Do German Firms Earn their Cost of Capital Considering Tax Effects caused by Debt and Provisions?

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Abstract

In this paper the performance of a sample of German companies is measured by comparing the initially invested capital adjusted for cost of capital, dividends paid, share repurchases and equity raised with the market value at the end of the holding period. All possible holding periods between 1987 and 2000 are covered. The sample is subdivided into companies listed in the DAX-, MDAX- and SMAX-index. Performance is measured based upon the actual capital structure (levered performance) and also after assuming the company is financed by equity entirely (unlevered performance).

It can be shown that tax shields on debt and provisions contribute considerably to levered performance. This applies especially to the subsample of DAX companies. These tax effects turn value decreasing holding periods into value increasing holding periods for a number of cases. If the tax disadvantage on bond income as in Miller (1977) is considered, tax effects of debt financing are close to zero or are even negative depending upon the level of tax free capital gains assumed. Tax shields on provisions exceed tax shields on debt quite regularly.

Key words: Valuation, performance measurement, taxes, net present value, cost of capital

Contents

1. Objectives

The measurement of shareholder value and the influence of capital structure on firm value are widely discussed in the literature. The paper contributes to this discussion by first developing a performance measure based upon market values which allows to separate the contribution of tax shields to firm value. The performance of a firm will be measured given its actual capital structure (levered performance). Then, the performance of a firm will be measured assuming the firm is only financed by equity (unlevered performance).

Secondly, the measurement concept is applied to a sample of 179 German companies which are part of the major German stock market indices (DAX, MDAX, SMAX). It will be shown that tax shields contribute considerably to performance. For a number of holding periods analyzed tax shields are crucial for classifying an investment as value generating or value destroying: the investment is classified as value increasing by levered performance, but is classified as value decreasing by unlevered performance.

Performance is measured by increasing the initially invested capital by a capital charge and further equity contributions and decreasing it by later payments to shareholders, i.e. dividends, share repurchases or capital reductions. The invested capital, adjusted accordingly until to the end of the holding period, can be interpreted as a required terminal value. It will then be compared with the observable market value at the end of the holding period. The difference equals net present value (or net terminal value).[1]

Since the paper discusses performance measurement and the impact of tax effects on firm value, contributions of the literature to both fields of research are relevant.

Fama/French (1999) compare the corporate cost of capital with the return on corporate investment for a large sample of US firms. They aggregate the data of all firms to a portfolio. The cost of capital of this portfolio are calculated by solving an equation for its internal rate of return (IRR) which uses the combined market value of debt and equity of all firms at the beginning of the sample period as initial investment; during the holding period (1950 to 1996) all cash inflows and outflows are accounted for; the market values of equity and debt in 1996 serve as the terminal value. The resulting real IRR is 5.95. Since the equation is formulated using the values of the entities and

[1] Performance will be measured ex post, i.e. at the end of the holding period. The term 'net *present* value' is used in the paper synonymously with net terminal value, since performance is measured in the current (present) period which is the end of the holding period.

unlevered cash flows, the resulting cost of capital has to be interpreted as a proxy for WACC. The estimated cost of capital serve as a point of reference for a second IRR which is labelled as IRR on cost. The second IRR solves the equation described above by using the sum of the book values instead of the market values as initial investment. The resulting IRR (7.38% in real terms) is interpreted as a proxy of the return on cost (return on investment). This might look like a signal of value creation. However, the first IRR can also be interpreted as the rate of return on the investment. One could also argue that the sum of the book values does not represent the initial investment properly. Fama/French conclude cautiously that the difference between both IRR's signals value creation. One has to concede that the 'original' equity contributions of the founding owners and all equity contributions thereafter might be hard to collect.

In this paper the sample is also aggregated to a portfolio as in Fama/French (1999). However, the market values of equity at the beginning of each holding period will be used as initial capital expenditures. All equity raised later on will be accounted for. Periodically adjusted, firm specific cost of capital will be applied. Performance will be measured by NPV and not by IRR. In order to be not dependent upon share prices at one date, all possible holding periods over a 13 year period are covered.

Tax shields on debt and also on non-debt have been discussed in the literature extensively.[2] A number of papers quantifies the contribution of tax shields to firm value. In a recent paper Kemsley/Nissim (2001) estimate the tax shield of debt to be 40% of debt balances considering tax disadvantages caused by personal taxes on debt income. As was pointed out by Farrar/Selwyn (1967) and most prominently by Miller (1977), this disadvantage occurs, if bond income is taxed higher than equity income, since capital gains on equity investments are taxed later and/or at a lower rate. Kemsley/Nissim estimate tax shields to account for 10% of levered firm value. Since the statutory tax rate was 46% during the sample period, this result (present value of tax shields equals 40% of debt) surprises a bit,[3] because the income tax disadvantage on bond income lowers tax shields considerably. In addition, the utilisation of tax shields is not granted: taxable income before interest expenses and after considering loss carryforwards has to be higher than interest expenses in order to ensure immediate and unrestricted tax reduction.

[2] See e.g. the survey by Graham/Harvey (2001) or the overview in Auerbach (2001); for non-debt tax shields e.g. DeAngelo/Masulis (1980).

[3] Compared to a perpetuity value of fully utilised and riskless tax shields of 46% of debt.

The problem of non-utilised tax shields is addressed by Altshuler/Auerbach (1990) and Graham (1996). Altshuler/Auerbach estimate an average shadow value of marginal tax shields on interest expenses of 32% compared to a statutory tax rate of 46%. Graham (1996) uses simulation runs and finds the average of the marginal tax shield to be 20% in 1992 when the statutory tax rate was 34%. The weighted average for 1992 is 27.8%. The differences between estimated and statutory tax rates are due to partial utilisation of tax shields. Graham (2000) estimates the present value of future tax shields to be 9.7% of firm value. If the income tax disadvantage is considered, the contribution to firm value decreases to 4% and 7% depending upon the discount rate used.
Thus far, German literature has dealt mainly with the definition of tax shields and their treatment in DCF-valuation.[4] Recently Schlumberger (2001) evaluates tax shields on debt and provisions for a sample of 49 German companies for the first time. He finds tax shields on provisions to be 137% of tax shields on debt.[5] However, he does not report the contribution of both tax shields to company value nor does he – and also not the other papers mentioned above – measure and compare levered performance with unlevered performance.

In this paper tax shields will be considered twofold: firstly, periodic tax shields will be calculated; secondly, the present value of all future tax shields will be estimated. The present value of only partially utilised tax shields is estimated with recourse to data published by Standard & Poor's. Not only tax shields on debt are analyzed but also tax shields on provisions,[6] since on average they account for 26% (provisions for pensions and other provisions) of total assets for large German companies (included in the stock market index DAX). It will be shown that tax shields on debt depend upon the assumed level of tax exempt capital gains. Negative tax effects caused by debt financing are possible. Tax shields on provisions exceed tax shields on debt quite regularly.

The paper is contributing to the existing literature by combining performance measurement and tax shield evaluation, and by providing empirical results for the

[4] See e.g. Drukarczyk/Richter (1995), Kruschwitz/Loeffler (1998), Loeffler (1998), Drukarczyk (2001), p. 214-230.

[5] Schlumberger (2001), p. 190-202.

[6] Increases in provisions can be expensed in advance of the corresponding cash outflows e.g. for pensions or guarantee payments.

German market. The following section outlines the methodology used by first using a simple tax system, then describes the German tax system and its impact on valuation and performance measurement. Section 3 presents the empirical results. Section 4 concludes.

2. Methodology

2.1 Valuation and performance measurement

The following chapter develops the concept to be used for measuring levered and unlevered performance. Since companies are evaluated from the point of view of investors, performance is measured with recourse to market values. The net present value (net terminal value) at the end of each holding period measures the increase in shareholder wealth. Net present value in t_0 equals the present value of future dividends to owners minus the initial investment. The measurement of net present value is not that straight forward for later periods. The market value still equals the present value of future dividends of course; but what is the benchmark in later periods which was the initial investment in t_0? The market value at the end of a period can be compared to the market value at the beginning of a period considering dividends paid (economic income). However, owners want to know the performance of their investment not only for one-year holding periods. Therefore, initially invested equity (IE_L) will be increased by a capital charge ($r_L x IE_L$) periodically and will be decreased by dividends paid and share repurchases.[7] Increases of paid in equity, net of return of equity to owners, during later periods are to be considered, too. For a levered company follows:

$$IE_{L,t} = IE_{L,t-1}\left(1 + r_{L,t}\right) - Div_{L,t} + Equity\,issued_{L,t} \qquad \textbf{(1)}$$

The market value of equity (E) equals the present value of future net payments to owners. Comparing the value of equity to the amount of equity invested in the firm yields periodic net present value.[8]

$$NPV_{L,t} = E_t - IE_{L,t} \qquad \textbf{(2)}$$

Assuming an unlevered company, it follows similarly (using V_U for unlevered firm value[9]):

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[7] The variables are indexed with L indicating leveraged companies.

