550	-0.0154	0.1721	0.0279	-0.9246	0.2258
Def/Assets	115,550	0.0596	0.1686	0.0191	-0.3380	0.7943
Debt issues	73,410	0.5210	0.4996	1.0000	0.0000	1.0000
Debt repurchases	42,140	0.7320	0.4429	1.0000	0.0000	1.0000

financed by debt issues every second time. This statistic indicates that in the common case of a financial deficit, firms seem not to follow a pecking order of financing. Firms that have a financial surplus repurchase debt in 73% of the cases. This fact provides moderate support for the pecking order hypothesis in the scenario in which firms have a financial surplus.

3.3.2 Target Debt Ratio Regressions

Table 3.2 shows the result of the target debt ratio regressions in which debt ratios are regressed on variables that relate to the costs and benefits of debt. We include time dummies for each year from

Table 3.2: Target Debt Ratio Regressions

This table presents the results for the regression of several independent variables on the debt ratio. The dependent variable is defined as short-term debt plus long term debt divided by total assets. MTR_{Graham} is Graham's simulated marginal tax rate. *ROA* is defined as earnings before interest and taxes divided by total assets. *Size* is the natural logarithm of sales, deflated by the implicit price deflator. *Collateral* is net property, plant and equipment divided by total assets. *Z-score* is the modified Altman's (1968) Z-score. *I(NODIV)* is a dummy variable that is equal to one if the firm does not pay dividends. *RND* is the research and development expense divided by sales. *MTB* is (total assets minus book equity plus market equity)/total assets. *I(RND)* is a dummy variable that is equal to one if the firm has missing *RND*. *Med* is the median of the industry debt ratio according to the 2-digit SIC code. For both specifications (unreported) time dummies are estimated. Firm FE indicates whether the model accounts for unobserved firm constant heterogeneity. The listed variables are winsorized at the 1st and 99th percentiles. Coefficients that are significant at the 10%, 5% and 1% levels are marked with * , ** and ***, respectively. The tests for significance are based on robust standard errors that are adjusted for heteroscedasticity and within firm correlation.

	(1)	(2)
MTR_{Graham}	0.0713***	-0.0291***
ROA	0.0415***	0.0552***
Size	0.0174***	0.0390***
Collateral	0.1244***	0.1679***
Z-score	-0.0248***	-0.0365***
I(NODIV)	0.0476***	0.0264***
MTB	-0.0247***	-0.0108***
RND	-0.0244***	0.0041
I(RND)	0.0248***	0.0053
Med	0.3910***	-
Year FE	Yes	Yes
Firm FE	No	Yes
R^2	0.2410	0.6604
Observations	115,550	115,550

1972 to 2009 to control for any unmodeled time-varying influences on the firms' capital structures. The tests for significance are based on robust standard errors that are adjusted for heteroscedasticity and within firm correlation.

In Column (1), all of the independent variables have the expected signs and are statistically significant. In accordance with the trade-off theory, the coefficients show positive signs for the variables that relate to the benefits of debt and negative signs for the variables that relate to the costs of debt. The debt ratio is significantly higher for firms with high marginal tax rates because these firms can probably benefit from larger interest deductions of the taxable income. Large firms with high *Collateral* tend to have higher debt ratios, consistent with the theory that these firms are less risky and can therefore afford to bear more debt. Profitable firms with low *Z-scores* have significantly higher debt ratios because these firms are more likely to not suffer from large costs of financial distress. This finding contradicts to the pecking order theory since this theory postulates that profitable firms work down to low debt ratio. Firms with high market to book ratios are more likely to preserve debt capacity for future growth opportunities and thereby prefer to use lower debt ratios. Debt ratios decrease with high research and development expenses, probably because these firms want to protect their intangible values that are created by these expenses. The median industry debt ratio has a positive and statistically significant influence on the debt ratio. Overall, the results of the target debt ratio regression provide strong support for the trade-off theory.

In Column (2), we include firm fixed effects into the regression equation for the target capital structure to account for unobserved time constant heterogeneity. In accordance with Lemmon et al. (2008), we find that including firm dummies markedly increases the amount of explained variation in the debt ratio; the adjusted R^2 more than doubles from 24% to 66%. In this specification, the sign of the tax rate variable becomes negative (see Chapter 1) and the variables that relate to research and development expenses are not statistically significant anymore. Overall, the model that accounts for unobserved firm characteristics fits the data well and seems to be a more precise approach for the prediction of target debt ratios than the specification with no firm fixed effects.

3.4 Partial Adjustment Regressions

In this section, we analyze the speeds of adjustments to target capital structure based on simulated samples and the actual data for two partial adjustment models (1) with the net increase of debt as the dependent variable and (2) with the first difference of the debt ratio as the dependent variable.[6]

We perform five different estimation techniques that are used by previous studies that examine

[6]Adding the lagged debt ratio at both sides of the regression equation of model (2) yields an equivalent model with the debt ratio as the dependent variable. We use the first difference of the debt ratio specification in the empirical section as it reports λ instead of $1 - \lambda$ for the coefficient of the lagged debt ratio and therefore allows for a better comparison to the net increase of debt specification.

adjustment to target capital structures. The first and the second technique rely on the full sample to estimate the target debt ratio with the first model using ordinary least squares and the second model including firm fixed effects (see e.g., Flannery and Rangan (2006)). In the third regression, we perform cross-sectional regressions to yield an estimate of the SOA that are used e.g., in Fama and French (2002). In the fourth and the fifth specification, we rely only on past information to predict the target debt ratio whereas the fifth model accounts for unmodeled firm constant heterogeneity (see e.g., Hovakimian and Li (2012)). In those specifications in which we do not use the historical sample to predict the target debt ratio we also present the results of the partial adjustment model that is estimated in a single step. Each model is estimated in a two step procedure where we use the predicted values from the debt ratio regressions as a proxy for the target debt ratio. We also show the coefficients of the variables of the target debt ratio and the lagged debt ratio separately. Hovakimian and Li (2012) find that the coefficient of the debt ratio at time $t-1$ captures most of the effects of the mechanical mean reversion.

3.4.1 Speeds of Adjustment Based on Simulated Samples

We follow Chang and Dasgupta (2009) and simulate three different samples based on random financing choices to test which specification of the partial adjustment model can reject the influence of mechanical mean reversion. The simulation procedure starts with the firm's initial debt, equity and assets at the year 1971 or when the firm first enters the Compustat sample. In the next year, we add the retained earnings and the deficit to the firm's assets at the beginning of the year. If the financing deficit is positive (negative), the outcome of a random variable determines if this deficit is financed through debt issuance (repurchase) or equity issuance (repurchase). We choose random financing to obtain samples in which a firm's financing choice does not follow target behavior. In the case of a debt issuance (repurchase) the firm's debt increases (decreases) by the financing deficit and the firm's equity is the equity at the beginning of the year plus the retained earnings. We follow this procedure as long as the firm's equity and debt do not exceed the assets of the firm and do not fall below zero. If the debt (equity) generated by this process exceeds the assets of a firm, the deficit is financed through an equity (debt) issuance to produce debt ratios between 0 and 1. If the debt (equity) falls below zero the negative deficit is used to repurchase equity (debt). We iterate these steps to yield the complete debt, equity and assets evolutions over the sample years 1971 to 2009.

