Deborah Knirsch*

Is a detailed tax planning for investment decisions worthwhile? – Evidence from Germany

Abstract

Real-world tax systems distort investment and financing decisions. Therefore, taxes are integrated into capital budgeting models. However, these models use very simplified tax bases. Investors typically assume tax bases to be equal to cash flows minus depreciation allowances. I analyse the investment incentives resulting from such a simplified tax planning. The analysis is based on a stochastic business simulation model applying empirical data from various industries in Germany. Using Monte Carlo simulations, I cover a wide variety of business developments.

I show that using cash flows minus depreciation allowances as a tax base generates deviations compared to investment planning with a detailed tax base in accordance with current tax laws. Based on the simplified capital budgeting model, the anticipated future values of companies can be too high or too low, depending on the company's legal structure and industry. Using only cash flows as a tax base leads to an anticipated future value which is always too high.

But these deviations are small compared to forecast errors concerning interest rates or tax rates. For example, if the income tax rate is reduced to 37%, while the anticipated tax rate is 42%, or if the interest rates increase by 3 percentage points, the future values and the deviations are much higher compared to tax base-induced deviations.

Hence, investors should pay more attention to the forecast of interest rates and tax rates, as opposed to reproducing a more detailed tax base of investment projects.

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1 Introduction

Real-world tax systems are non-neutral with respect to investment and finance decisions[1]. Due to their non-neutrality, the pre-tax ranking of different investment alternatives might change when considering a detailed investment planning including taxes[2]. Therefore, investment and finance decisions are usually made in consideration of taxes[3]. Any applied investment model should integrate the tax law on a very detailed level. But in research and business practice, the applied models usually comprise a very simplified tax base. Due to the extreme complexity of tax systems and high resulting tax planning costs[4], the simplification of investment models is necessary. There must be a trade-off between necessary simplifications to cut costs, and enough accuracy to guarantee usefulness of the model. If the model is oversimplified, the investment decision might be mistaken and the investment planning would be worthless.

Usually, well-established investment models take cash flows as well as depreciation into account[5]. For reasons of simplification, other accruals of the tax systems are ignored. Empirical studies show that these models are often used for capital budgeting in business practice[6]. Yet another common model is even simpler: it uses cash flows as a tax base without conducting any modifications[7].

[1] In Croatia, a neutral tax system, the 'Allowance for Corporate Equity' (ACE), had been implemented in 1994. After political changes the system was abolished in 2000, even though the abolishment was in no way due to technical problems of the ACE. See Keen/King (2002).

[2] Brown (1948) developed conditions for neutral taxation of cash flows, Johansson (1969) and Samuelson (1964) for taxation of income including interests. A modification of the cash flow tax that avoids the problem of implementation, the ACE system, was firstly presented by Wenger (1983) and at the same time developed by Boadway/Bruce (1984). Devereux/Freeman (1991) have analyzed the ACE approach and discussed effects of implementation in the UK.

[3] See Mills et al. (1998); Brealey et al. (2005); Scholes/Wolfson (2002); Niemann/Sureth (2005); Kruschwitz/Löffler (2005).

[4] See Wagner (2005), p. 416; Mills et al. (1998). Plumlee (2003) shows that the more complex tax systems are, the less the company's information is used by financial analysts to make revisions of their forecasts. In this paper, tax planning costs are assumed to be zero, because no empirical data are available.

[5] See Wagner/Dirrgl (1980); pp. 24 ff.; Niemann (2004), p. 267; Brealey et al. (2005); Kruschwitz (2005), pp. 140 ff.

[6] See Schwenk (2003); Wagner/Schwenk (2003), p. 393.

[7] See Schwenk (2003), pp. 153 ff.

Until now, the size of the error of the deduced tax burden resulting from such a simplified tax planning is not known. In order to analyse the economic effects of using these simplified investment models, I develop a business model simulation by applying empirical data from Germany. The simulation quantifies the forecast errors of companies from different industries and with differing legal structures.

The analysis takes several industries and legal structures into account, as the simplification of the anticipated tax base affects different companies differently. Hence, the simulation considers the industries manufacturing, energy and water supply, the building sector, transport, wholesale and retail trade. Stochastic enterprise developments are illustrated by means of a Monte Carlo simulation.

First, forecast errors resulting from a simplified tax planning model are computed. In a second step, other parameters like tax rates and interest rates are varied. The errors due to the simplified tax base are compared to those resulting from the parameter variation.

The remainder of the article is organised as follows: Section 2 describes the business model simulation. In section 3, the findings of the Monte Carlo simulations regarding a detailed and a simplified tax base are introduced. The findings of the simulation with varied tax rates and interest rates are presented in section 4. The results are compared in section 5. Section 6 summarizes and concludes.

2 The model

2.1 Introduction

The business model simulation developed in this paper reproduces the cash flows of a company's supply, production, sales, and the financing process. The pre-tax cash flows of a 10 year period are computed in detail, as well as the tax profit and loss statement. From this, tax payments can be derived. Both corporate and shareholder taxes are considered. The after-tax future value of the investment is deduced, because it can serve as a target figure of the investor[8].