[8] See Drukarczyk/Schueler (2000).

$$IE_{U,t} = IE_{U,t-1}(1 + r_{U,t}) - Div_{U,t} + Equity\,issued_{U,t} \quad \textbf{(3)}$$

$$NPV_{U,t} = V_{U,t} - IE_{U,t} \quad \textbf{(4)}$$

The CAPM will be used to calculate the cost of equity. Since beta-values as reported by Bloomberg, Datastream, Barra and others are based upon given capital structures (b_L) , these betas have to be unlevered (b_U) for deriving the unlevered cost of equity (r_U). Unlevered beta is derived assuming an infinite perpetuity and a simple tax system with only a corporate tax rate t_C and no income tax by (D: market value of debt; TS_D: present value of future tax shields on interest expenses)

$$\beta_U = \frac{\beta_L}{1 + (1 - t_C)\frac{D}{E}} \quad \textbf{(5)}$$

Or more generally allowing cost of capital to change periodically due to variations in the capital structure, it follows recurring to Inselbag/Kaufold (1997):

$$\beta_{U,t} = \frac{\beta_{L,t}}{1 + \frac{D_{t-1} - TS_{D,t-1}}{E_{t-1}}} \quad \textbf{(6)}$$

The relation between levered and unlevered cost of equity is defined by

$$r_{L,t} = r_U + (r_U - r_D)(1 - t_C)\frac{D_{t-1}}{E_{t-1}} \quad \textbf{(7)}$$

Or more generally

$$r_{L,t} = r_U + (r_U - r_D)\frac{D_{t-1} - TS_{t-1}}{E_{t-1}} \quad \textbf{(8)}$$

Unlevered cost of equity and the cost of debt are assumed to be constant for this section.

Levered (unlevered) net present value changes over time by dividends paid (including share repurchases and net of changes in paid in equity), the capital charge on invested equity and the change in market value:

$$NPV_{L,t} = NPV_{L,t-1} + \Delta E_t + Div_{L,t} - r_{L,t} IE_{L,t-1} \quad \textbf{(9)}$$

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[9] Since the company is assumed to be unlevered, V_U is identical to the market value of equity of the unlevered firm.

$$NPV_{U,t} = NPV_{U,t-1} + \Delta V_{U,t} + Div_{U,t} - r_{U,t} IE_{U,t-1} \qquad \textbf{(10)}$$

Assuming that shareholders' enrichment is not paid by creditors as it might be the case e.g. by an unfair use of limited liability, neglecting inter alia costs of financial distress and transaction costs and leaving the investment program of the firm unchanged, the difference between levered and unlevered net present value is caused by tax shields on interest expenses. Considering that

- the difference in dividends is caused by after tax interest expenses and the change in debt
- according to (2) levered invested equity equals the value of equity minus levered NPV and
- according to (4) unlevered invested equity equals the value of the unlevered firm minus unlevered NPV,

the difference in net present values ((9) – (10)) can be formulated as:

$$\begin{aligned} &NPV_{L,t} - NPV_{U,t} = \\ &= NPV_{L,t-1} - NPV_{U,t-1} - r_D D_{t-1}(1-t_C) + \Delta D_t - r_{L,t}(E_{t-1} - NPV_{L,t-1}) + \\ &+ r_U(V_{U,t-1} - NPV_{U,t-1}) + \Delta E_t - \Delta V_{U,t} \end{aligned} \qquad \textbf{(11)}$$

Tax shields are evaluated by first assuming perfect foresight without revision of expectations. It follows that $TS_{D,t} = TS_{D,t-1}(1+r_D) - r_D t_C D_{t-1}$ and $\Delta TS_{D,t} = r_D TS_{D,t-1} - r_D t_C D_{t-1}$. Since following the Adjusted-Present-Value-Approach $V_U = E + D - TS_D$, and the levered cost of equity are defined by (8), it follows

$$\begin{aligned} &NPV_{L,t} - NPV_{U,t} = \\ &= NPV_{L,t-1} - NPV_{U,t-1} + r_{L,t} NPV_{L,t-1} - r_U NPV_{U,t-1} - r_D D_{t-1}(1-t_C) + \Delta D_t - r_U V_{U,t-1} \\ &+ r_D(D_{t-1} - TS_{D,t-1}) + r_U V_{U,t-1} + \Delta E_t - \Delta V_{U,t} = \\ &= NPV_{L,t-1}(1+r_{L,t}) - NPV_{U,t-1}(1-r_U) \end{aligned} \qquad \textbf{(12)}$$

Thus, the difference between levered and unlevered NPV without revision of expectations is defined by the difference of the previous period increased by the cost of capital.

The empirical measurement of levered performance according to (9) requires the definition of the initially invested capital. Fama/French (1999) use book values for a similar purpose. As was shortly discussed above it can be argued whether book values are a good proxy for initial investment. Since it is impossible, especially for a large sample, to follow back each company's history to its foundation in order to determine the initially invested capital and follow up every change in equity, the market value at the beginning of each holding period will be used as initial investment. Levered performance as in (9) can then be measured based upon published information.

For measuring the difference between levered and unlevered performance it was first assumed for the derivation of (12) that future tax shields are known. This assumption will be relaxed in the following.
Measuring unlevered performance requires the definition of unlevered invested equity at first. The value of the unlevered firm equals the total value of the levered firm minus the present value of future tax shields. In order to signal the performance disadvantage due to missing tax shields in the case of equity financing right from the beginning, the investor is assumed to have invested an amount equivalent to the value of the levered firm (V_L). This could also be explained by interpreting the missing performance, i.e. the present value of future tax shields ($TS_D = V_L - V_U$), as a possible value contribution, if the firm changes its capital structure. It is assumed preliminarily, that TS_D equals the corporate tax rate multiplied with the amount of debt in the current year. This implies that the amount of debt employed remains constant infinitely and the tax shelters can be used with certainty.[10] This assumption is also used e.g. by Kaplan (1989) and Kemsley/Nissim (2001). TS_D is adjusted accordingly in later periods, i.e. TS_{D1} is determined by $t_C D_1$. The difference between levered and unlevered performance –using (7) due to the perpetuity assumption[11, 12] – can then be rearranged, yielding:

$$\begin{aligned} &NPV_{L,t} - NPV_{U,t} = \\ &= NPV_{L,t-1} - NPV_{U,t-1} + r_{L,t} NPV_{L,t-1} - r_U NPV_{U,t-1} - r_D(1-t_C)D_{t-1} + \Delta D_t - r_U V_{U,t-1} \\ &+ r_D(1-t_C)D_{t-1} + r_U V_{U,t-1} + \Delta E_t - \Delta V_{U,t} = \\ &= NPV_{L,t-1}(1+r_{L,t}) - NPV_{U,t-1}(1+r_U) + \Delta TS_{D,t} \end{aligned} \quad \textbf{(13)}$$

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[10] Thus, they will be discounted by the riskless rate of return.

[11] And using $\Delta TS_D = \Delta D + \Delta E - \Delta V_U$

[12] Although the amount of debt employed in year *t* is uncertain from the point of view of years prior to *t*, the tax shields are still assumed to be riskless in year *t*. Thus, (7) can be applied. If the debt employed is dependent upon the value of the firm, (7) would have to be adjusted following Miles/Ezzell (1980) and Harris/Pringle (1985).

The difference in performance in *t* consists of the difference in *t-1* adjusted by a capital charge which differs for the levered and unlevered case plus the change in perpetuity tax shield.

This idea is illustrated by an example. The market value of debt and equity are assumed to be observable in each year. The riskless rate of return and the cost of debt equal 6%. Corporate earnings are taxed at 34%. The market risk premium is assumed to be 5%. Levered betas are known. Unlevered betas und unlevered cost of equity are derived using (6) and (8). Expected *EBIT* for the next three years are 150, 150 and 50. The market value of equity is determined by expectations about all future dividends, not only until year 3. Levered and unlevered *NPV* are calculated using (9) and (10).