Coin Flip Financing and Random Deficit

In the simulated sample with coin flip financing and a random deficit, we assume that the financing deficit divided by total assets (*Def/Assets*) and the retained earnings divided by total assets (*Re/Assets*) are normally distributed with the mean and the variance of the variable of *Def/Assets* and the variable of *Re/Assets* in the actual sample, respectively. We further assume, that the firm issues (repurchases) debt with a probability of 50% in the case of a positive (negative) financing deficit. We choose a random deficit and random retained earnings to assure that the process of the debt ratio in this simulated sample does not follow target behavior through time-series patterns of the actual deficit or the actual retained earnings.[7]

Table 3.3 shows the results of the partial adjustment regressions that are based on the sample that reflects random financing and random deficit. The explanatory variables that are used for the target debt ratio estimation are the same as in the actual data. Column (1) of this table presents the coefficients that are estimated by regression models that use the net increase of debt as the dependent variable. The estimated speeds of adjustment do not differ much between the one step model and the two step model and lie between 7 and 16% per year for the specifications that measures the SOA as the coefficients of the difference between the target debt ratio and the initial debt ratio. Within these specifications, the historical fixed effects specification shows the lowest adjustment speed and the fixed effect specification that uses the full sample produces the highest SOA. When we estimate the coefficient of the target debt ratio and the lagged debt ratio separately, the coefficient of the target debt ratio becomes significantly negative in each model except the fixed effects model that relies on the full sample. Column (2) of Table 3.3 shows the coefficients that are estimated by partial adjustment regressions that use the first difference of the debt ratio as the dependent variable. All of

[7]See Equation 3.2 for the evolution of total assets in the simulated sample

Table 3.3: Adjustment Speeds to the Target Capital Structure: Coin Flip Samples

This table presents the results of the partial adjustment models that are used to estimate the speed of adjustment to the target capital structure based on simulated samples with coin flip financing. Dr_{t-1} is the lagged debt ratio that is defined as short-term debt plus long term debt divided by total assets. Dr^* is the predicted value of the debt ratio regression with independent variables as in Table 3.2. Firm FE indicates whether the model accounts for unobserved firm constant heterogeneity. In the cross-sectional specification, the coefficients are estimated by cross-sectional regressions as in Fama and French (2002). Historical indicates whether the full or historical sample is used to predict target debt ratios. The coefficients of the specifications that are based on simulated samples represent the averages that are obtained from 50 simulations. Coefficients that are significant at the 10%, 5% and 1% levels are marked with * , ** and ***, respectively. The tests for significance are based on robust standard errors that are adjusted for heteroscedasticity and within-firm correlation.

			(1)	(2)	(3)	(4)
Dep. Var.			Δ*Debt/Assets*	Δ(*Debt/Assets*)	Δ*Debt/Assets*	Δ(*Debt/Assets*)
Sample			S(p = 0.5, random deficit)		S(p = 0.5, actual deficit)	
OLS	One Step	Dr_{t-1}	0.0879***	0.1711***	0.0549***	0.2055***
	Two Step	Dr^*-Dr_{t-1}	0.0881***	0.1714***	0.0501***	0.2105***
	Two Step	Dr^*	-0.0195***	0.0605***	-0.0467***	0.2680***
		Dr_{t-1}	-0.0881***	-0.1713***	-0.0515***	-0.2096***
Firm FE	One Step	Dr_{t-1}	0.1581***	0.3481***	0.1224***	0.4330***
	Two Step	Dr^*-Dr_{t-1}	0.1674***	0.3590***	0.1161***	0.4553***
	Two Step	Dr^*	0.1459***	0.3602***	0.1056***	0.4843***
		Dr_{t-1}	-0.1671***	-0.3590***	-0.1164***	-0.4546***
Cross-	One Step	Dr_{t-1}	0.0880***	0.1672***	0.0552***	0.1940***
Sectional	Two Step	Dr^*-Dr_{t-1}	0.0880***	0.1669***	0.0517***	0.1985***
OLS	Two Step	Dr^*	-0.0172***	0.0534***	-0.0230***	0.2403***
		Dr_{t-1}	-0.0881***	-0.1671***	-0.0527***	-0.1978***
Historical	Two Step	Dr^*-Dr_{t-1}	0.0865***	0.1640***	0.0495***	0.1979***
OLS	Two Step	Dr^*	-0.0128***	0.0447***	-0.0219***	0.2135***
		Dr_{t-1}	-0.0885***	-0.1664***	-0.0528***	-0.1970***
Historical	Two Step	Dr^*-Dr_{t-1}	0.0709***	0.2173***	0.0754***	0.2661***
Firm FE	Two Step	Dr^*	-0.0252***	0.0961***	0.0248***	0.1566***
		Dr_{t-1}	-0.0742***	-0.2225***	-0.0791***	-0.2742***
Observations			115,550	115,550	115,550	115,550

the specification shows positive and statistically significant SOA between 5% and 36% per year.

Overall, some specifications of the partial adjustment model with the net issuance of debt as the dependent variable show no effects of mechanical mean reversion in the coin flip sample with random deficits and retained earnings. All specifications of the partial adjustment model that uses the debt ratio for the dependent variable produce positive and economically significant values for the SOA and thus suffer from mechanical mean reversion.

Coin Flip Financing and Actual Deficit

In the simulated sample with coin flip financing and the actual deficit, we assume that firms randomly choose between equity financing and debt financing by the outcome of a coin toss. The deficit and the change in the retained earnings are the same as in the actual data. This procedure produces a sample in which only the debt and equity process differs from the actual sample but the size of the total assets remains the same.

Column (3) shows the estimated speeds of adjustment for the simulated sample in which the actual deficit is used and the firms' financing behavior is modeled as a coin flip decision. The results of the partial adjustment models that use the net issuance of debt as the dependent variable are similar to the regression results based on the coin flip sample with a random deficit. Only the SOA that is estimated by the historical fixed effects specification is now positive and statistically significant. However, the estimated coefficient of 2.5% for the target debt ratio is not economically significant.

The partial adjustment models with the first difference of the debt ratio as the dependent variable produce large speeds of adjustment for this simulated sample that range from 16% in the historical fixed effects specification and 49% in the fixed effects specification that uses the full sample for the target estimation. Again, the results for this simulated sample show that partial adjustment models that rely on debt ratios as the dependent variable are largely biased by the mechanical mean reversion of debt ratios.

Table 3.4: Adjustment Speeds to the Target Capital Structure: Random Sample and Actual Data

This table presents the results of the partial adjustment models which are used to estimate the speed of adjustment to the target capital structure based on a simulated and the actual sample. Dr_{t-1} is the lagged debt ratio that is defined as short-term debt plus long term debt divided by total assets. Dr^* is the predicted value of the debt ratio regression with independent variables as in Table 3.2. Firm FE indicates whether the model accounts for unobserved firm constant heterogeneity. In the cross-sectional specification, the coefficients are estimated by cross-sectional regressions as in Fama and French (2002). Historical indicates whether the full or historical sample is used to predict target debt ratios. The coefficients of the specifications that are based on the simulated sample represent the averages that are obtained from 50 simulations. Coefficients that are significant at the 10%, 5% and 1% levels are marked with * , ** and ***, respectively. The tests for significance are based on robust standard errors that are adjusted for heteroscedasticity and within-firm correlation.