An explicit linkage of subsequent periods is realised by calculating the interest on the current cash in hand and at banks that depend on prior tax payments. The short-term (long-term) credit interest rate amounts to 2% (4%); the short-term (long-term) debit interest rate is 8% (6%)[9]. After a simulation period of 10 years,

[8] The future value is chosen as a target figure, because calculating the net present value raises the problem of choosing the appropriate discount rate. Further transformations of the future value can not induce further information. See Niemann/Bachmann/Knirsch (2003), p. 133.

[9] Assumptions are based on time series of interest rates published by the German Central Bank.

liquidation of the company is assumed to be optimal. Thus, both current and final tax payments are taken into account in the model. This approach allows the analysis of different accounting rules for computing profits.

The future value of the investment is composed of after-tax cash flows that result from the company's liquidation, and from other financial assets of the shareholders. The value of the firm's liquidation is derived by summing up the net value of the tangible and intangible assets of the company, minus liabilities and provisions. The amount is withdrawn by the owners or distributed to the shareholders after consideration of the corporate income tax and trade tax. Thereafter, the personal income tax must be deducted. In case of a loss carry forward, a flat-rate value adjustment is assumed: The loss carry forward of the corporate income tax and the trade tax is sold for 20% of its nominal value, while the loss carry forward of the personal income tax looses half of its nominal value[10]. The second component of the future value, the other financial assets of the owners, consist of accumulated and reinvested withdrawals and dividends. At the end of each year, the owners of partnerships withdraw funds or the shareholders receive dividends from the company, and reinvest them into financial assets. They bear 2 per cent interest p.a. and are subject to personal income taxation.

In the model, empirical data from the German Central Bank and the BACH-database of the European Union are applied. They contain financial statements of German companies of different sectors. Due to the authoritative principle, 90% of the financial statements are similar to those made for tax purposes[11]. The empirical data are used as starting values of the business model simulation. Moreover, the annual growth rates of different items of the balance sheet and the income statement are derived from the empirical data. For this purpose, the mean annual growth rate is determined over a period of five years[12].

The development of a company is reproduced under uncertainty. In the Monte Carlo simulation, the growth rates are implemented as Gaussian variables with $\phi \sim N(\mu, \sigma^2)$ and $\sigma^2 = [0.1 \cdot \mu]^2$, where the expected value of the Gaussian variable is the empirical mean value. The number of recurrences is 25,000 for every legal

[10] Assumptions are based on empirical data from Germany from 1987, see Schneider (1988), p. 1222. The empirical value of 25% is slightly adjusted, because the time restriction of the loss carry forward has been abolished and a minimum tax has been established in the meantime.

[11] See Deutsche Bundesbank (2001), pp. 45-77; Deutsche Bundesbank (1998), p. 59; European Communities (n.d.).

[12] The growth rates ϕ of the balance sheet items are derived from the empirical book values bv $\phi = \left[\frac{bv_t}{bv_{t-4}}\right]^{\frac{1}{4}}$ and for the items of the profit and loss account from the empirical income i and the expenses e $\phi = \left[\frac{\mathrm{e}_t/\mathrm{i}_t}{\mathrm{e}_{t-5}/\mathrm{i}_{t-5}}\right]^{\frac{1}{5}}$.

structure and sector. Each random number applied in the simulation is produced only once. As a consequence, differences in tax payments and future values occur only due to different determinations of the taxable income, not because of different random variables.

The business model simulations are run under two different assumptions concerning the loss offset rules. In the first instance, the loss offsetting is implemented according to legal regulations. In the second, this assumption is altered. In case of losses, an immediate tax refund is assumed. This allows the separation of two economic effects: On the one hand, the effect resulting from different computations of taxable income can be exposed; on the other hand, the effect due to limitations in the loss offsetting can be shown.

As mentioned above, uncertainty is integrated into the model in terms of an uncertain development of the company. But this is the only uncertainty integrated into the model. Once the business development is planned, there will be no further deviation from the plan. Uncertainty affects the planning process, but the plan will be realised without variations.

2.2 Model setup

The income statement of the company is shown in table 1.

Table 1: Profit and loss account of the business model simulation.

	Sales*
±	Increase/decrease in finished goods and work-in-progress
+	Other operating income*
−	Cost of materials*
−	Personnel expenses: Wages and salaries*
−	Personnel expenses: expenses relating to pension plans and employee benefits*
−	Depreciation of tangible and intangible assets
−	Other operating expenses*
+	Dividends from associated companies
+	Interest income
−	Depreciation of financial assets
−	Interest expenses
−	Taxes on income
=	Net income / Net loss for the year

The items sales, other operating income, cost of materials, personnel expenses, and other operating expenses increase with their specific annual growth rate as explained in section 2.1. Dividends from associated companies, interest income, interest expenses, increases or decreases in finished goods and work-in-progress, and expenses

for provisions will be deduced endogenously[13]. For intangible and tangible assets, the starting net book values and depreciation allowances are assumed according to the empirical data. The annual net investment in assets can be derived endogenously.

The balance sheet items financial assets, receivables and other assets, inventories, provisions, liabilities, and accrued and deferred items are valued according to the empirical data[14]. Their book values increase annually with the empirical growth rate. The receivables from goods and services are written off annually with sector-specific rates. Shareholder's equity and cash in hand and at banks are derived endogenously. The empirical book values are adjusted such that the total of the balance sheet at the end of period t=0 equals 10,000,000 €. The company's balance sheet is stated in table 2.