	0	1	2	3
Debt	200	250	150	150
Observable market value of equity	700	750	850	1000
Periodic tax shield		4.08	5.10	3.06
Tax shield perpetuity	68	85	51	51
V_L	900	1000	1000	1150
Observed β_L		0.951	0.976	0.893
β_U		0.80	0.80	0.80
r_L		0.108	0.109	0.105
r_U		0.10	0.10	0.10
EBIT		150	150	50
Interest		-12	-15	-9
EBT		138	135	41
Taxes		46.92	45.9	13.94
Change in debt		50	-100	0
$Div_{L,t}$		141.08	-10.90	27.06
Levered NPV				
$IE_{L,t-1}$		700.00	634.20	714.10
$IE_{L,t-1}$ after capital charge		775.28	703.20	788.84
$Div_{L,t}$		-141.08	10.90	-27.06
$IE_{L,t}$	700.00	634.20	714.10	761.78
Market value of $equity_t$	700.00	750.00	850.00	1000.00
$NPV_{L,t}$	0.00	115.80	135.90	238.22
Unlevered NPV				
$IE_{U,t-1}$		900.00	891.00	881.10
$IE_{U,t-1}$ after capital charge		990.00	980.10	969.21
$Div_{U,t}$		-99.00	-99.00	-33.00
Assumed $IE_{U,t}$	900.00	891.00	881.10	936.21
$V_{U,t}$	832.00	915.00	949.00	1099.00
$NPV_{U,t}$	-68.00	24.00	67.90	162.79
$NPV_{L,t} - NPV_{U,t}$	*68.00*	*91.80*	*68.00*	*75.43*

Table 1: Example

The initial difference in net present value equals the perpetuity tax shield on the beginning debt level. The difference changes in the following periods due to capital charges and changes in tax shields. Changes in market values of equity are accounted for in NPV_L and because of $V_U = E + D - TS_D$ also - net of tax effects and changes in debt - in NPV_U. This implies, that the capital structure is changed towards purely equity financing without adjusting the investment program. This is also assumed implicitly by the literature reviewed in Section 1. The change in capital structure leads to a change in net present value caused by tax shields solely. Table 2 contains two alternative possibilities for illustrating the difference between levered and unlevered net present values.

Explaining the difference				
$NPV_{L,t-1}$		0.00	115.80	135.90
$Div_{L,t}$		141.08	-10.90	27.06
Capital charge on $IC_{L,t-1}$		-75.28	-69.00	-74.74
ΔE		50.00	100.00	150.00
$NPV_{L,t}$		115.80	135.90	238.22
$NPV_{U,t-1}$		-68.00	24.00	67.90
$Div_{U,t}$		99.00	99.00	33.00
Capital charge on $IC_{U,t-1}$		-90.00	-89.10	-88.11
ΔV_U		83.00	34.00	150.00
$NPV_{U,t}$		24.00	67.90	162.79
$NPV_{L,t}$ - $NPV_{U,t}$	*68.00*	*91.80*	*68.00*	*75.43*
Or				
$NPV_{L,t-1}$ - $NPV_{U,t-1}$		68.00	91.80	68.00
r_L * $NPV_{L,t-1}$		0.00	12.60	14.22
- r_U * $NPV_{U,t-1}$		6.80	-2.40	-6.79
Sum		74.80	102.00	75.43
Change in assumed perpetuity tax shield		17.00	-34.00	0.00
$NPV_{L,t}$ - $NPV_{U,t}$	*68.00*	*91.80*	*68.00*	*75.43*

Table 2: Example continued

2.2 Sample

Performance is to be measured for German companies from the point of view of domestic private shareholders. Although the majority of shares listed are held by other companies and financial institutions, the focus still lies upon private shareholders, since other companies and financial institutions are also held by private investors except for companies owned by the state.

The sample consists of 179 listed German companies. These companies are part of the DAX100-index, i.e. of the DAX and MDAX-subindices, which contains the largest one hundred German companies measured by market capitalisation and stock turnover. Furthermore, companies of the SMAX, which contains smaller companies, are also investigated. In order to ensure comparability regarding data drawn from financial statements, banks and insurance companies are excluded from the sample. Furthermore, to enable several possible holding periods for one firm it is required that at least 3 years of company data are available. The sample has been chosen, since these companies represent the majority of the market capitalisation and stock turnover, are all part of an index and are more closely monitored than other companies. This might apply to the SMAX companies only partially. Therefore, the sample will be split up into subsamples for DAX30-, MDAX- and SMAX-companies later on. Defining the sample from 2000 backwards focusses the analysis upon current shareholders. 2000 has been chosen as the end of the sample period, since it is the most recent year for which almost all financial data were available. Restricting the sample to firms which are listed at least three years and are included in the indices mentioned above, ensures that the sample comprises companies which are not in the early stage of their development. Those firms might be less interesting, when it comes to tax shields due to low or negative taxable income.[13] Table 3 shows the number of companies by industry and year.

Industry (classified according to CDAX subsamples as suggested by the German Stock Exchange)	No. of companies (as in 2000)	Year	No. of companies
Automobile	13	1987	55
Basic Resources	4	1988	61
Chemicals	6	1989	68
Construction	19	1990	79
Consumer Cyclical	14	1991	89
Financial Services	9	1992	93
Food & Beverages	6	1993	100
Industrial	18	1994	106
Machinery	23	1995	115
Pharma & Healthcare	18	1996	126
Retail	22	1997	141
Software	3	1998	157
Technology	12	1999	179
Telecommunications	2	2000	168

Table 3: Sample

Consolidated data are used, since it can be assumed that they provide a more complete picture of a company. Rajan/Zingales (1995) point out, that consolidated accounts are more informative than non-consolidated accounts since non-consolidated accounts provide possibilities to exclude financial liabilities of subsidiaries.[14] For the empirical

[13] Thus, the sample does not include companies listed on the new market segment (*Neuer Markt*).

[14] See Rajan/Zingales (1995), pp. 1425-1426.

analysis of tax shields corporate tax statements would be relevant, but they are not published.
The German commercial code (§ 292a *Handelsgesetzbuch; HGB*) allows listed companies to base their consolidated accounts upon the accounting rules of the HGB or IAS or US-GAAP. Since all three accounting systems can be found in the sample (e.g. in 2000: US-GAAP: 15 companies; IAS: 29 companies; HGB: 124 companies) none can be excluded for further analysis.[15]

The sample consists of large German companies with considerable international activities leading to the application of various tax regimes. Furthermore, companies are trying to avoid taxes. This leads to efforts using low-tax-countries for recognition of income and using high-tax-countries for recognition of expenses. In this paper statutory German tax rates are applied, since data allowing the analysis of firm specific tax policies are not available. Germany, however, is considered to be a high-tax-country.[16] Thus, when it comes to tax shields on debt and provisions, one can argue that there are incentives for German companies for expensing interest payments and increases in provisions in Germany. For that reason and also following the literature as e.g. Graham (1996a), (2000) or Kemsley/Nissim (2001) the domestic tax system will be applied.

2.3 Application under the German tax regime

2.3.1 German tax system

Up to December, 31st 2000 the German tax system can be characterised as an imputation system. Since the beginning of 2001, a shareholder relief system has been introduced. For an empirical analysis covering the period 1987 - 2000 the imputation system has still to be applied. It is assumed, that changes in the tax system are not anticipated in market capitalisation. The tax reform was decided upon by the government in July 2000. Market capitalisation at the end of 2000 should be affected by a revision of expectations about future dividends (after taxes) due to the change in the tax system. However, since this effect might be cumbersome to identify and affects only

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[15] An EU-Directive administers the member states to adjust country specific regulations to IAS by 2005/2007.

[16] See Giannini/Maggiulli (2002) for a comparison between EU-countries and Schreiber/Spengel/Lammersen (2002) for a comparison between USA and Germany.

the performance for 2000, it is neglected here. Other changes in the tax system like the abolition of taxes on corporate wealth raise the question also, at what point of time these changes are incorporated into share prices. The paper analyses yearly data. Event study analysis of price reactions around the date of publication might be the right method to get specific results. It is assumed here, that changes in the tax system are reflected in share prices in the year the change occurs.

The German imputation system is not a pure imputation system. Thus, corporate earnings are not taxed solely by the owner's income tax rates. The system deviates from a pure imputation system due to the taxation of corporate wealth, local earnings taxes and the taxation of retained earnings with a tax rate that is not identical to the income tax rate. Corporate tax shields occur due to these deviations. The German imputation system can be described as follows:

Taxation of corporate earnings

Corporate earnings are taxed by a local earnings tax (*Gewerbeertragsteuer;* t_{CL}) which varies across regions; it is assumed to be 16.67%. Corporate earnings are also taxed by a federal corporate tax (*Koerperschaftsteuer*). This tax rate varies for earnings paid out as dividends (in 2000: $t_{C\,Div}$: 30%) and retained earnings (in 2000: $t_{C\,RE}$: 40%). If earnings are paid out as dividends, corporate taxes on earnings ($t_{C\,Div}$) are added back to dividends. The sum of dividends paid and imputed corporate taxes is then to be taxed by the personal income tax rate. Thus, earnings paid out are taxed by local earnings taxes and income taxes. Since local earnings taxes decrease the tax base for income taxes, the combined corporate tax rate on paid out earnings (t_E) is defined by

$$t_E = t_I + t_{CL}(1 - t_I)$$

The personal income tax rate varies with the level of an investor's taxable income. Tax rates range from 19.9% to 48.5% currently. In addition, several smaller tax rates are raised: church tax and solidarity surtax. Since the former does not apply to every investor and the latter was introduced as an temporary tax in order to help to finance German reunification, these taxes are not considered here. Income in form of dividends has to be taxed at the same rate as income from bonds. Capital gains are to be taxed upon realisation under certain conditions: if a private investor owns shares only up to six months (from January 1st 1999: up to one year) or if an investor holds more than 25

% of total shares (from January 1st 1999: at least 10 %).[17] Otherwise, capital gains are tax-free for private investors. For almost the whole sample period capital gains are tax-free for holding periods exceeding 6 months. Thus, taxation of capital gains at the end of a holding period can be neglected, because the shortest holding period considered here is one year. According to the association of German auditors the average income tax rate can be assumed to be 35%.[18] This rate will be used in the paper.