			(1)	(2)	(3)	(4)
Dep. Var.			Δ*Debt/Assets*	Δ(*Debt/Assets*)	Δ*Debt/Assets*	Δ(*Debt/Assets*)
Sample			S(p = empirical, actual deficit)		S(real)	
OLS	One Step	Dr_{t-1}	-0.0608***	-0.2177***	-0.1032***	-0.1693***
	Two Step	Dr^*-Dr_{t-1}	0.0563***	0.2229***	0.1123***	0.1789***
	Two Step	Dr^*	-0.0350***	0.2795***	0.2252***	0.2270***
		Dr_{t-1}	-0.0577***	-0.2220***	-0.1098***	-0.1780***
Firm FE	One Step	Dr_{t-1}	-0.1368***	-0.4439***	-0.3485***	-0.3921***
	Two Step	Dr^*-Dr_{t-1}	0.1322***	0.4665***	0.3835***	0.4306***
	Two Step	Dr^*	0.1264***	0.4969***	0.4805***	0.4597***
		Dr_{t-1}	-0.1324***	-0.4657***	-0.3773***	-0.4291***
Cross-	One Step	Dr_{t-1}	-0.0625***	-0.2057***	-0.1111***	-0.1764***
Sectional	Two Step	Dr^*-Dr_{t-1}	0.0591***	0.2104***	0.1158***	0.1842***
OLS	Two Step	Dr^*	-0.0100***	0.2523***	0.2093***	0.2334***
		Dr_{t-1}	-0.0600***	-0.2097***	-0.1127***	-0.1823***
Historical	Two Step	Dr^*	0.0566***	0.2094***	0.1115***	0.1824***
OLS	Two Step	Dr^*	-0.0138***	0.2261***	0.1949***	0.2297***
		Dr_{t-1}	-0.0596***	-0.2086***	-0.1053***	-0.1784***
Historical	Two Step	Dr^*	0.1035***	0.2825***	0.3211***	0.3185***
Firm FE	Two Step	Dr^*	0.0539***	0.1735***	0.3344***	0.2723***
		Dr_{t-1}	-0.1083***	-0.2942***	-0.3158***	-0.3307***
Observations			115,550	115,550	115,550	115,550

Empirical Financing and Actual Deficit

In the simulated sample with empirical financing and the actual deficit, we assume that firms randomly choose between equity financing and debt financing by the outcome of a random variable that reflects the empirical frequency of debt issuances and repurchases. If the financing deficit is positive the firms in the sample issue debt in 52% of the cases and take on equity in 48% of the cases. Firms with a financing surplus repurchase debt with a probability of 73% and buy back equity with a probability of 27%. The deficit and the change in the retained earnings are the same as in the actual data. If firms follow a pecking order behavior of financing which in turn produces mean reverting debt ratios, the partial adjustment models based on this sample would produce speeds of adjustment that are positive and statistically different from zero (see Shyam-Sunder and Myers (1999)).

Column (1) of Table 3.4 presents the results of the partial adjustment regressions with the net debt issuance of debt on the left-hand side of the regression equation for this more realistic sample. We estimate a SOA for the fixed effects specification based on historical target information of 5.4% per year in this sample. The other coefficients that measure the existence of mechanical mean reversion range from -1% meaning no mean reversion to 13% for the fixed effects specification based on the full sample.

Column (2) shows the results of the partial adjustment models with the first difference of the debt ratio as the dependent variable. Again, the specifications based on this model produce significant speeds of adjustments from 17% for the historical fixed effects regression to 50% for the full sample fixed effects regression.

3.4.2 Speeds of Adjustment Based on Actual Data

The speeds of adjustment in the actual sample are shown in Column (3) of Table 3.4 for the model that is based on the net issuance of debt and in Column (4) for the model that is based on the first difference of the debt ratio as the dependent variable. The estimated speeds of adjustment range from 10% to 48% in the net issuance of debt specification and from 18% to 46% in the first difference of the debt ratio specification.

Of central focus in this chapter is the difference in the coefficients of Column (3) and (1) for the net issuance of debt specification and (4) and (2) for the first difference of the debt ratio specification. This value shows if the specification of the partial adjustment model can distinguish between real adjustment to a target debt ratio and mechanical mean reversion. The target debt ratio regressions that include firm fixed effects produce the best fit of the data, so we assume that including firm fixed effects into the target debt ratio estimation yields a better approximation of the 'true' target debt ratio. Following Hovakimian and Li (2011), we interpret the coefficient of the target debt ratio in the specification in which the coefficients of the target approximation and the initial debt ratio are separately estimated as the relevant SOA. Based on this specification, we find that the unbiased average speed of adjustment to target capital structure is 28% (33.4%-5.4%) per year. This value shows that the target debt ratio is an important determinant of the financing decision of firms. Partial adjustment models based on the first difference of debt as the dependent variable produce spurious adjustment speeds as simulated samples show that these models suffer from significant mechanical mean reversion.

As a robustness check, we analyze whether the bounded nature of the debt ratio produces an additional bias due to the reversion of debt ratios that are near zero and one. In the simulated samples, firms that face a financial surplus are forced to repurchase debt (equity) when debt (equity) would otherwise become negative. Firms with a financial deficit for which debt (equity) would exceed the total assets in the case of a debt (equity) issuance are forced to issue equity (debt). To check whether these restrictions produce mechanical mean reversion we delete the observations for which these scenarios occur or would occur if the random financing variable shows the opposite value. The results for these reduced samples remain essentially the same as described above.

3.5 Conclusions

In this chapter, we analyze how to yield an estimate of the speed of adjustment to target capital structure that is not biased by mechanical mean reversion. To test for the existence of mechanical mean reversion, we estimate the SOA in simulated samples in which firms randomly choose between debt and equity without considering a specific target debt ratio. These tests show that partial adjustment models produce high spurious speeds of adjustment in the simulated samples and are therefore largely biased in favor of finding support for the trade off hypothesis. We examine two partial adjustment models that are based on different dependent variables with various specifications that are used by previous studies to analyze which of these specifications do not suffer from a large SOA due to mechanical mean reversion in the simulated samples. These partial adjustment models differ in the estimation technique of the target debt ratio and use two different dependent variables (1) the debt ratio and (2) the net increase of debt.

We find that partial adjustment models that use the net increase of debt as the dependent variable produce lower biases than those models that rely on the debt ratio. Furthermore, specifications that are based only on historical information to estimate the target debt ratio largely reduce the speeds of adjustment in the simulated samples. The target debt ratios should be estimated in a two step procedure in which the coefficient of the proxy of the target debt ratio yields a good estimate of the SOA. We recommend to use a firm fixed effects regression based on the historical information up to the previous year to predict the target.

This combination of methods produces an unbiased estimate of the SOA of 28% per year. Hence, it takes a firm two years to offset 50% of the initial deviation from the target which provides strong support for the importance of the target debt ratio for a firm's financing policy. Further research should focus on the determinants of target capital structure to obtain better target proxies and should examine which circumstances deter firms from adjusting to target.

Chapter 4

Accounts Receivable Management and the Factoring Option: Evidence From a Bank-Based Economy

4.1 Motivation

In interfirm-trade, selling firms must decide whether buying firms must pay for merchandise immediately or whether payments may be obtained over the course of a specified period of time. In the common situation of trade credit financing the seller must also decide how to finance and operate the accounts receivable that are generated by the extension of trade credit to buyers. The management of accounts receivable can either be organized within the firm or delegated to a specialized financial intermediary, such as a factor.[1] In this chapter, we examine the decision between the internal management of accounts receivable and the use of factoring.

Accounts receivable constitute a significant portion of companies' balance sheets, highlighting

[1]We emphasize that in analyzes of the decision to factor, it is important to consider the services that are included in the factoring contract. We use the term factoring to encompass both full-service factoring and in-house factoring; to specify a particular type of factoring, we use the specific individual terms.

the importance of the management and financing of this type of asset.[2] The extension of trade credit requires the assignment of five functional responsibilities: (1) customers' credit risks must be assessed, (2) the decision to grant trade credit must be made (including the establishment of credit terms and limits), (3) the trade credit must be collected, (4) the default risk must be borne and (5) the receivable must be financed until it has been paid by the purchaser (see Mian and Smith Jr. (1992)). In full-service factoring contracts, all of these credit management functions are performed by a factor, whereas firms that use in-house factoring (which is also known as invoice discounting) manage the accounting and collection of their accounts receivable on their own.[3]

Factoring is increasing in prominence as a financial source for firms that are based in Germany. Data from the German Factoring Association and the German Federal Factoring Association for Medium-Sized Businesses indicate that the sales of German factoring companies have increased by more than 400%, rising from 30 billion euro in 2001 to 160 billion euro in 2011, which indicates that over 5% of the German GDP was financed through factoring.[4]

However, theoretical and empirical studies on the determinants of firms' accounts receivable management are rare. In a seminal work, Mian and Smith Jr. (1992) analyze the choice of accounts receivable from a primarily theoretical point of view. Their study distinguishes among general corporate credit, accounts receivable secured debt, captive finance subsidiaries and factoring. These researchers are unable to test the majority of the hypotheses that they develop due to data limitations of their accounting-based sample of US firms. Because factoring is not comprehensively reported in financial statements, accounting-based data systematically understate the use of factoring. Therefore, recent empirical studies rely on surveys to acquire data. Smith and Schnucker (1994) regard the

[2]The average ratio of accounts receivable to assets is 30-40% in our sample and 35% in the UK as a whole (see Summers and Wilson (2000)).