Table 2: Balance sheet of the business model simulation.

Assets		Liabilities and shareholders' equity	
A.	Fixed assets	A.	Shareholders' equity
I.	Intangible assets*	1.	Registered capital
II.	Tangible assets*	2.	Accrued profits
1.	Land and buildings	3.	Net income / net loss of the year
2.	Plant and machinery	B.	Provisions
3.	Plant and equipment	1.	Provisions for pensions*
4.	Deposits paid / construction in progress	2.	Other provisions*
III.	Financial assets	C.	Liabilities
1.	Investments*	1.	Trades payable*
2.	Securities, stocks, and bonds*	2.	Short-term financial liabilities*
3.	Other long-term accounts receivable*	3.	Long-term financial liabilities*
B.	Current assets	D.	Deferred items*
I.	Inventories		
1.	Raw materials and supplies*		
2.	Work in process*		
3.	Finished goods*		
4.	Deposits paid		
II.	Receivables and other assets		
1.	Receivables from goods and services*		
2.	Other short-term accounts receivable*		
III.	Cash in hand and at banks		
C.	Accrued items*		
Total assets		Total liabilities and shareholders' equity	

The items of the cash flow statement are derived from the empirical balance sheet and income statement. For reasons of simplification, incoming and outgoing payments, tax payments, and withdrawal of funds or distribution of dividends are assumed to take place at the end of a year. Withdrawals and dividends are defined as a percentage rate of the taxable earnings using the detailed tax base.

[13] These items are labelled with an '*' in table 1.
[14] These items are labelled with an '*' in table 2.

Computing the income without simplifications, sales are not equal to incoming payments, since part of the sales are not paid in cash. Instead, they are sold on credit, which leads to growing receivables from goods and services. Likewise, purchases are not always paid in cash. In that event, the book value of trades payable would increase. Part of the personnel expenses are paid in cash, while the expenses relating to pension plans are not. Making provisions for pensions affects the profit and loss account, but not the cash flow statement.

Profit taxes are modelled according to German tax law. Depending on the legal structure of the company, the corporate income tax (25%, only levied on corporate earnings), the trade tax with a municipal rate of 386%, and the income tax are implemented in the model. For reasons of simplification, the income tax is integrated in a proportional form with a marginal rate of 42% instead of the progressive tariff. In order to avoid double taxation, shareholders of corporations pay income tax only on half of their dividends and capital gains. A solidarity surcharge of 5.5% is levied on the value of corporate and personal income tax. Sole proprietorships and partnerships receive a rate reduction on their business income which is approximately equivalent to the trade tax paid ('pauschalierte Gewerbesteueranrechnung').

In the basic setting, loss offset rules are implemented according to current tax law. Concerning the corporate income tax and the personal income tax, a loss carryback is allowed for one period, but limited to 511,500 €. Concerning all taxes on profits, that is corporate income tax, personal income tax, and trade tax, a loss carry forward is allowed without time restrictions. The yearly amount is limited to 1,000,000 € plus 60% of the current profits above that amount. Additionally, the business model simulation is run under the assumption of an immediate full tax refund.

3 Results of the Monte Carlo simulation with varying tax bases

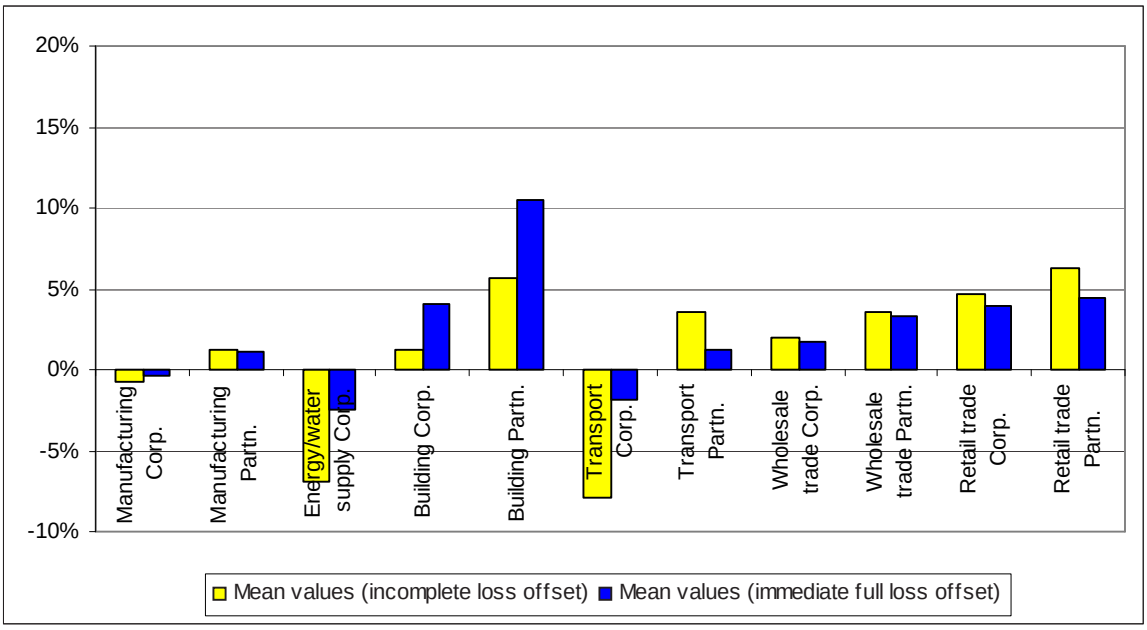
3.1 Difference of future values using cash flows minus depreciation as a tax base