The change in retained earnings is to be taxed by a corporate tax ($t_{C\ RE}$) in addition to the local earnings tax. The rate $t_{C\ RE}$ has varied across the years. It decreased from 56% to 40% until 2000. The personal income tax is not applied to increases in retained earnings. Since imputation occurs only for dividends paid and t_I differs from $t_{C\ RE}$ regularly, an additional tax effect has to be considered, if earnings are not paid out totally. If retained earnings are paid out later on, a compensating tax effect occurs, since imputation is then to be applied. This effect is neglected in the following for the sake of simplicity.

Taxation of corporate wealth

Until the end of 1996 German corporations had to pay two taxes on net corporate wealth which can be defined roughly as total assets minus liabilities, i.e. book value of equity. One was raised nationwide (t_{w1}; *Vermoegensteuer*).[19] The rate was 4.5 %o. It was not deductible from taxable earnings. The effective rate was therefore $0.0045/(1-t_{C\ RE})$. This tax is not collected anymore since the end of 1996. The second tax rate (t_{W2}; *Gewerbekapitalsteuer*) is raised by regional authorities. The local tax on wealth t_{W2} varies across regions. It is assumed to be 0.008 of book equity. It is deductible from taxable earnings. It was abolished at the end of 1997. Therefore, from 1987 to 1996 both taxes on wealth have to be considered; only t_{W2} has to be applied in 1997; from 1998 on corporate wealth is not taxed anymore. Total taxes on corporate wealth (t_W) before income taxes are defined by:

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[17] This rule was changed during the tax reform 2001: capital gains of private investors are to be taxed also for holding periods exceeding one year, if the investor holds at least 1% of total shares.

[18] IDW (1998), p. 37.

[19] Taxation of wealth on the investors' level is not considered here because of comparatively high tax-exempt amounts of 120.000 DM (240.000 DM for married couples and additional 120.000 for each child). This tax is also not raised anymore since the end of 1996.

$$t_W = \left[\frac{t_{W1}}{1 - t_{C\,RE}} + t_{W2}(1 - t_{CL}) \right] \quad \textbf{(14)}$$

2.3.2 *Fully utilised tax shields*

If leverage is 'homemade' by investors, interest expenses on private debt are also deductible from taxable income under the German tax regime. Or from the point of view of bondholders: interest income has to be taxed by income taxes, too. The income tax rate applied to income from bonds or to interest expenses on homemade leverage is identical to the tax rate on dividends.

Thus, only corporate taxes, which are not part of the imputation process, are to be considered for the definition of tax shields. If we first assume that loss carryforwards are zero and corporate taxable income after interest expenses and expenses caused by provisions is positive, tax shields can be utilised fully. Tax shields are caused by local earnings taxes and taxes on corporate wealth: interest expenses on short term debt are fully deductible from the taxation base of local earnings taxes, but interest expenses on long term debt are only half deductible; debt lowers corporate wealth compared to a company financed by equity entirely and thus lowers taxes on corporate wealth. Therefore, it follows for TS_D in the perpetuity case, fully deductible interest expenses and tax shields as risky as the underlying debt:[20]

$$TS_D = \left[\frac{r_D t_{CL}(1 - t_I)}{r_D(1 - t_I)} + \frac{t_W(1 - t_I)}{r_D(1 - t_I)} \right] D = \left(t_{CL} + \frac{t_W}{r_D} \right) D \quad \textbf{(15)}$$

Following Farrar/Selwyn (1967), Myers (1967) and Miller (1977) lower taxation of capital gains is to be taken into account. This leads to the following tax shields on debt (t_{IE} and t_{ID} denote the income tax rate on equity and on debt, respectively) leaving all other assumptions unchanged:

$$TS^*_D = D \left[1 - \frac{\left(1 - t_{CL} - \frac{t_W}{r_D} \right)(1 - t_{IE})}{1 - t_{ID}} \right] \quad \textbf{(16)}$$

[20] See also Drukarczyk/Richter (1995).

The income tax rate t_{IE} has to be estimated. Using an uniform income tax rate first, the payout to investors and creditors of a company financed by debt and equity can be formulated as:[21]

$$[EBIT - r_D D - t_{CL}(EBIT - r_D D) - t_W(TA - D)](1 - t_I) + r_D D(1 - t_I) \quad \textbf{(17)}$$

After rearranging follows:

$$[EBIT(1 - t_{CL}) - t_W TA](1 - t_I) + r_D D(1 - t_I)\left(t_{CL} + \frac{t_W}{r_D}\right) \quad \textbf{(18)}$$

Income taxes on income from equity investments will usually be lower due to lower and/or later taxation of capital gains. This is also the case for the German tax regime as was described in 2.3.1. Usually this argument is considered by formulating an average tax rate on dividends and capital gains.[22] One can derive this tax rate also by comparing the income to investors and creditors of the levered company with the income to investors of the unlevered company. The income of investors is subject to income taxes. Assuming an unlevered firm, the payout to investors is higher due to interest expenses saved. t_{IE} can be derived by asking how much of the additional income is paid out via dividends – thus subject to income taxes – or is transformed into capital gains, which are not subject to income taxes.[23]

If all additional income can be transformed into capital gains, income taxes have only to be paid on the same level of income as for the levered case. Based upon (17) it follows for the unlevered case:

$$EBIT(1 - t_{CL}) - t_W TA - t_I[EBIT - r_D D - t_{CL}(EBIT - r_D D) - t_W(TA - D)] \quad \textbf{(19)}$$

Levered income according to (18) and unlevered income according to (19) differ perdiodically by

$$r_D D(1 - t_I)\left(t_{CL} + \frac{t_W}{r_D}\right) - t_I r_D D\left[1 - \left(t_{CL} + \frac{t_W}{r_D}\right)\right] \quad \textbf{(20)}$$

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[21] *TA*: Total Assets

[22] See e.g. Graham (2000).

[23] Still considering private domestic investors who do not own more than 25% (10%) of all shares and hold their shares longer than six months.

Or: $r_D D\left(t_{CL} + \frac{t_W}{r_D} - t_I\right)$

Assuming a perpetuity, (20) discounted by the cost of debt after income taxes can be rearranged to

$$D\left[1 - \frac{1 - \left(t_{CL} + \frac{t_W}{r_D}\right)}{1 - t_I}\right] \qquad \textbf{(21)}$$

This equals equation (16) for t_{IE} =0.

In general, using b as the portion of after tax interest expenses saved (i.e. the additional income) which is not subject to income taxes, (19) can be rewritten as:

$$EBIT\,(1 - t_{CL}) - t_W TA - t_I\left[EBIT - b\,r_D D - t_{CL}\left(EBIT - b\,r_D D\right) - t_W\left(TA - b\,D\right)\right] \qquad \textbf{(22)}$$

Using the same steps as before yields a periodic tax effect of:

$$r_D D\left\{(1 - t_I)\left(t_{CL} + \frac{t_W}{r_D}\right) - t_I b\left[1 - \left(t_{CL} + \frac{t_W}{r_D}\right)\right]\right\} \qquad \textbf{(23)}$$

For the perpetuity case follows:

$$D\left\{1 - \frac{\left[1 - \left(t_{CL} + \frac{t_W}{r_D}\right)\right]\left[1 - (1 - b)t_I\right]}{1 - t_I}\right\} \qquad \textbf{(24)}$$

For the empirical analysis it will be argued here, that b is not 100% due to the following reasons:

- If the additional funds are reinvested into financial assets – leaving the operating investment program unchanged and assuming interest rates are the same for companies and investors –corporate taxes which are not part of the imputation process turn the net present value of these reinvestments to be negative.
- If the additional funds are not reinvested into financial assets, repurchase of own shares could be considered. However, share buybacks are restricted for German stock corporations to 10% of the nominal value of equity (§ 71 (2) *AktG*). Even

after the conditions for share repurchases were relaxed in 1998, the number of firms using share repurchases is very limited.

For illustrating the effect of asymmetric income taxation, the empirical analysis will be conducted for $b = 0$, $b = 0.5$ and $b = 0.75$.