[3]The credit terms of existing customers generally remain the same, but the terms for the granting of trade credit to new customers must be negotiated with the factor if the new accounts receivable are to be transferred to the factor. Overviews of the factoring contracts can be found in Smith and Schnucker (1994), Lea and Trollope (1996) and Hawkins (1993).

[4]The German Factoring Association and the German Federal Factoring Association for Medium-Sized Businesses include 44 factoring companies as members; in combination, these companies represent over 85% of the German factoring market.

decision to employ a factor as a choice of whether to vertically integrate the trade credit functions. Consequently, their model focuses on information and monitoring costs. Their results are replicated by Summers and Wilson (2000), who investigate factoring in the context of the UK; Summers and Wilson (2000) also examine the roles of the demand for short-term financing and the preferences of factors as determinants of the use of factoring. Klapper (2006) analyzes the determinants of the provision of factoring services across different countries.

According to data from the International Factor Group, in-house factoring produces over 81% of factoring revenues in Germany and the UK, whereas full-service factoring accounts for 16% of factoring revenues in Germany and 11% of factoring revenues in the UK. However, the aforementioned academic papers do not consider in-house factoring. In these papers, firms that use in-house factoring are either excluded from the examined sample or treated similarly to firms that do not use factoring at all; this type of treatment produces biased estimated coefficients in the corresponding models.

Our study provides two major contributions to the existing literature. First, we incorporate the use of in-house factoring into multinomial models in which firms decide between internal accounts receivable management, in-house factoring and full-service factoring.[5] Second, we examine the risk and the financial flexibility of the seller as determinants of the decision to employ a factor. Our empirical analysis is based on the responses to a detailed large-scale survey about the characteristics of non-financial German firms and the policy choices of these firms with respect to accounts receivable management. To ensure that our study is not biased towards large listed companies, the sample that is used in this study includes small, medium-sized and large companies that are spread across several industries.[6]

[5]The survey offered the opportunity to mark other factoring alternatives. As these alternatives cover a too small percentage of the overall distribution to be able to draw statistical conclusions we focus on the two dominant factoring agreements.

[6]Both the securitization of accounts receivable and the formation of captive finance subsidiaries are neglected in our study because these financial instruments are not available to small and medium-sized companies in Germany.

In Section 4.2, we discuss the determinants of accounts receivable management policy choices. The presented hypotheses are developed from theories that relate to transaction costs, economies of scale, financial needs, suppliers' risks, financial flexibility and industry sector. In Section 4.3, we describe the data of this study and present various summary statistics regarding the surveyed firms. In Section 4.4, we perform univariate and multivariate regression analyzes of the use of full-service factoring and in-house factoring. In addition, we discuss the reasons that firms provided in our survey for their use or avoidance of factoring options. Section 4.5 presents the conclusions of this study.

4.2 The Determinants of Accounts Receivable Management

In the following subsections, we review and extend the existing theories regarding the decision to employ a financial intermediary for accounts receivable management. Table 4.1 summarizes the hypotheses that are developed from the theories that are presented below.

4.2.1 Transaction Costs

Smith and Schnucker (1994) examine the decision to factor as a choice between vertically integrating trade credit functions or using a specialized contract with an external firm. The vertical integration theory suggests that in markets with imperfect information, contracts serve the purpose of reducing transaction costs (see Coase (1937)). Information costs and monitoring costs arise for both buyers and sellers during the selling process. The buyers must value the delivered products or services, and the seller must collect information regarding the creditworthiness of the buyer. Factors act as information sources for the seller and the customers. If a factor deals with multiple different sellers that have large overlaps in their customer bases, the intermediary has a cost advantage over the seller because the factor can deliver information about a single customer to several sellers. We identify two dimensions of customer concentration: (1) the number of customers that are offered trade credit and (2) the number of industries among which these customers are distributed. A firm that sells its

Table 4.1: The Determinants of Accounts Receivable Management

This table presents testable hypotheses with respect to the effects of the listed determinants on the listed alternative accounts receivable management choices. In the table, + entries indicate determinants that produce an increased predicted probability of factoring, - entries indicate determinants that produce a decreased probability of factoring, and 0 entries indicate determinants with no effect on a particular factoring decision.

	In-House Factoring	Full-Service Factoring
Transaction Costs		
Number of buyers that are offered trade credit	+	+
Number of industries that are served	+/-	+/-
Economies of Scale		
Size (sales)	+	-
Financial Needs		
Percentage of the credit line that is used	+	+
Accounts receivable / Assets	+	+
Net income	-	-
Funding requirements of current assets	+	+
Seller's average redemption period	+	+
Effective average collection period	+	+
Risk / Financial health		
Equity / Assets	-	-
Seller's interest rates on current debt	+	+
Seasonality of the seller's sales	+	+
Financial Flexibility		
Seller's dependence on banks	+	+

product to a greater number of buyers on credit will reap greater benefits from externalizing its trade credit functions because the involvement of more buyers renders it more likely that a factor would already have existing credit information regarding a subset of these buyers. We include a variable that measures the number of customers that a seller serves and expect this variable to display a positive relationship with factoring tendencies. A seller will also derive greater benefits from using a factor if the seller serves a greater variety of different industries. However, factors must balance diversification across industries with the costs of obtaining additional industry-specific knowledge. We account for the distribution of customers with respect to different industries in our empirical analysis. The sign of the coefficient of this variable may be either positive or negative, depending on which of the effects that are described above proves to be predominant.

4.2.2 Economies of Scale

Large economies of scale are produced by the high fixed costs that are associated with trade credit functions. In an in-house factoring contract, the accounting and the credit collection are managed within the firm, whereas credit insurance and the financing of accounts receivable are provided by the intermediary. In full-service factoring, all of the aforementioned services are performed by the factor. A larger firm is more likely to have the capability to internally manage its accounts receivable in a cost-efficient manner. Mian and Smith Jr. (1992) argue that compared with smaller firms, larger firms are expected to invest in more highly skilled credit administration personnel and more sophisticated IT-systems. Therefore, we expect the advantages of externalizing trade credit functions to be larger for small firms than for large firms. Moreover, as a requirement for providing in-house factoring, a factor typically requires companies to demonstrate that they have a sufficiently sophisticated accounting system. Therefore, in-house factoring is often an option that is only offered to firms with a certain minimum value of sales. We include a variable for firm size; this variable is measured in terms of sales. We predict a negative sign for the coefficient of the size variable for full-service factoring and a positive sign for the coefficient of this variable with respect to in-house factoring.

4.2.3 Financial Needs

For the decision of how to finance accounts receivable, the firm weighs the costs and assesses the availability of different financial instruments. In our analyses of the effect of credit rationing on the firm's financing decision, we need to use a broad definition of credit rationing. Not only the firms that are not able to obtain bank credit at all are classified as credit rationed by the banking sector but also those firms that do not obtain financing at the requested level.[7] A firm that is facing this type of scenario may be unable to finance an investment with a positive net present value and hence, is more likely to employ a factor. We incorporate the percentage of the credit line that a seller has

[7] See e.g., Stiglitz and Weiss (1981) and Arnold and Riley (2009) for explanations why credit rationing exists in financing markets, at equilibrium.

used into our empirical analysis and expect to find a positive coefficient for this variable for both full-service and in-house factoring.