If cash flows minus depreciation allowances are used as an investment model's tax base, income and expenses according to the profit and loss account usually equal cash flows. There are only a few exceptions. First, depreciation allowances are booked after the capital spending of the investment. Second, nondepreciable assets like land and financial assets appear only in the income statement if they are sold

or taken out of the company. Interest income and interest expenses are part of the income statement, while borrowing or lending and other financial transactions do not affect profits. In contrast to the detailed computation of taxable income according to current law, inventories, deposits paid, receivables from goods and services, provisions, trades payable, and accrued and deferred items do not appear in the balance sheet.

In the following, the results of the Monte Carlo simulation using cash flows minus straight-line depreciation allowances[15] as a tax base are compared to the results of determining profits without any simplification. The outcome of each simulation run is the future value of the investment. The mean future values $\overline{\text{FV}}$ of the 25,000 recurrences of the simulation with the detailed tax base (*detail*) and the simplified tax base (cash flows minus depreciation *CF-D*) are compared as relative deviation $\frac{\overline{\text{FV}}_{CF-D} - \overline{\text{FV}}_{detail}}{\overline{\text{FV}}_{detail}}$. In figure 1, Corp. denotes corporations, Partn. denotes sole proprietorships and partnerships.

Figure 1: Mean relative differences of future values resulting from using cash flows minus depreciation as a tax base as compared to a detailed tax base.



Using cash flow minus depreciation as the tax base of the planning model, the future values of investments can be overrated or underrated in comparison to the true tax base. If the deviation is positive or negative depends particularly on the

[15] The results vary very little, if the declining balance method is applied instead of the straight-line depreciation. See König/Sureth (2002).

legal structure of the company. Within one sector, the differences of future values $\overline{\text{FV}}_{CF-D} - \overline{\text{FV}}_{detail}$ of corporations are always smaller compared to those of sole proprietorships and partnerships. In most sectors, the corporations' differences are even negative. Only in the trade sector and the building industry are there positive differences. In the basic setting applying legal loss offset rules, the positive mean differences amount up to 6.3%. With an immediate full loss offset, they amount up to 10.5%. The negative mean differences amount up to -7.9% in the basic setting, and up to -2.5% with an immediate full loss offset.

These differences are caused mainly by the displacement of tax and interest payments. Only rarely does a second effect take place: If there is a loss carry forward at the end of the simulation period of 10 years, part of the outstanding tax refund is lost without compensation, which lowers the future value of the investment.

3.2 Difference of future values using cash flows as a tax base

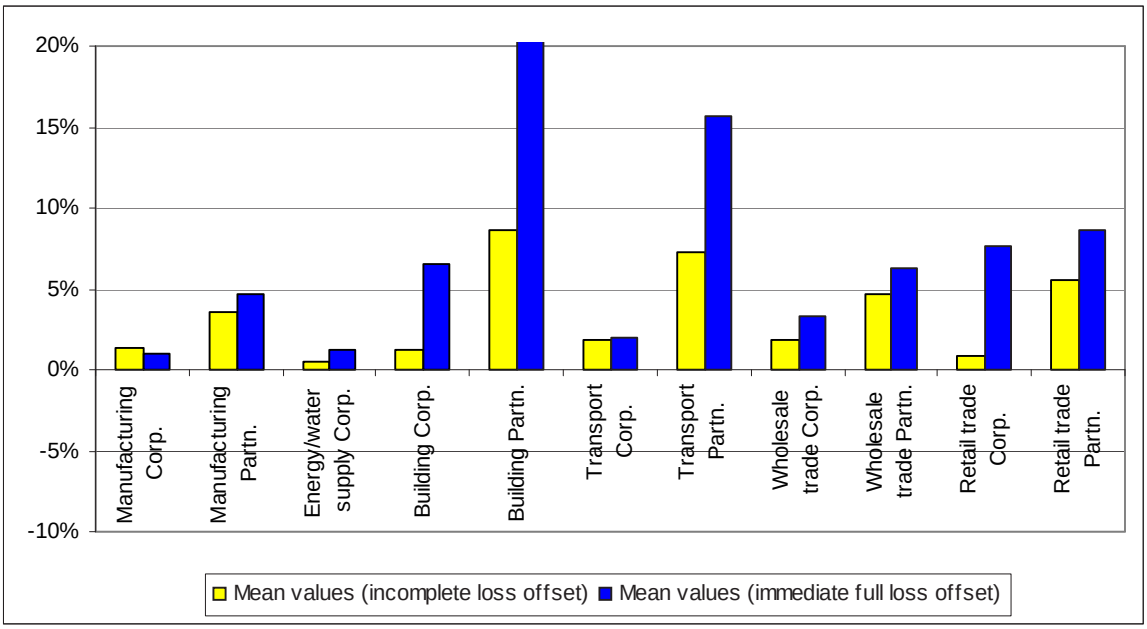
If unadjusted cash flows (CF)[16] are used as an investment model's tax base, tangible and intangible assets, inventories, deposits paid, receivables from goods and services, provisions, trades payable, and prepaid and deferred items do not appear in the balance sheet.