Provisions decrease corporate wealth and therefore taxes on corporate wealth.[24] Increases in provisions considered here are assumed to be tax deductible.[25] This applies to local earnings taxes as well as to income taxes: the tax shields cannot be duplicated at the investors' level; there are no 'homemade provisions'. Payments out of provisions e.g. pension payments or guarantee payments are assumed to occur independently upon building up provisions in the financial statement. If no provisions are built up before the payment occurs, taxable income is reduced by these payments. Thus, this tax shield on provisions arises only temporarily. However, the relevant period and the corresponding interest advantage can be significant.[26] Assuming full payout of earnings, periodic earnings tax shield on provisions are defined by:

$$[t_I + t_{CL}(1-t_I)]\Delta Prov = t_E \Delta Prov \qquad \textbf{(25)}$$

For the empirical analysis, changes in provisions exceeding 20% which occur simultaneously with a change in total assets minus provisions exceeding 20% will be excluded, assuming that such an increase is due to an change of the scope of consolidation.

For the perpetuity case only taxes on corporate wealth are considered, since provisions are not allowed to increase or decrease infinitely. Cost of debt after income taxes are applied for deriving the present value:

$$TS_{Prov} = \frac{t_W(1-t_I)}{r_D(1-t_I)} Prov = \frac{t_W}{r_D} Prov \qquad \textbf{(26)}$$

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[24] Provisions which are not tax deductible are not considered here.

[25] If the reason for building up a provision vanishes, provisions have to be decreased. This decrease is taxable income: expenses for increasing provisions are to be interpreted as net expenses, i.e. they are allowed to be negative.

[26] This advantage was decreased by a change in the tax code in 1999: expenses for long term provisions are only tax deductible up to the present value of the expected payments.

2.3.3 Partially utilised tax shields

Now non-utilisation of tax shields on debt and provisions will be considered. This problem occurs, since it is uncertain, whether taxable income is high enough for fully utilising tax shields.

Riskiness of tax shields caused by debt levels which are certain percentages of company value in each period (targeted debt ratio) will not be discussed here.[27] It will be assumed that debt levels are defined independently upon other variables as e.g. company value. Therefore, the tax shields on interest expenses on a bond with zero probability of default can be discounted by the risk free rate.

Prerequisite for a full utilisation of tax shields are sufficiently high earnings. The standard case regularly assumed in text books is that earnings before taxes (EBT) are positive and no loss carryforwards are to be considered. In that case tax shields on interest expenses lower tax payments immediately.[28] However, if EBT is negative, tax shields cannot be used immediately and it has to be differentiated between positive and negative EBIT. In the former case tax shields can be utilised partially and in the latter case they cannot be utilised in the current period at all. Negative EBT leads to loss carryforwards or to loss carrybacks.[29] Tax shields can only be used with a delay and if future earnings are sufficiently large. The problem of non-utilised tax shields was evaluated by e.g. Altshuler/Auerbach (1990) and Graham (1996).[30] Using confidential data from U.S. Treasury Altshuler/Auerbach estimate shadow values of marginal tax shields on interest expenses to be 19% for companies with tax losses for two consecutive years compared to a statutory rate of 46%. The weighted average for the total sample is 32%. Graham (1996) uses simulations runs assuming that income follows a random walk with a drift and estimates the (weighted) average of the marginal tax rate to be 20% (27.8%) in 1992 when the statutory tax rate was 34%.

Averaging the results of both papers, the effective tax rate is around 75% of the statutory rate. Since the sample consists of companies still in the market in 2000, only survivors are included, although the sample contains companies that underwent major

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[27] See Miles/Ezzell (1980) and Harris/Pringle (1985).

[28] Taxes are assumed to be paid in the same period as taxable income is recognised.

[29] Before 1999 tax loss carrybacks were restricted to a maximum of 10 million DM over two years under the German tax regime. 1999 and 2000 only 2 million DM could be carried back one year. Due to their minor influence carrybacks are neclected for the rest of the paper.

[30] See also Auerbach (2001).

financial restructuring during the observation period.[31] Therefore, it seems to be justifiable to estimate the effective tax rate on currently unused tax shields to be 75% of the statutory rate. This procedure will only be used for unused tax shields of the current period.

Non-utilisation of tax shields has to be considered also for measuring the present value of future tax shields. Graham (2000) estimates the mean present value of future tax shields to be 9.7% of firm value. If the income tax disadvantage on bond income as in Miller (1977) is considered the value contribution decreases to 4% and 7% depending upon whether the cost of debt before or after income tax is used to discount estimated future tax shields. Tax loss carryforwards, investment tax credits and alternative minimum tax are considered. Plesko (1999) analyzes the validity of estimates of average and marginal tax rates based upon financial statements by comparing it with the tax rates based upon confidential tax return data. He points out that simple proxies – e.g. the statutory rate if the firm reports positive pretax income and a tax rate of zero if the firm reports loss carryforwards – have similar explanatory power as tax rates estimated by more sophisticated approaches.

Since the sample analyzed is a 'sample of survivors', it will be argued here to use a rather pragmatic approach also for evaluating future tax shields. For this purpose data published by Standard & Poor's concerning EBIT-interest-coverage will be used: The risk of insufficient taxable income and thus an effective tax rate below the statutory tax rate will be considered by using the probability of transition to a rating category for which the ratio of EBIT to interest based upon historical data has been below 100%. As reported by Standard & Poor's (2001) the median (1998-2000) EBIT-interest-coverage for issuers rated B and CCC is 0.8 and 0.1 respectively. Standard & Poor's reports the following probabilities of transition to rating categories for which full utilisation of tax shields cannot be expected:

[31] E.g. Philipp Holzmann, Wuensche, mg Technologies (as former Metallgesellschaft).

Rating at year end / Initial rating	B $Prob_B$	CCC $Prob_{CCC}$	D $Prob_D$	Cumulative probability $Prob_{+B}$	 $Prob_{B-}$
AAA	0	0	0	0	0
AA	0.09	0.02	0.01	99.97	0.03
A	0.2	0.01	0.04	99.95	0.05
BBB	0.81	0.16	0.24	99.6	0.4
BB	7.46	1.05	1.08	97.87	2.13
B	83.62	3.84	5.94	90.24	9.76
CCC	10.28	61.23	25.26	13.51	86.49

Table 4: Not-Rated Adjusted Average One-Year Transition Rates in% - Standard & Poor's (2001b), p. 14.[32]

The present value of the perpetuity of expected tax shields, assuming that

- transition rates as in Table 4 remain constant,
- the utilisation rate of companies rated B is 1 and
- the utilisation rate of companies rated CCC is zero,

will be defined as follows:[33]

$$TS^* = \frac{[(r_D t_{CL} + t_W)D + t_W\,Prov](1-t_I)(1-Prob_{B-})}{r_D(1-t_I) + Prob_{B-}} \qquad \textbf{(27)}$$

Because the majority of companies in the sample is not rated, another pragmatic approach is needed in order to come up with an estimated rating. The rating will be roughly estimated by using the median values of key financial ratios for industrial companies as reported by Standard & Poor's.[34] If a company fits e.g. into rating category AAA (AA, A…) according to its return on capital,[35] this will be considered by using a value of 1 (2, 3…) for this ratio. Then the simple average of the values for all

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[32] $Prob_{+B}$ ($prob_{B-}$) stands for the probability of a rating better than or equal to (lower than) B.

[33] (27) is derived according to the assumptions made above as a perpetuity with a negative growth rate $Prob_{B-}$

[34] EBIT interest coverage; EBITDA interest coverage; free operating cash flow/total debt; return on capital; operating income/sales; long-term debt/capital; total debt/capital; Standard & Poor's (2001a), pp. 53-55.

[35] Example: Standard & Poor's reports a median EBIT interest coverage for AAA (AA) companies of 21.4 (10.1); thus, a company is assumed to be rated AAA for this ratio, if its coverage ratio is at least 15.75 [= (21.4+10.1)/2]; in this case the coverage ratio will be considered with a value '1' in the average of the scoring values of all ratios. This procedure is repeated for each year of the holding period.

seven ratios is calculated. If the result is e.g. 3.2, the company is estimated to be rated A, since a company is rated A for simple averages between 2.6 and 3.5. In this case, the perpetuity tax shield is calculated using a probability for a rating better then B of 99.95%.

Applying this approach, 1.37% of all observations show a rating worse than B. Thus, the overall empirical results are dependent only to a minor extent upon the methodology chosen for dealing with low performers. This allows us also to set book values of debt equal to market values and thereby to neglect default probabilities and recovery rates.

2.3.4 Cost of capital

Despite the empirically supported criticism of the validity of the CAPM, the cost of equity are calculated using this model due to the lack of a better alternative. The risk free rate (r_F) equals the average yield on long term government bonds. Levered betas were provided by Barra. Stehle (1999) calculates a market risk premium of 4.4 in nominal terms based upon data from 1969 to 1998 for an income tax rate equal to $t_{C\,Div}$. This market risk premium is used in the following. Performance will be measured net of income taxes. Therefore, dividends paid will be adjusted for the imputation effect, i.e.

$$Div_{after\ income\ tax} = Div_{paid} \frac{1 - t_I}{1 - t_{C\,Div}}. \qquad \textbf{(28)}$$

The cost of capital used are defined after income taxes following Brennan (1970). For applying the CAPM after income taxes, the risk free rate will be defined after income taxes. The expected market return will be split up into the rate of return due to capital gains and the dividend yield. Capital gains are assumed to be tax free. Income taxes are applied to the expected dividend yield ($\bar{r}_{Div}$). The weighted average dividend yield for the sample is 2.52 % before adjusting for the imputation effect. This yield is used as a proxy for the expected dividend yield. The imputation effect as shown in (28) is applied. Thus, levered cost of equity using observable levered betas can be defined by

$$\bar{r}_L = r_F(1 - t_I) + \beta_L\left[\bar{r}_M - \bar{r}_{Div} t_I - r_F(1 - t_I)\right] \qquad \textbf{(29)}$$

The weighted average levered beta is 0.948. The weighted average levered cost of equity are 0.0947.[36]

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[36] Weighted by market values of equity.