When a firm enters into a factoring contract, the immediate liquidity that the firm obtains can be used to mitigate its financing problems. German banks seldom provide credit that is secured with accounts receivable. Summers and Wilson (2000) argue that compared with banks, the factors experience less difficulty in protecting the accounts receivable that they possess because the trade credit functions that relate to these accounts receivable are also delegated to the factors. In fact, German banks established factoring subsidiaries in the past to offer credit that is secured with accounts receivable. Additionally, a greater quantity of a firm's accounts receivable can typically be involved in a factoring contract than in the context of securing bank credit. Therefore, a firm will typically realize more cash from its accounts receivable through factoring than it could obtain through bank loans involving these accounts receivable. This phenomenon likely occurs because the seller must reveal all of its invoices to the factor. Moreover, compared with a bank, a specialized factor may also be more capable of protecting the value of these invoices which in turn lowers the financing costs for the seller. We suggest that factoring is more likely for firms that possess a strong need for refinancing accounts trade credits. We measure the need for financing by the firm's funding requirements for its current assets and hypothesize the existence of a positive relationship between financing needs and factoring. Furthermore, we expect a high ratio of accounts receivable to total assets also to increase the likelihood that a firm will employ a factor.[8] The higher the firm's net income the more funds are available to finance accounts receivable and the less likely the firm suffers from cash flow problems. We expect that factoring is less likely for a firm with a high net income. We include a variable that measures the average days that a seller requires to pay off its debts. A high redemption period of the seller indicates difficulties regarding to liquidity problems. For example, the immediate liquidity that is obtained through factoring can be used to realize discounts for early payment of the seller's accounts payable. We predict that the use of factoring

[8] Accounts receivable that are sold to a factor are normally not shown on the balance sheet in Germany. Therefore, a measure of the accounts receivable to total assets ratio that is based on a financial statement is flawed. In our empirical study that is based on a survey, we directly ask the participating firms for this ratio.

will be positively related to the seller's average redemption period.

The use of factors may also help to improve customers' payment behaviors, thereby making the full value of a seller's accounts receivable (less fees) available to the seller at an earlier time. Summers and Wilson (2000) state that a factor can place more pressure on customers to pay early, given that buyers that delay in paying their obligations to a factor could experience reduced creditworthiness with several different sellers. A lower effective average collection period reduces liquidity problems of the seller. We include a variable that measures the average days that customers require to pay off their trade credits. We hypothesize that factoring is more likely for firms with lengthy average collection periods.

4.2.4 Risk / Financial Health

The factoring contract provides full insurance for a firm's accounts receivable. Therefore, firms that are vulnerable to bad debt are more likely to enter into a factoring contract. Moreover, because a factoring relationship involves the sale of accounts receivable to a factor, a high-risk seller is effectively able to borrow funds based on the creditworthiness of its high-quality buyers. We include two variables that account for the financial health of the seller: (1) the equity ratio and (2) the interest rates on current debt. We predict that a higher equity ratio reduces the probability of using factoring. The existence of higher interest rates on current debt is expected to increase the probability of employing a factor.

Pike and Cheng (2001) argue that firms with seasonal sales are more likely to engage in riskier trade credit arrangements to stimulate their sales. Therefore, we expect these types of firms to be more likely to utilize various risk reduction policies, such as factoring. We incorporate a variable that measures the seasonality of a firm's sales into our model and hypothesize that this variable is positively related to the use of factoring

4.2.5 Financial Flexibility

In several US and European surveys, CFOs were asked to identify important factors that influence their financing decisions (see Graham and Harvey (2001), Bancel and Mittoo (2004), Brounen et al. (2004)). These studies find that corporate executives place significant value on having financial flexibility. Byoun (2007) defines financial flexibility as "the degree of capacity and speed at which the firm can mobilize its financial resources in order to take reactive, preventive and exploitive actions to maximize the firm value."[9] In Germany, small firms are frequently particularly dependent on a house bank and therefore face the risk of being unable to either finance future opportunities or to obtain liquidity during times of financial distress. The more bank relationships a sellers has the less likely all banks suffer from financial distress leading to restricted credit extension. However, during the financial crisis, almost the whole banking sector was unable or unwilling to provide financing, encouraging firms to seek alternative financing instruments. We hypothesize that a firm with only one bank relationship is more likely to diversify across another type of financing source than to establish a second relationship with another bank. Factoring can be used as an instrument for financial diversification that mitigates the threat of future financial constraints. We expect that firms that are dependent on a house bank are more likely to employ a factor. We measure a firm's dependence on banks with a dummy variable that is set equal to one if the firm has a business relationship with only one bank and zero otherwise.

4.2.6 Industry Sector

Factoring practices may be more traditional and established in certain industries, e.g., textiles; therefore, firms in these industries will be more likely to use factoring. Furthermore, factors' preferences may not be attained by certain industries. For instance, in the construction industry, accounts receivable are only factorable to a limited degree because the goods and services that have been purchased often have not completely been delivered.

[9] See Byoun (2007), p. 2.

4.2.7 Full-Service Factoring vs. In-House Factoring

In-house factoring presents two major advantages over full-service factoring. First, the seller is able to individually react to customers that pay late, thereby preventing the deterioration of the customer-supplier relationship for these customers. Second, because in-house factoring involves direct payments from the customers to the seller, these customers are not aware that the supplier has sold its accounts receivable to an intermediary entity. This characteristic may represent an advantage for situations in which engaging a factor is interpreted as a signal of financial distress. In these types of scenarios, buyers may become reluctant to buy the products or services of the seller because the ability of the seller to supply and maintain products in the future is not secure.

4.3 Data and Summary Statistics

The data that were used for the empirical analysis of the current study are obtained from firms that responded to a mail survey that was conducted throughout Germany in April and September of 2010 in cooperation with the German Factoring Association.[10] The survey consists of two components: the first component requested detailed information regarding a firm's characteristics and credit management policy, whereas the second component contains qualitative questions about various topics, including reasons for using or avoiding factoring. The survey was sent to over 17,000 firms. In total, 1,444 companies that use and don't use factoring returned the survey, a response rate of 8.3 percent. We restrict the sample to non-financial firms that exhibited no missing values for the dependent and explanatory variables that were considered in this study. After applying these constraints, 736 firms remain in the sample. In total, 167 (22.7%) of the sampled firms use full-service factoring, 255 (34.6%) of the sampled firms use in-house factoring and 314 (42.7%) of the sampled firms use no factoring. Details regarding the survey may be obtained from the authors upon request.

Table 4.2 provides certain summary statistics for the explanatory variables of this study. The

[10]The survey was submitted again in September 2010 to reach firms that did not use factoring.

Table 4.2: Summary Statistics of the Independent Variables

This table presents the means and standard deviations of the explanatory variables. The variables of the *Seller's average redemption period* and *Effective average collection period* are winsorized at the 99th percentile. The sample consists of 736 non-financial German firms that responded to a survey that was conducted in 2010. Descriptions of the ordinal variables can be found in the Appendix.