The relative deviations of the future values $\frac{\overline{\text{FV}}_{CF} - \overline{\text{FV}}_{detail}}{\overline{\text{FV}}_{detail}}$ are shown in figure 2. In comparison with the true tax base, the mean future values resulting from the model with the simplified tax base are overrated independent of the legal structure or sector of the companies. In the basic setting applying legal loss offset rules, the mean future values rise between 0.5% and 8.6%. With an immediate full loss offset, they rise between 1.0% and 21.0%. Within one sector, the differences of future values of sole proprietorships and partnerships are considerably larger compared to those of corporations.

Using cash flows as a tax base in the planning model, the mean differences of future values depend particularly upon the assumption concerning the loss offset rules. Assuming the basic setting with incomplete loss offset rules according to current law, using cash flows as a simplified tax base approximates the true future values quite well. But this is caused by two opposing effects. One the one hand, applying a simplified tax base causes an increase in future values. On the other hand,

[16] Several types of cash flow taxes are known. In the following, the R-based cash flow tax is chosen, where financial transactions are not part of the tax base. In contrast to the neutral cash flow tax, credit interests and debit interests remain part of the tax base, because unadjusted cash flows as known from the cash flow tax are used as a tax base in this paper, but the other parts of the neutral tax system will not be analysed. Modifications of the tax base for calculating the trade tax remain.

Figure 2: Mean relative differences of future values resulting from using unadjusted cash flows as a tax base as compared to a detailed tax base.



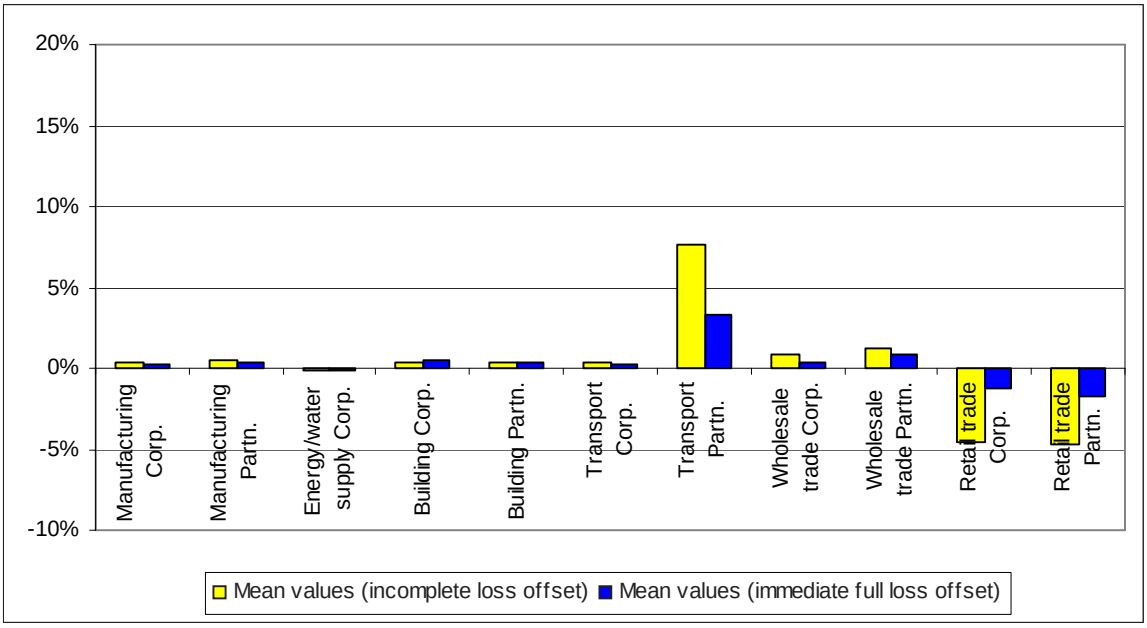
incomplete loss offset rules cause a decline in future values. Coincidentally both effects may adjust themselves. As this compensation does not occur systematically, using cash flows as a tax base of an investment model can not serve as a simplified approximation of the true tax base. If a full loss offset is assumed, the future values are always far too high when compared to the true tax bases.

3.3 Difference of future values using a simplified tax base under consideration of assets, inventories, and provisions

In the following, the Monte Carlo simulation is run using a simplified tax base that takes the changes in assets, inventories, and provisions (AIP) into account. As opposed to the detailed balance sheet according to current law, deposits paid, receivables from goods and services, trades payable, and prepaid and deferred items do not appear in the balance sheet. Straight-line depreciation is applied for tangible and intangible assets.

In spite of the number of simplifications of the tax base, the resulting future values resemble those of the true tax base. Independent of the assumed loss offset rules, the majority of mean differences has a positive value. Only in the trade sector and for the corporations of the energy and water supply industry is the mean difference negative.