Unlevering the leveraged beta assuming tax shields as risky as the underlying debt yields[37]

$$\beta_U = \frac{\beta_L}{1+\frac{D-TS_D-TS_{Prov}}{E}} + \frac{\beta_D}{1+\frac{E}{D-TS_D-TS_{Prov}}} \tag{30}$$

and thus

$$\bar{r}_U = r_F(1-t_I)+\beta_U\left[\bar{r}_M - \bar{r}_{Div}t_I - r_F(1-t_I)\right] \tag{31}$$

The weighted average unlevered beta is 0.864; the unlevered cost of equity are on average 0.0896.[38]

As with the cost of equity, it would be preferrable to use firm specific cost of debt. However, they are not reported by companies on a regular basis. Furthermore, by far not all German companies went through a rating process. Finally, it is not recommended to estimate firm specific cost of debt by dividing interest expenses by interest bearing liabilities as reported in financial statements: these results suffer from comparing yearly interest expenses with the debt employed at a specific date. The cost of debt used in the paper are the yearly long term and short term costs of debt on corporate loans and bonds as reported by the Deutsche Bundesbank. Since the same cost of debt is used for determining interest expenses and for discounting tax shields assuming a perpertuity, the cost of debt is not relevant in this context. It is relevant for unlevering beta-values and cost of equity.

The market value of equity is calculated by using share prices at the end of the fiscal year. The market value of debt is set equal to the book value of debt.

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[37] With $cov(Div_U, r_M) = cov(Div_L, r_M) + cov\left(r_D\left(1-t_{CL}-\frac{t_W}{r_D}\right)(1+t_I)D + \Delta D + t_W\ Prov(1-t_I), r_M\right)$

divided by the variance of market returns and V_U, since $\beta_U = \frac{\frac{cov(Div_U, r_M)}{\sigma_M^2}}{V_U}$, yielding:

$$\beta_U = \frac{1}{V_U}\frac{cov(Div_L, r_M)}{\sigma_M^2} + \frac{1}{V_U}\frac{cov(r_D(1+t_I)D+\Delta D, r_M) - cov\left(r_D\left(t_{CL}+\frac{t_W}{r_D}\right)(1+t_I)D, r_M\right) - cov(t_W(1+t_I)Prov, r_M)}{\sigma_M^2}$$

and

$\beta_U = \frac{E}{V_U}\beta_L + \frac{D-TS_D-TS_{Prov}}{V_U}\beta_D$; this is equivalent to (30).

[38] Weighted by unlevered firm values.

3. Empirical results

3.1 Tax effects on debt and provisions

3.1.1 Symmetric income taxation

This section shows the empirical relevance of tax shields on debt and provisions. All companies are aggregated to a portfolio following Fama/French (1999). Observations were excluded, if a merger of two companies disturbs the comparability over time.[39] Tax shields will be measured first by taxing income from bonds and equity with the same income tax rate (b =0). After that, income from equity will be assumed to be taxed by a lower income tax rate due to lower taxation of capital gains compared to dividends paid.

Tabel 5 contains data relating tax shields to levered firm value, debt and provisions. Periodic tax shields on interest expenses are considerably lower than periodic tax shields on provisions. This is due to the effect that earnings tax shields on interest expenses occur only due to local earning taxes, since interest expenses also reduce income taxes in the case of homemade leverage. Earnings tax shields on provisions are caused by both local earnings taxes and income taxes, since homemade provisions are not possible.

Periodic tax shields on debt and provisions decrease in the last years of the sample period due to the abolition of corporate wealth taxes in 1996 and 1997.

[39] E.g.: 1998 DaimlerChrysler merged with Chrysler. Daimler Benz is included in the sample for the period 1987 to 1997. DaimlerChrysler enters the sample from 1998 to 2000. Other examples are the mergers between VEBA and VIAG (Eon), and Krupp and Thyssen (ThyssenKrupp).

The perpetuity tax shields on debt contain corporate wealth taxes until 1996 and local earnings tax shields on interest expenses. Tax shields on provisions for the perpetuity case consist only of taxes on corporate wealth. No infinite changes in provisions are assumed. Therefore, the last perpetuity tax shield on provisions appears in 1996. Tax shields on provisions dominate tax shields on debt up to 1996. The average perpetuity tax shields on debt is 5.1% of levered firm value over the total sample period and 6% over the period 1987 to 1996. The corresponding average for provisions is over 9.7% up to 1996. Taken together these tax shields amount to 15.7 of levered firm value for 1987 to 1996. This is a considerable figure. The impact of tax shields on performance is even more considerable, since tax shields are a part of NPV_L and thus have an immediate influence on net performance as will be shown in Section 3.3.

b=0	Periodic TS_D in % of EBIT	Periodic TS_{Prov} in % of EBIT + Incr. Prov.	Perpetuity TS_D in % of V_L	Perpetuity TS_{Prov} in % of V_L	Perpetuity TS_D in % of D	Perpetuity TS_{Prov} in % of Prov
1987			0.071	0.154	0.331	0.246
1988	0.021	0.163	0.064	0.152	0.286	0.242
1989	0.018	0.102	0.050	0.097	0.253	0.190
1990	0.027	0.118	0.059	0.088	0.241	0.156
1991	0.032	0.130	0.057	0.082	0.231	0.148
1992	0.044	0.182	0.066	0.090	0.224	0.136
1993	0.057	0.211	0.060	0.080	0.243	0.147
1994	0.049	0.171	0.059	0.089	0.245	0.157
1995	0.039	0.174	0.073	0.100	0.283	0.172
1996	0.033	0.115	0.040	0.042	0.185	0.088
1997	0.022	0.082	0.027		0.109	
1998	0.012	0.050	0.027		0.109	
1999	0.016	0.071	0.027		0.114	
2000	0.018	0.035	0.029		0.091	
Average	0.030	0.123	0.051		0.210	
Avg. 87-97	0.034	0.145	0.057		0.239	
Avg. 87-96	0.036	0.152	0.060	0.097	0.252	0.168

Table 5: Tax shields on debt vs tax shields on provisions total sample

If the sample is split up into the three subsamples it becomes evident, that the performance of DAX companies is influenced more by tax shields than the performance of the other subsamples. Table 6 reveals that total tax shields on debt and provisions account for 18.3 % of total firm value (1987 – 1996) for the DAX-subsample. Tax shields on provisions exceed tax shields on debt until 1996. Perpetuity tax shields on debt and provisions account for different percentages of debt and provisions compared to the result for the total sample, since total debt is divided up differently in short term and long term debt and the impact of nonutilisation of tax shields is lower for the DAX sample.

The impact of tax shields on debt and provisions on MDAX and SMAX companies is considerably lower. Especially provisions contribute not as much to corporate performance as it was the case for DAX companies. Tax shields are lower for the MDAX-subsample compared to the other subsamples, because it contains a few companies for which tax shields can only be used partially (e.g. Philipp Holzmann).