	Variable Type	Mean	Std. Dev.
Transaction costs			
Number of buyers that are offered trade credit	Ordinal	4.4593	1.5809
Number of industries that are served	Ordinal	2.5109	1.1344
Economies of scale			
Size (sales)	Ordinal	3.5557	1.9116
Financial needs			
Percentage of the credit line that is used	Ordinal	2.9565	1.8349
Accounts receivable / Assets	Ordinal	3.0666	1.4015
Net income	Ordinal	1.5380	0.9411
Funding requirements of current assets	Ordinal	2.2133	1.3907
Seller's average redemption period	Continuous	25.2194	15.6186
Effective average collection period	Continuous	33.6141	15.4177
Risk / Financial health			
Equity / Assets	Ordinal	2.9932	1.5912
Seller's interest rates on current debt	Ordinal	2.7106	0.9920
Seasonality of seller's sales	Ordinal	3.4198	1.1341
Financial Flexibility			
Seller's dependence on banks	Dummy	0.1685	0.3745

continuous variables of *Seller's average redemption period* and *Effective average collection period* are winsorized at the 99th percentile to mitigate the effects of extreme values. The independent variables exhibit reasonable variation, indicating that the sample covers a wide range of companies with different firm characteristics. The dependent variable for this study has three values: 0, which represents no use of factoring; 1, which represents the use of in-house factoring; and 2, which represents the use of full-service factoring.

4.4 Results

To obtain an understanding of the relationship between the explanatory variables and the use of either full-service factoring or in-house factoring, we first conduct a univariate analysis. In the second part of this section, we perform a multinomial logistic regression based on the theoretical model that is explained above. The third part of this section discusses firms' reasons to use or avoid factoring.

4.4.1 Univariate Results

Table 4.3 presents the results of the univariate analysis. The means of the explanatory variables for the three categories, (1) the internal management of the trade credit functions, (2) the use of in-house factoring and (3) the use of full-service factoring, were calculated to analyze the differences between these statistics. We perform a t-test to assess whether the differences in the means of the independent variables for these three categories are statistically significant.

Transaction Costs

The results for the variables that relate to transaction costs are in accordance with the developed hypotheses. Companies that externalize their trade credit management offer trade credit to more customers. This relationship is statistically significant for firms that use in-house factoring. Companies that use in-house factoring also serve significantly fewer industries. In addition, there is a negative relationship between the use of a factor and the number of industries that the seller serves; however, this relationship is not statistically significant. On the whole, the results indicate that factors prefer to work with companies with customers that are concentrated in only a few industries. Moreover, factors that serve firms that sell to several different buyers are more likely to benefit from customer overlaps. This benefit which produces transaction cost advantages for these factors. Therefore, companies with many clients are more likely to use factoring.

Economies of Scale

Firm size has an effect on the use of full-service factoring versus in-house factoring. As predicted, firm sales are positively related to in-house factoring and negatively related to full-service factoring, providing support for the importance of economies of scale. Although smaller firms benefit from transferring the management of their debtors to a factor, larger firms are willing to manage the accounting and credit collection of their accounts receivable.

Table 4.3: The Univariate Results

This table shows the mean values of the explanatory variables for the three categories of the dependent variable. The sample consists of 736 non-financial German firms that responded to a survey that was conducted in 2010. The variables of the *Seller's average redemption period* and *Effective average collection period* are winsorized at the 99th percentile. Differences to the base category of internal management of the accounts receivable that are statistically significant at the 1%, 5% and 10% levels are marked with ***, ** and *, respectively. Descriptions of the ordinal variables can be found in the Appendix.

	Internal Management (Mean)	In-House Factoring (Mean)	Full-Service Factoring (Mean)
Transaction costs			
Number of buyers that are offered trade credit	4.2378	4.7689 +**	4.4028 +
Number of industries that are served	2.6338	2.3294 - ***	2.5569 -
Economies of scale			
Size (sales)	3.1051	4.6549 +***	2.7246 - **
Financial needs			
Percentage of the credit line that is used	2.3217	3.4627 +***	3.3772 +***
Accounts receivable / Assets	2.7357	3.4627 +***	3.0838 +**
Net income	1.5191	1.7137 +**	1.3054 - ***
Funding requirements of current assets	1.6911	3.0549 +***	1.9102 +*
Seller's average redemption period	20.9628	29.1542 +***	27.2145 +***
Effective average collection period	30.5510	35.7961 +***	36.0419 +***
Risk / Financial health			
Equity / Assets	3.3153	2.8706 - ***	2.5749 - ***
Seller's interest rates on current debt	2.6465	2.5961 -	3.0060 +***
Seasonality of the seller's sales	3.4427	3.4431 +	3.3413 -
Financial Flexibility			
Seller's dependence on banks	0.1592	0.1020 - **	0.2874 +***
Observations	314	255	167

Financial Needs

We find strong support in the univariate results for the impact of the need for financing on the decision to use either full-service factoring or in-house factoring. Firms that have used a high percentage of their credit lines are more likely to engage a factor. Both a high ratio of accounts receivable to assets and larger *Funding requirements of current assets* produce a higher probability of using full-service factoring or in-house factoring. Moreover, firms that sell their accounts receivable to a factor extend trade credit for a longer period of time and are slower to pay off their debt. The results for the measurements of the cash flow that is available to a firm are somewhat mixed. The sign of the *Net income* variable is significantly negative for the use of full-service factoring, as expected. However, significantly greater quantities of cash are available to firms that enter an in-house factoring contract than to firms that manage their trade credit management internally. This relationship appears to be spurious; large firms are more likely to have a high *Net income* , and this correlation produces a positive sign for the *Net income* variable in a univariate analysis.

Risk / Financial Health

The equity ratio is negatively correlated with the use of full-service factoring and the use of in-house factoring, providing support for the risk-related theory regarding factoring. The interest rates on current debt are significantly higher for companies that use full-service factoring; however, this type of result is not obtained with respect to in-house factoring. Moreover, this finding may be related to the larger size of firms that use in-house factoring. We find that the seasonality of a firm's sales does not appear to affect decisions to externalize trade credit management.

Financial Flexibility

The univariate results demonstrate that the dependence on a house bank is significantly negatively related to full-service factoring, providing support for the theory that firms seek financial diversification through their entry into factoring contracts. Firms that use in-house factoring are more likely to have business relationships with more than one bank. This finding may simply reflect the fact that larger firms have greater access to institutional finance.

On the whole, the correlation of several explanatory variables with firm size in the univariate analysis indicates the need for a multivariate analysis, which is performed in the next section.

4.4.2 Multivariate Results

Because the dependent variable in this study only assumes the values of 0, 1 and 2, estimations of the model using OLS would produce heteroscedasticity in the error terms and could generate estimations that lie outside the (0,2) interval. Therefore, we use a multinomial logistic regression model for the multivariate analysis.[11] The logistic regression approach assumes a linear relationship between the natural logarithms of the odds of an event (called the logits) and the explanatory variables:

$$\ln\left(\frac{P_i(Y_i = j)}{P_i(Y_i = 0)}\right) = \alpha_j + \beta_j \cdot \mathbf{X}_i \tag{4.1}$$

where $j = 1$ and $j = 2$ represent the events of using in-house factoring and full-service factoring, respectively, and $\mathbf{X}_i$ is the vector of the explanatory variables.[12] Therefore, the probability of using full-service factoring and in-house factoring is described by the following logistic function:[13]

$$P_i(Y_i = j) = \frac{\mathrm{e}^{\alpha_j + \beta_j \cdot \mathbf{X}_i}}{1 + \mathrm{e}^{\alpha_1 + \beta_1 \cdot \mathbf{X}_i} + \mathrm{e}^{\alpha_2 + \beta_2 \cdot \mathbf{X}_i}}. \tag{4.2}$$

The probability of using neither full-service factoring nor in-house factoring can be expressed as follows:

$$P_i(Y_i = 0) = \frac{1}{1 + \mathrm{e}^{\alpha_1 + \beta_1 \cdot \mathbf{X}_i} + \mathrm{e}^{\alpha_2 + \beta_2 \cdot \mathbf{X}_i}}. \tag{4.3}$$

The coefficients of the independent variables are estimated by the maximum likelihood method. To measure the goodness of fit of the model, we estimate the model's McFadden's R^2 value and the percentage of observations that the predicted model classifies correctly.