Figure 3: Mean relative differences of future values resulting from using a simplified tax base considering assets, inventories, and provisions as compared to a detailed tax base.



The relative deviations of the future values $\frac{\overline{\mathrm{FV}}_{AIP}-\overline{\mathrm{FV}}_{detail}}{\overline{\mathrm{FV}}_{detail}}$ are shown in figure 3. In the basic setting applying legal loss offset rules, the mean differences amount to less than 1% of the future values in nearly all cases. The retail trade sector and sole proprietorships and partnerships of the transport sector are an exception. Assuming an incomplete loss offset, their mean deviations reach -4.7% and 7.7%, respectively. Assuming an immediate full loss offset, their mean deviations reach -1.7% and 3.3%, respectively. Assuming an immediate full loss offset, the deviations amount to less than 0.5% of the future values in two-thirds of the sectors.

In the retail trade sector, the future values decline heavily, because the companies have a high level of trades payable. If purchases are not taken into account in the income statement until they are paid, the tax base expands and the present value of tax payments rises. The future values of the sole proprietorships and partnerships of the transport sector increase, because they have a large stock of prepaid items. In the simplified tax planning model considering only assets, inventories, and provisions, the prepaid items are not taken into account. Compared to the true tax base, expenses are taken into account prematurely in the income statement. Thus, the present value of anticipated tax payments is underrated.

4 Results of the Monte Carlo simulation with varying interest rates and tax rates

Until now, interest rates and tax rates have been kept constant in the business model simulation. In the following sensitivity analysis, the interest rate will be raised by 3 percentage points in order to reveal to what extent future values can differ due to incorrectly anticipated interest rates[17]. Afterwards, the anticipated tax rates will be varied and the resulting future values will be derived. In both settings, the tax base will be planned according to current tax law.

4.1 Difference of future values due to varied interest rates

The interest rates used until now are ex-post raised by 3 percentage points (Δi). From this point on, the anticipated short-term (long-term) credit interest rate amounts to 5% (7%); the anticipated short-term (long-term) debit interest rate is 11% (9%)[18]. The anticipated interest rates remain as mentioned above. Therefore, the true interest rates are underrated in the planning model.

The relative deviations of future values with varying interest rates $\frac{\overline{\mathrm{FV}}_{\Delta i} - \overline{\mathrm{FV}}_{detail}}{\overline{\mathrm{FV}}_{detail}}$ are shown in figure 4. In all sectors, liabilities are higher than receivables plus cash in hand and at banks. Therefore, an increase of the interest rates by 3 percentage points would always lead to lower future values. Readjustments within companies such as a reduction of liabilities has not been considered in the simulation. The future values of sole proprietorships and partnerships decline especially heavily. Their liabilities are up to five times higher than their receivables plus cash in hand and at banks. A reason for this difference might be the shift of financial assets in the private means, while liabilities are kept in the company for tax reasons[19].

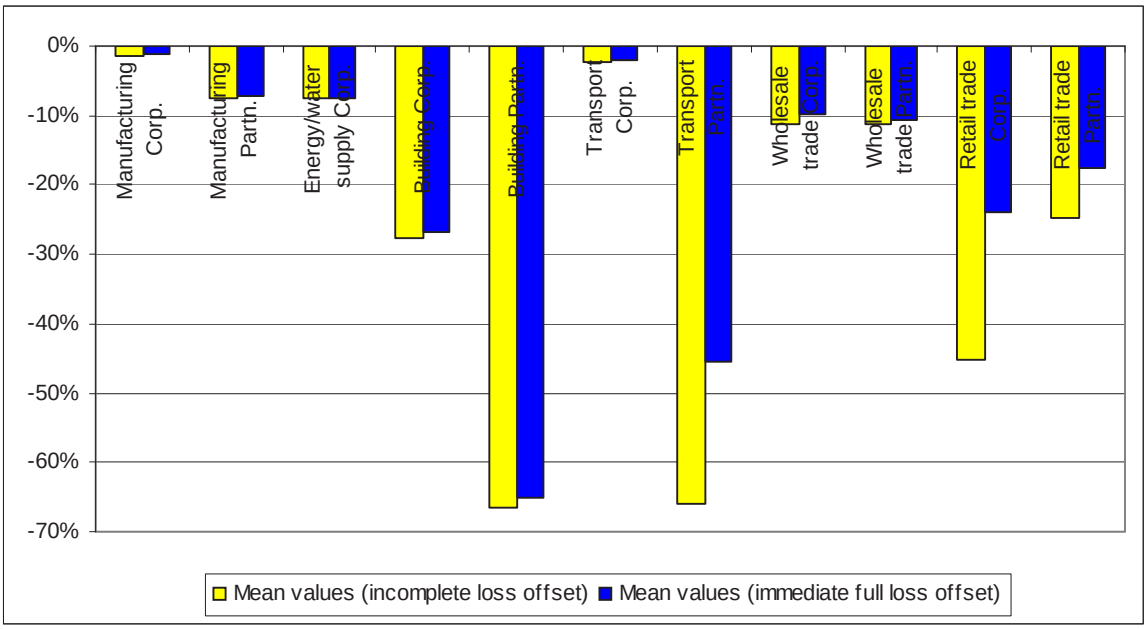
In the basic setting applying legal loss offset rules, the mean differences of future values amount up to -45.2% for corporations, and up to -66.4% for sole proprietorships and partnerships. With an immediate full loss offset, they reach up to -26.9% and -65.1%, respectively.