3.1.2 Asymmetric income taxation

Now, tax exemption of capital gains is considered. First, the results for the total sample are presented. After that, the sample will be split up again into subsamples. These tax shields differ from the tax shields reported in 3.1.1, of course. The value of the levered company still equals the sum of the market values of equity and debt. Thus, the same equity values are used as a point of reference assuming that the market prices tax shields now differently as suggested in 3.1.1. The differentiated income taxation will only be applied to debt. It can be argued that provisions do not cause a similar tax effect, since provisions are – according to the data – increasing over time: income in the case of using provisions (levered case) is higher than income in the case of not using provisions (unlevered case) because of the earlier use of earnings tax reductions and lower taxes on corporate wealth. Related cash outflows e.g. for pension payments are considered in both the levered and the unlevered case, i.e. they occur independently upon the recognition of provisions. Thus, there is not more income to investors in the unlevered case which could be transformed in capital gains, but less income.

b=0	DAX				MDAX				SMAX			
	Perpetuity TS_D in % of V_L	Perpetuity TS_{Prov} in % of V_L	Perpetuity TS_D in % of D	Perpetuity TS_{Prov} in % of Prov	Perpetuity TS_D in % of V_L	Perpetuity TS_{Prov} in % of V_L	Perpetuity TS_D in % of D	Perpetuity TS_{Prov} in % of Prov	Perpetuity TS_D in % of V_L	Perpetuity TS_{Prov} in % of V_L	Perpetuity TS_D in % of D	Perpetuity TS_{Prov} in % of Prov
1987	0.075	0.178	0.342	0.248	0.057	0.070	0.291	0.233	0.069	0.148	0.300	0.246
1988	0.066	0.175	0.295	0.245	0.055	0.072	0.254	0.222	0.055	0.117	0.260	0.248
1989	0.054	0.120	0.257	0.191	0.037	0.040	0.236	0.183	0.056	0.058	0.256	0.194
1990	0.072	0.120	0.248	0.158	0.038	0.032	0.221	0.146	0.034	0.033	0.205	0.147
1991	0.065	0.107	0.239	0.149	0.039	0.031	0.204	0.137	0.053	0.031	0.230	0.143
1992	0.071	0.113	0.229	0.137	0.052	0.039	0.201	0.123	0.071	0.035	0.245	0.138
1993	0.068	0.101	0.255	0.150	0.040	0.032	0.196	0.123	0.058	0.028	0.258	0.147
1994	0.061	0.110	0.248	0.157	0.051	0.043	0.235	0.150	0.074	0.032	0.250	0.160
1995	0.071	0.116	0.292	0.174	0.078	0.059	0.279	0.167	0.079	0.035	0.220	0.155
1996	0.040	0.047	0.196	0.089	0.040	0.025	0.160	0.080	0.056	0.018	0.151	0.081
1997	0.028		0.111		0.022		0.101		0.032		0.098	
1998	0.027		0.111		0.022		0.102		0.030		0.082	
1999	0.027		0.118		0.029		0.103		0.028		0.072	
2000	0.029		0.090		0.025		0.097		0.031		0.081	
Average	0.054		0.217		0.042		0.191		0.052		0.194	
Avg. 87-97	0.061		0.247		0.046		0.216		0.058		0.225	
Avg. 87-96	0.064	0.119	0.260	0.170	0.049	0.044	0.227	0.156	0.061	0.054	0.238	0.166

Table 6: Tax shields subsamples for b=0

Tables 7 and 8 contain tax shields on debt for the total sample, if b = 0.5, i.e. t_{IE} = 0.175, and b =0.75, i.e. t_{IE} = 0.0875, respectively. As mentioned above, tax shields on provisions are not dependent upon *b*, since provisions employed increase over time. Periodic tax shields and perpetuity tax shields are considerably lower than for the undifferentiated case when t_{IE} was assumed to be 0.35. For b = 0.5, tax shields on debt account on average only for 1.8% of levered firm value and 7.4% of debt employed over the period 1987 to 1996. For b = 0.75 tax shields are slightly negative.

b=0.5	Periodic TS_D in % of EBIT	Perpetuity TS_D in % of V_L	Perpetuity TS_D in % of D
1987		0.034	0.157
1988	0.010	0.025	0.114
1989	0.007	0.013	0.065
1990	0.007	0.015	0.060
1991	0.008	0.012	0.050
1992	0.010	0.018	0.062
1993	0.016	0.017	0.069
1994	0.014	0.018	0.076
1995	0.012	0.028	0.107
1996	0.013	-0.005	-0.022
1997	-0.005	-0.030	-0.121
1998	-0.012	-0.026	-0.107
1999	-0.014	-0.025	-0.104
2000	-0.015	-0.026	-0.082
Average	0.004	0.005	0.023
Avg. 87-97	0.009	0.013	0.056
Avg. 87-96	0.011	0.018	0.074

Table 7: Tax shields on debt if t_{IE} = (1-0.5)0.35=0.175 – total sample

b=0.75	Periodic TS_D in % of EBIT	Perpetuity TS_D in % of V_L	Perpetuity TS_D in % of D
1987		0.015	0.069
1988	0.004	0.006	0.028
1989	0.002	-0.006	-0.028
1990	-0.003	-0.007	-0.030
1991	-0.004	-0.010	-0.040
1992	-0.007	-0.006	-0.019
1993	-0.004	-0.005	-0.018
1994	-0.003	-0.002	-0.009
1995	-0.001	0.005	0.018
1996	0.003	-0.027	-0.125
1997	-0.018	-0.058	-0.235
1998	-0.025	-0.053	-0.215
1999	-0.029	-0.051	-0.213
2000	-0.032	-0.054	-0.169
Average	-0.009	-0.018	-0.071
Avg. 87-97	-0.003	-0.009	-0.035
Avg. 87-96	-0.002	-0.004	-0.015

Table 8: Tax shields on debt if t_{IE} = (1-0.75)0.35=0.0875 – total sample

The results for the subsamples are shown in Table 9. The tax shieds on debt in percent of levered total firm value depends upon the amount of debt employed and the impact of unused tax shields. Tax shields on debt are slightly lower for MDAX-companies. Again, if t_{IE} is set at 8.75%, tax effects of debt financing are negative.

	DAX	MDAX	SMAX		DAX	MDAX	SMAX
b=0.5	Perpetuity TS_D in % of V_L			b=0.75	Perpetuity TS_D in % of V_L		
1987	0.036	0.025	0.028	1987	0.017	0.009	0.007
1988	0.027	0.021	0.018	1988	0.007	0.003	-0.001
1989	0.015	0.008	0.012	1989	-0.005	-0.007	-0.010
1990	0.019	0.008	0.008	1990	-0.008	-0.007	-0.005
1991	0.015	0.007	0.012	1991	-0.010	-0.009	-0.009
1992	0.020	0.014	0.020	1992	-0.006	-0.005	-0.005
1993	0.020	0.011	0.017	1993	-0.005	-0.004	-0.004
1994	0.019	0.015	0.024	1994	-0.002	-0.003	-0.001
1995	0.027	0.029	0.029	1995	0.005	0.005	0.003
1996	-0.004	-0.008	-0.007	1996	-0.026	-0.032	-0.039
1997	-0.031	-0.023	-0.029	1997	-0.061	-0.046	-0.059
1998	-0.027	-0.023	-0.026	1998	-0.054	-0.045	-0.053
1999	-0.024	-0.025	-0.028	1999	-0.050	-0.052	-0.056
2000	-0.027	-0.021	-0.030	2000	-0.055	-0.044	-0.060
Average	0.006	0.003	0.003	Average	-0.018	-0.017	-0.021
Avg. 87-97	0.015	0.010	0.012	Avg. 87-97	-0.008	-0.009	-0.011
Avg. 87-96	0.019	0.013	0.016	Avg. 87-96	-0.003	-0.005	-0.006

Table 9: Tax shields on debt if t_{IE} = (1-0.5)0.35=0.175 and t_{IE} = (1-0.75)0.35=0.0875 – subsamples

3.2 Levered Performance

Levered performance for the total sample is shown in Table 10 for each holding period. The columns represent the (end of the) year of investment and the lines stand for the (end of the) year of desinvestment. The ratio used is a profitability index (*Index*$_{NPV}$) defined by

$$Index_{NPV\,,Levered\,t} = \frac{E_t - IE_{L,t}}{E_t} = \frac{NPV_{L,t}}{E_t} \qquad \textbf{(32)}$$

Year t denotes the last year of the holding period. Due to the definition of IE_L , profitability is defined net of cost of capital, while taking dividends paid, share repurchases and changes in paid in equity into account. Out of 91 possible holding periods, 52 signal value creation, i.e. the index is positive, and 39 signal value destruction, i.e. the index is negative.

Levered Performance

1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1988	-0.0001												
1989	0.187	0.206											
1990	-0.036	-0.024	-0.278										
1991	0.000	0.010	-0.220	0.025									
1992	-0.251	-0.250	-0.548	-0.243	-0.290								
1993	-0.030	-0.022	-0.257	-0.005	-0.040	0.193							
1994	-0.134	-0.110	-0.365	-0.095	-0.136	0.119	-0.091						
1995	-0.260	-0.214	-0.488	-0.204	-0.243	0.034	-0.195	-0.096					
1996	-0.072	-0.043	-0.257	-0.029	-0.049	0.175	-0.007	0.071	0.155				
1997	0.025	0.093	-0.057	0.106	0.099	0.259	0.131	0.186	0.252	0.146			
1998	0.015	0.099	-0.018	0.082	0.101	0.210	0.122	0.162	0.202	0.149	0.078		
1999	0.041	0.129	0.043	0.118	0.125	0.207	0.136	0.169	0.197	0.146	0.262	0.177	
2000	0.099	0.189	0.097	0.190	0.190	0.296	0.218	0.258	0.295	0.240	0.177	-0.010	-0.241

Table 10: Performance total sample

The calculations are based upon the assumptions made above as e.g.: the market prices tax shields as outlined in Section 2.1; the average investor faces an income tax rate of 35%; the market risk premium is set at 4.4%.