We model the decision regarding different forms of accounts receivable management as a function of several variables; these variables reflect transaction costs, economies of scale, financial needs, the supplier's risk and the supplier's financial flexibility.

Table 4.4 presents the results of the multivariate regressions. Columns (1) and (2) report the logit estimates of the model that is described above without controlling for the industry. The pseudo R^2 of the estimated model is approximately 20 percent. In a comparison of the predicted use of

[11] An ordered logistic regression approach is not appropriate because the proportional odds assumption is violated.

[12] We do need to estimate the logit values for the decision to use full-service factoring and not to use in-house factoring; these values can be expressed as the difference between $j = 1$ and $j = 2$ for Equation 4.1.

[13] Smith and Schnucker (1994) use a probit model to empirically analyze the decision to factor. The probit model is based on the assumption of a normal distribution. As a robustness assessment, we also conduct probit model regressions, but the results of this model are essentially the same as the results that are already presented in the text.

Table 4.4: The Multinomial Logistic Regression Results

This table presents the results for the multivariate logistic regressions. The base category is the internal management of the accounts receivable. The sample consists of 736 non-financial German firms that responded to a survey that was conducted in 2010. The variables of the *Seller's average redemption period* and *Effective average collection period* are winsorized at the 99th percentile. In Model B, industry dummies (which are unreported) are included in the regression equation. The coefficients that are statistically significant at the 1%, 5% and 10% levels are marked with ***, ** and *, respectively. Descriptions of the ordinal variables can be found in the Appendix.

	Model A		Model B	
	(1) In-House Factoring	(2) Full-Service Factoring	(3) In-House Factoring	(4) Full-Service Factoring
Transaction costs				
Number of buyers that are offered trade credit	0.1204*	0.1565**	0.0252	0.1099
Number of industries that are served	-0.2646***	-0.0784	-0.2798***	-0.1609
Economies of scale				
Size (sales)	0.3495***	-0.2740***	0.3657***	-0.2549**
Financial needs				
Percentage of the credit line that is used	0.1179*	0.1974***	0.1383**	0.2479***
Accounts receivable / Assets	0.1983***	0.1280*	0.2218***	0.1557*
Net income	-0.3420**	-0.0091	-0.2040	0.0282
Funding requirements of current assets	0.4935***	0.3999***	0.4101***	0.3344**
Seller's average redemption period	0.0227***	0.0052	0.0239***	0.0064
Effective average collection period	0.0054	0.0165**	0.0072	0.0141*
Risk / Financial health				
Equity / Assets	-0.1820***	-0.1916***	-0.2145***	-0.2368***
Seller's interest rates on current debt	0.1322	0.1707	0.1429	0.1146
Seasonality of the seller's sales	0.0036	-0.1265	0.0950	-0.0757
Financial Flexibility				
Seller's dependence on banks	0.1597	0.8600***	0.0701	0.7508***
Industry dummies	No		Yes	
Pseudo R^2	0.1988		0.2764	
% Classified correctly	61.69		67.39	
Observations	736		736	

full-service factoring and in-house factoring with the observed values, 62 percent of the observations are classified correctly. These two statistics indicate that the model fits the data well. The included variables are also jointly statistically significant.

The coefficients of the variables that are related to transaction costs have the expected signs; this result is consistent with the univariate findings. The variable of *Number of buyers that are offered trade credit* is significantly and positively related to factoring, indicating that as more customers are offered trade credit, a greater benefit is generated from delegating all of the trade credit functions to a factor. The variable *Number of industries that are served* is significantly and negatively correlated with the use of in-house factoring; therefore, factors prefer suppliers with debtors that are concentrated in only a few industries.

The results for firm size confirm the conclusions that were obtained from the univariate analysis. Firm size is an important factor in the decision to use factoring and in the choice of which different form of factoring to utilize. The probability of delegating all credit functions to the factor is significantly higher for small firms. Through full-service factoring, these firms can benefit from efficiency increases and reduced accounting staff requirements. The significant positive sign of the *Size* coefficient for the use of in-house factoring can be explained by (1) factors' restrictions with respect to the sales of the supplier, (2) the capability of large firms to perform debt collection internally and (3) concerns about customer-relationships.

A seller's availability of and need for financing also play a crucial role in the choice of an accounts receivable policy. All of the variables that are related to this theory have the expected sign and most of these variables are statistically significant. Firms with almost completely utilized credit lines seek alternative financing instruments and use factoring significantly more frequently. Increased values of the size of the collateral and financial requirements of a firm in terms of the firm's ratio of accounts receivable to total assets or the firm's demand for short-term financing significantly increase the probability of employing a factor. In contrast to the findings of the univariate analysis, the coefficient for the *Net income* variable, which measures the cash available to a firm, is significantly negative for firms that use in-house factoring. This result is in accordance with theoretical predictions and differs from the univariate findings because the multivariate model controls for firm size. The hypothesis that firms that require immediate liquidity are more likely to use in-house factoring is also confirmed by the significant and positive relationship between the *Sellers average redemption period* variable and the use of in-house factoring; this relationship is positive but not significant with respect to full-service factoring. Firms with debtors that pay late benefit from the more efficient dunning process of factors that offer full-service factoring. The results for the *Effective average collection period* variable indicate that firms that use in-house factoring already command an efficient collection facility and therefore do not need to delegate their debt collection activities to a factor.

The multivariate results provide support for the risk-related theory. A low ratio of equity to assets significantly increases the probability of entering a factoring contract. This result may occur for two reasons. First, firms that enter into a factoring arrangement benefit from the factor's full insurance of bad debts. Second, firms may be able to use the additional cash that they obtain through factoring to pay down their debt and increase their equity ratio. The coefficient of the *Seller's interest rates on current debt* variable has a positive sign, as expected, but this variable is not statistically significant. Consistent with the univariate analysis, we do not find evidence that the variable of *Seasonality of seller's sales* affects the decision to use factoring.

As predicted, firms with relationships with only a single bank are more likely to use full-service factoring. This finding supports the theory that factoring is used to diversify the financing portfolio of firms, thereby ensuring that these firms are better prepared to finance future investments or survive during periods of financial distress and credit shortages. In contrast to the results of the univariate analysis, the coefficient of the *Seller's dependence on banks* variable has the expected sign in the multivariate analysis, although this coefficient is not statistically significant.

Columns (3) and (4) present the coefficients of the multinomial logistic regression that includes industry dummies. The signs and significances of the coefficients of the explanatory variables remain essentially the same in this modified regression. The pseudo R^2 increases substantially to 27.64% and the number of correctly classified observations increases by 5.7 percentage points. The (unreported) coefficients of the industry dummies are jointly statistically significant at the 1% level. These findings indicate that the use of in-house factoring and full-service factoring varies somewhat among different industries. This result provides support for the industry-related theory regarding factoring.

The regression approach assumes that the explanatory variables are exogenous. However, the introduction of factoring may influence the independent variables in several ways that could result in biased estimations of the coefficients of the above model. We emphasize that it is important to examine the directions of the possible changes in the explanatory variables that could produce either under- or overestimates of certain coefficients. For instance, factoring may provide the possibility of extending trade credit to new customers; this extension of trade credit may increase the seller's customer base. This phenomenon could subsequently affect the sales and *Net income* of the firm in question. Therefore, the coefficients of these three variables may be overestimated, which could affect the sign and significance of the *Number of buyers that are offered trade credit* variable for both types of factoring contracts and the *Size* variable for the use of in-house factoring (the sign and significance of the other coefficients would remain unchanged).