[17] The differences of future values are very dependent on the time horizon of the investment planned. The longer the planning period, the more the future value reacts to differing interest rates.

[18] These fluctuations are quite usual in a period of 10 years. See the time series of interest rates published by the German Central Bank.

[19] See Deutsche Bundesbank (2001), pp. 54 ff.

Figure 4: Mean relative differences of future values resulting from interest rates that are underrated by 3 percentage points.



4.2 Difference of future values due to varied tax rates

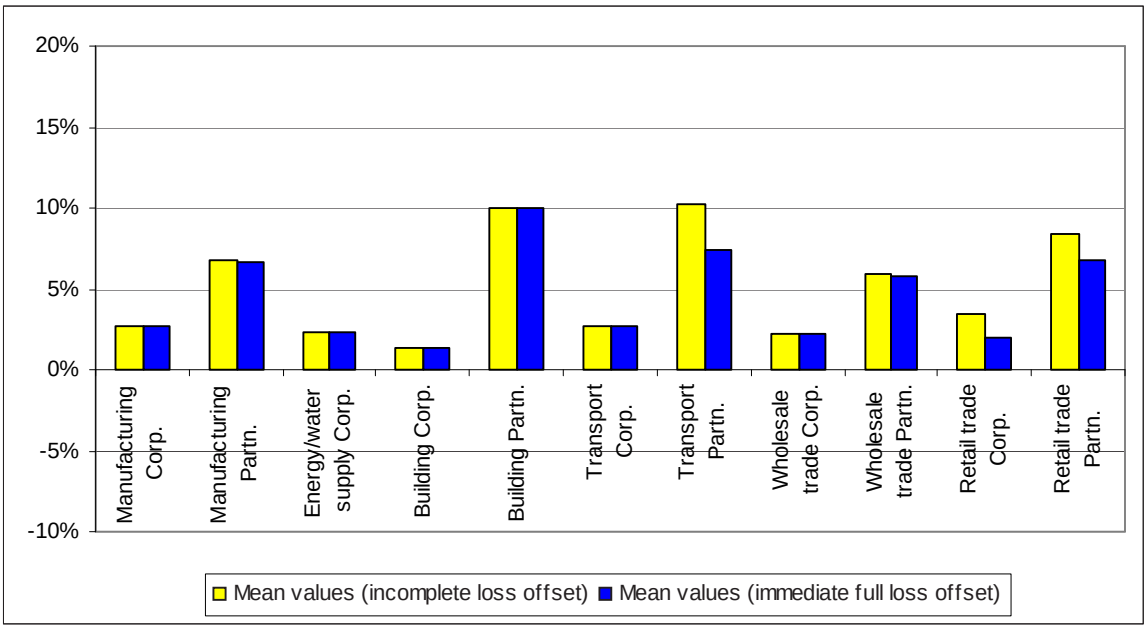
The income tax rate used until now is assumed to be ex-post reduced by 5 percentage points to 37% (Δtax). The anticipated income tax rate remains as mentioned above. Therefore, the true income tax rate is overrated in the planning model.

If the true income tax rate is lower than the anticipated one, the mean future values increase, as shown in figure 5. In the basic setting applying legal loss offset rules, the mean future values increase between 1.4% and 10.2%. With an immediate full loss offset, they rise between 1.4% and 10.0%.

Likewise, an ex-post reduction of the corporate income tax rate by 6 percentage points to 19%[20] leads to an increase of the future values. In the basic setting applying legal loss offset rules, the mean future values increase between 2.1% and 11.9%. With an immediate full loss offset, they rise between 2.1% and 5.4%.

[20] The German government had planned to cut the corporate income tax from 25% to 19% in 2006. Since the Bundestag elections, the reform has been delayed until 2008.

Figure 5: Mean relative differences of future values resulting from an income tax rate that is overrated by 5 percentage points.