The sample is then divided into subsamples. The DAX sample performs better than the other subsamples. During 64 (27) holding periods value is generated (destroyed). Investing in the MDAX sample has yielded value added (destroyed) for only 21 (70) holding periods. The sample of SMAX-companies delivered similar results: during 20 (71) holding periods value is created (destroyed).

3.3 Levered vs unlevered performance

If levered and unlevered performance are compared, it is interesting to observe that tax shields on debt and provisions contribute to performance considerably depending upon the level of tax exempt capital gains.

Applying (13), unlevered net present value of year *t* can be derived by:

$$NPV_{U,t} = NPV_{L,t} - NPV_{L,t-1}(1+r_{L,t}) + NPV_{U,t-1}(1+r_U) - \Delta TS_{D,t}$$

For illustration purposes the unlevered index is related to the market value of equity, too:

$$Index_{NPV,Unlevered,t} = \frac{NPV_{U,t}}{E_t} \tag{33}$$

Levered and unlevered index differ by:

$$Index_{NPV,Levered,t} - Index_{NPV,Unlevered,t} = \frac{NPV_{L,t} - NPV_{U,t}}{E_t} \tag{34}$$

Table 11 shows the results for the unlevered performance according to (33). Starting with t_{IE} = 0.35, after eliminating tax shields on debt and provisions 13 holding periods classified as value enhancing measured by levered performance turn into value decreasing observations. The impact of tax shields is higher in the years before the abolition of taxes on corporate wealth. If t_{IE} = 0.175, 7 holding periods formerly identified as value enhancing turn out to be value decreasing. Finally, for t_{IE} = 0.0875, 4 holding periods classified as value enhancing in terms of levered performance, turn out to be value decreasing, if unlevered performance is measured.

Thus, even if tax exempt capital gains are considered, for several periods tax shields are important for yielding positive levered performance. Especially for t_{IE} = 0.0875 (*b* = 0.75), tax shields on provisions are responsible for that result.

Dividing the sample into subsamples reveals that for the DAX-sample 19 holding periods identified as value generating according to levered performance are turned into value decreasing periods assuming t_{IE} = 0.35; setting t_{IE} = 0.175 (0.0875), performance signals for 13 (12) holding periods are changing from positive to negative. For the MDAX and SMAX subsamples tax shields are less decisive:

Unlevered Performance

b=0

1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1988	-0.340												
1989	-0.055	-0.022											
1990	-0.315	-0.285	-0.518										
1991	-0.255	-0.229	-0.440	-0.179									
1992	-0.593	-0.572	-0.847	-0.521	-0.578								
1993	-0.320	-0.295	-0.511	-0.240	-0.286	-0.035							
1994	-0.448	-0.408	-0.643	-0.354	-0.407	-0.135	-0.331						
1995	-0.630	-0.563	-0.815	-0.512	-0.572	-0.276	-0.489	-0.374					
1996	-0.297	-0.254	-0.448	-0.206	-0.232	0.004	-0.163	-0.073	0.021				
1997	-0.099	-0.017	-0.153	0.019	0.014	0.181	0.064	0.127	0.201	0.104			
1998	-0.075	0.018	-0.087	0.023	0.041	0.157	0.077	0.122	0.167	0.121	0.047		
1999	-0.038	0.058	-0.018	0.063	0.071	0.158	0.094	0.131	0.163	0.117	0.229	0.132	
2000	0.007	0.106	0.026	0.126	0.125	0.237	0.168	0.213	0.253	0.206	0.138	-0.064	-0.288

b=0.5

1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1988	-0.287												
1989	-0.002	0.028											
1990	-0.243	-0.217	-0.454										
1991	-0.181	-0.157	-0.372	-0.117									
1992	-0.496	-0.479	-0.758	-0.440	-0.502								
1993	-0.232	-0.210	-0.430	-0.167	-0.217	0.027							
1994	-0.356	-0.319	-0.556	-0.277	-0.335	-0.071	-0.271						
1995	-0.524	-0.460	-0.713	-0.422	-0.486	-0.200	-0.418	-0.309					
1996	-0.204	-0.161	-0.357	-0.124	-0.153	0.076	-0.094	-0.010	0.081				
1997	-0.024	0.058	-0.078	0.086	0.079	0.242	0.123	0.182	0.253	0.156			
1998	-0.026	0.067	-0.038	0.066	0.083	0.195	0.115	0.157	0.201	0.156	0.100		
1999	0.006	0.102	0.026	0.103	0.110	0.195	0.130	0.165	0.196	0.151	0.278	0.203	
2000	0.062	0.160	0.081	0.176	0.174	0.282	0.213	0.255	0.295	0.249	0.200	0.027	-0.207

b=0.75

1987	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1988	-0.260												
1989	0.024	0.052											
1990	-0.207	-0.183	-0.423										
1991	-0.144	-0.122	-0.338	-0.086									
1992	-0.449	-0.433	-0.714	-0.400	-0.465								
1993	-0.190	-0.169	-0.390	-0.131	-0.182	0.058							
1994	-0.312	-0.276	-0.515	-0.240	-0.300	-0.039	-0.242						
1995	-0.472	-0.410	-0.665	-0.379	-0.444	-0.162	-0.382	-0.277					
1996	-0.159	-0.117	-0.313	-0.085	-0.114	0.111	-0.060	0.021	0.111				
1997	0.012	0.094	-0.043	0.119	0.111	0.271	0.152	0.209	0.279	0.181			
1998	-0.003	0.090	-0.016	0.087	0.104	0.214	0.133	0.174	0.218	0.174	0.127		
1999	0.027	0.122	0.046	0.123	0.129	0.212	0.147	0.181	0.212	0.168	0.302	0.239	
2000	0.088	0.186	0.107	0.200	0.197	0.304	0.235	0.276	0.315	0.270	0.230	0.072	-0.167

Table 11: Unlevered performance for b=0 (t_{IE} = 0.35), b=0.5 (t_{IE} = 0.175) and b=0.75 (t_{IE} = 0.0875)

For MDAX (SMAX) tax shields are responsible for a change from positive to negative performance for 1 (7) holding periods assuming t_{IE} = 0.35. Setting t_{IE} equal to 0.175 the number of value increasing holding periods observations remains unchanged for the MDAX-subsample. If t_{IE} is set equal to 0.0875, the number of value increasing holding periods is even increasing by 3 due to negative tax shields on debt.
Setting t_{IE} equal to 0.175 for the SMAX-subsample 3 value increasing holding periods turn into value decreasing periods. If t_{IE} is set equal to 0.0875, the number of value increasing holding periods is increasing by 3 due to negative tax shields on debt also for the SMAX-subsample.
Tax shields turn less positive indices into negative indices for the MDAX- and SMAX-subsamples compared to DAX-companies due to the lower level of tax shields and also because the number of value decreasing holding periods is already quite high in terms of levered performance for MDAX- and SMAX-companies.

As Table 12 reveals, the number of value creating holding periods is not very sensitive to income tax rates ranging from 30 to 40%. They are influenced considerably by the market risk premium used. Table 12 contains the results of the sensitivity analysis for levered and unlevered performance.

Levered Performance				
	Market risk premium	0.04	0.044	0.05
	Income tax rate			
	0.3	56	54	49
	0.35	56	52	49
	0.4	56	52	49
Unlevered Performance				
	Market risk premium	0.04	0.044	0.05
Income tax rate	b			
0.3	0	40	39	33
	0.5	45	44	42
	0.75	49	47	45
0.35	0	40	39	33
	0.5	47	45	44
	0.75	50	48	47
0.4	0	40	39	33
	0.5	49	47	44
	0.75	51	50	48

Table 12: Number of value creating holding periods - sensitivity

4. Conclusions

The levered performance of a sample of 179 industrial German companies is measured and compared to unlevered performance. Levered performance is defined as the difference between market value of equity at the end of the holding period and invested equity. Invested equity is defined by adjusting the initial investment, i.e. the market value of equity at the beginning of the holding period, by cost of capital, by decreasing it due to dividends paid and share repurchases, and by increasing it due to changes in paid in equity. All possible holding periods between 1987 and 2000 are analyzed. The levered performance of the sample depends upon the holding period chosen. The subsample of companies which are included in the index DAX at the end of 2000 performed considerably better than companies listed in the index MDAX or SMAX. In order to evaluate the impact of tax shields on debt and – because of their importance for German companies – provisions on performance, these tax shields have to be defined based upon the German tax system. All changes in statutory tax rates over the sample period were considered. Since it can be expected that tax shields cannot be utilised in total, tax shields are adjusted using estimated effective tax rates.

The impact of tax shields on debt and provisions is considerable. Moreover, tax shields are responsible for classifying a number of holding periods as value generating in terms of levered performance, despite of the fact that unlevered performance is negative. This becomes especially evident for the subsample of DAX companies. Tax shields matter since they are an immediate contribution to net present value. The influence of tax effects of debt on performance approaches zero and can turn out to be negative, depending upon the assumed level of tax exempt capital gains. Tax shields on provisions dominate tax shields on debt quite regularly.

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