Furthermore, if the additional cash that is available through a factoring contract is used to pay down debt, the *Percentage of the credit line that is used* by the seller, the *Seller's average redemption period* and the *Seller's interest rates on current debt* may decrease, whereas the seller's equity ratio may increase. However, the signs and significances of the coefficients of these four variables should remain unaffected, as the endogeneity biases would only reduce the absolute size of the coefficients.

We can think of no mechanism by which the *Funding requirements of current assets*, *Seasonality* *of the seller's sales* and *Seller's dependence of banks* variables would be affected by this type of endogeneity.

On the whole, we cannot rule out the possibility that endogeneity distorts the estimated coefficients. Therefore, the regression results of the multivariate model must be regarded with caution. However, the rejection of the majority of the tested null hypotheses remains valid given the existence of this type of endogeneity.

4.4.3 Qualitative Results

To address the endogeneity problems in the above empirical analysis, we also perform a qualitative analysis. In this part of the study, we check whether the above-mentioned theoretical reasons for the use of factoring are important for the decision of a firm to externalize its management of the accounts receivable. The second component of the administered questionnaire contained qualitative questions. Table 4.5 summarizes the answers to these questions with respect to why the firms (1) use factoring, (2) no longer use factoring and (3) do not use factoring.

Panel A of this table indicates that 95% or more of the firms that use factoring engage in this practice to gain liquidity and to financially diversify their portfolio; this result is consistent with the theories that relate to financial needs and financial flexibility. Furthermore, the second most frequent answer that was provided by survey respondents as a reason that they use factoring is the possibility of decreasing their firm's dependence on banks. The reduction in risk that factoring produces due to increases in a firm's equity ratio is cited as a motivation by more than 54% of the firms that use in-house factoring. Because small and growing firms are more vulnerable to bad debt and are often credit rationed by the banking sector, the full insurance of bad debt and the acquisition of growth financing are other important reasons for the use of full-service factoring.

Panel B reports the answers of the 37 firms in the no-factoring subsample that had previously used factoring. Over 75% of these firms responded that factoring was more expensive than they had

Table 4.5: The Reasons to Use or Avoid Factoring

This table presents the results of the questions about the reasons to use or avoid factoring. The sample consists of 736 non-financial German firms that responded to a survey that was conducted in 2010. The responding firms were allowed to provide multiple answers.

Panel A

	In-House Factoring (in %)	Full-Service Factoring (in %)
Liquidity / Financial diversification	94.86	96.41
Independence from banks	57.31	59.88
Full insurance of bad debt	39.92	55.09
Growth financing	31.62	41.92
Increase in equity ratio	54.55	33.53
Service / Relief of accounting	-	29.34
Possibility of increasing the duration of trade credit	24.51	28.74
Observations	253	167

Panel B

	Former Use of Factoring (in %)
More expensive than expected	75.68
The ongoing process of factoring was overly complicated	37.84
Factoring was only an interim solution during times of illiquidity	27.03
Negative feedback from customers	21.62
Bad experiences with the factor	8.11
Negative feedback from banks	5.41
Observations	37

Panel C

	No Use of Factoring (in %)
Checked, but too expensive	49.61
Factoring has not yet been considered	33.98
Checked, but the risk of negative feedback from customers was too high	25.00
Checked, but the implementation / process of factoring was complicated	17.58
Consultants advised against factoring	6.64
Rejected by factor	0.25
Observations	256

expected. Negative feedback from customers, the excessive complexity of implementing factoring and the use of factoring as an interim solution to solve illiquidity problems are also frequently cited reasons for the re-internalization of accounts receivable management by these firms.

Panel C provides reasons for the decision to manage the trade credit functions within a firm. The most frequently stated reasons for this approach are the excessively complicated implementation of factoring, the risk of negative customer feedback from factoring and the high cost of factoring. Surprisingly, one third of the responding firms answered that they had not yet considered factoring as an option for an accounts receivable policy.

4.5 Conclusions

In this chapter, we analyze the determinants underlying the choice of accounts receivable management policies. We develop and test a model in which firms are classified as either internally managing their trade credit, externalizing the majority of the credit functions but maintaining the accounting and debt collection in-house (in-house factoring) or delegating the entire management of accounts receivable to a factor (full-service factoring). The model considers transaction costs and economies of scale; in addition, it incorporates the financial needs, risks and financial flexibility of the supplier. Statistical evidence is obtained from univariate and multivariate multinomial logistic regression approaches. Furthermore, we analyze the qualitative components of an administered survey in which firms identified their reasons for using or avoiding factoring.

We find that firms use either in-house or full-service factoring if they are in need of short-term financing and wish to diversify their financial portfolio (as measured by their dependence on a house bank). Furthermore, firms also engage in factoring because factors provide full insurance of potential bad debts and because the funds that are generated by factoring allow firms to increase their equity ratios. We also find evidence that firms with many different customers enter a factoring contract to reduce their information and monitoring costs. The main differentiating factor driving firms' choice of accounts receivable management policy is firm size; large firms prefer the control provided by in-house factoring, whereas small, growing firms benefit from the additional relief of accounting requirements that is provided by full-service factoring. On the whole, this study contributes to a better understanding of the factors that affect firms' choices with respect to their accounts receivable policies.

Further research should focus on the seller-buyer relationship and on the problems that are involved in the ongoing implementation of factoring arrangements. It would be highly useful to gather information about all three of the parties that are involved in a factoring contract, i.e., the factor, the seller and the buyer. Iterative surveys could reduce the endogeneity problems that the influence of the introduction of factoring produces on several explanatory variables that relate to factoring decisions.

4.6 Appendix: Descriptions of the Categorial Variables

Number of buyers that are offered trade credit: Product of the number of buyers and one minus the percentage of buyers that pay immediately.

Number of buyers: Respondents indicated response as follows:

1-10	11-20	21-50	51-100	101-200	>200
[1]	[2]	[3]	[4]	[5]	[6]

Number of industries that are served: Respondents indicated response as follows:

1	2-3	4-6	>6
[1]	[2]	[3]	[4]

Size (sales): Respondents indicated response as follows (sales in million euro):

<2	2-5	6-10	11-25	26-50	51-100	101-500	>500
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]

Percentage of the credit line that is used: Respondents indicated response as follows:

<10%	11-30%	31-50%	51-70%	71-90%	>90%
[1]	[2]	[3]	[4]	[5]	[6]

Accounts receivable / Assets: Respondents indicated response as follows:

<5%	5-10%	11-20%	21-30%	31-40%	>40%
[1]	[2]	[3]	[4]	[5]	[6]

Net income: Respondents indicated response as follows (in million euro):

<0.5	0.5-1.0	1.1-5.0	5.1-10.0	>10.0
[1]	[2]	[3]	[4]	[5]

Funding requirements of current assets: Respondents indicated response as follows (in million euro):

<0.5	0.5-1.0	1.1-3.0	3.1-10.0	10.1-20	>20
[1]	[2]	[3]	[4]	[5]	[6]

Equity / Assets: Respondents indicated response as follows:

<10%	11-20%	21-30%	31-40%	41-50%	>50%
[1]	[2]	[3]	[4]	[5]	[6]

Seller's interest rates on current debt: Respondents indicated response as follows:

<3%	3-6%	7-9%	9-13%	14-17%	>17%
[1]	[2]	[3]	[4]	[5]	[6]

Seasonality of the seller's sales	Respondents indicated response as follows: Completely [1] · Very heavily [2] · Heavily [3] · Not Heavily [4] · Hardly [5] · Not at all [6]
Industry	Respondents chose between one of the following industry sectors: Automotive, Construction, Chemistry, Services, Energy & Commodities, Wholesale & Retail, Manufacturing, Consumer Goods, Media, Foods, Pharmaceuticals, Software, Technology, Telecommunications, Transportation & Logistics, Utilities, Temporary Work and Other.

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