5 Comparison of the results with varying tax bases, interest rates, and tax rates

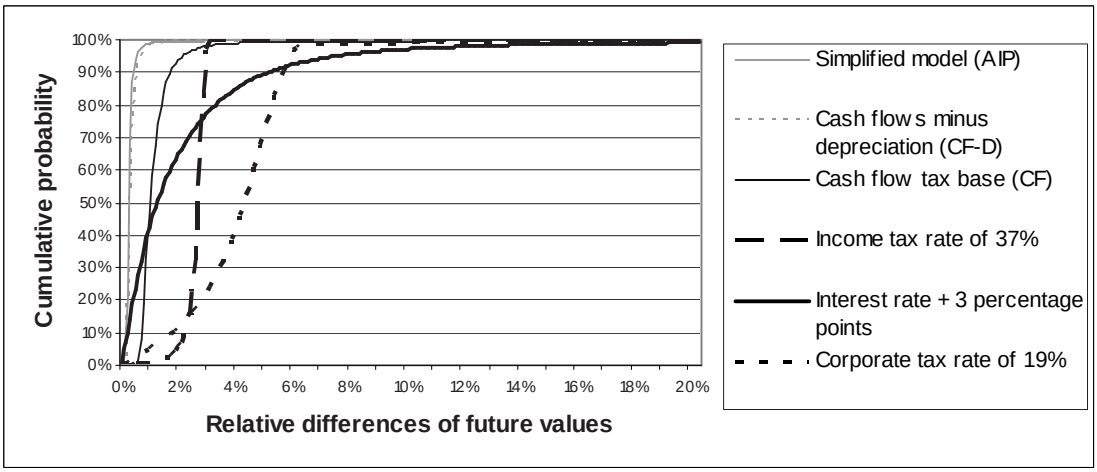
In order to reveal which incorrect anticipation of parameters leads to the highest errors in estimating the true future values, the empirical distribution functions of the future values derived in the prior chapters will be compared. The analysis will show if one distribution function dominates the others[21]. If this is the case, an investor can deduce which parameter should more accurately be anticipated. The examples presented in this section, figures 6, 7, and 8, and figure 9 in the appendix, depict empirical distribution functions of the absolute values of the relative differences of future values $\frac{\overline{\mathrm{FV}}_{varied}-\overline{\mathrm{FV}}_{detail}}{\overline{\mathrm{FV}}_{detail}}$. From this point on, an immediate full loss offset is assumed.

In figure 6, the distribution functions of the corporations of the manufacturing industry are chosen as an example. The distribution of the relative differences of future values using the simplified model that considers only changes in assets, inventories, and provisions (see section 3.3) and using the model that takes cash flows minus depreciation as a tax base (see section 3.1) dominate the other distributions. The cash flow tax base (see section 3.2) does not always lead to lower differences of fu-

[21] The following figures show first-order stochastic dominance.

ture values compared with incorrectly anticipated interest rates. The probability of a relative difference in future values below 1.0% is 40% using the cash flow tax base and in event of incorrectly anticipated interest rates. The probability for relative differences of more than 1.0% is always higher with a change in the interest rates than with the cash flow tax base.

Figure 6: Empirical distribution functions of the differences of future values for the corporations in the manufacturing sector.



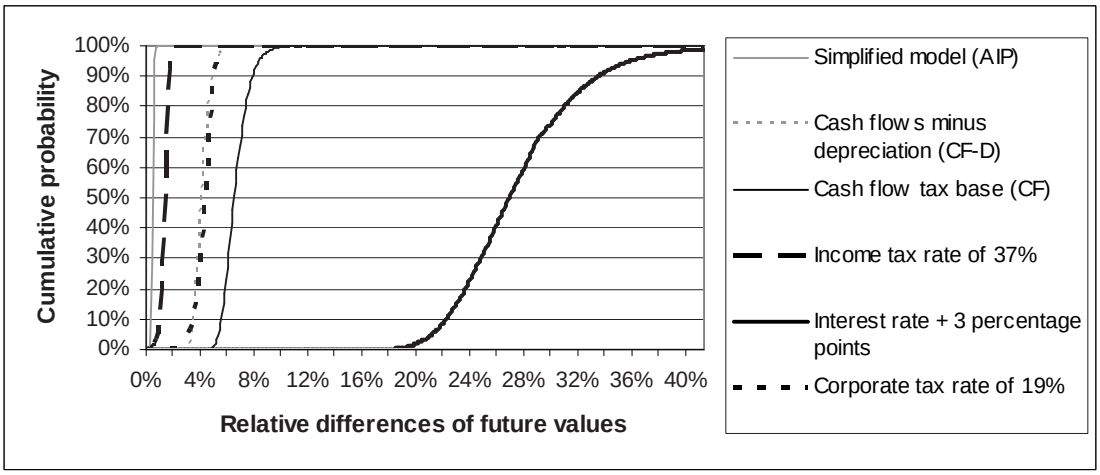
The probability of relative differences below 2.8% is 75% if the interest rates or the income tax rate are incorrectly anticipated. Higher relative differences are more likely if there is a change in the interest rates. The intersection of the distribution functions with the incorrect forecast of interest rates and the incorrect forecast of the corporate tax rate is about 92%. In both cases, nearly all differences of future values are higher compared with those resulting from a simplified tax base. With the exception of the cash flow tax base, it is more important for investors to forecast interest rates and tax rates more precisely rather than planning a more detailed tax base[22]. The more precise anticipation of macroeconomic parameters leads to lower forecast errors.

Figure 7 depicts the relative future values of the corporations of the building sector. Their results differ compared to corporations in the manufacturing industry. The simplified model that takes assets, inventories, and provisions into account dominates the other distributions in both figures. But profits are as low in the building sector that an incorrect anticipation of the income tax rate will bring about no big differences in future values. The distribution function dominates the others resulting

[22] Concerning the report of the European Union, Giannini and Maggiuli describe a larger importance of nominal tax rates compared to the accurate computation of the tax base. See Giannini/Maggiuli (2002), p. 649; Commission of the European Communities (2001).

from the cash flow tax base or using cash flows minus depreciation as a tax base. The distribution of incorrect estimates in the corporate tax rate dominates only the distribution function resulting from the cash flow tax base. The distribution of incorrect estimates in the corporate tax rate resembles those of the simplified tax base that takes cash flows minus depreciation into account.

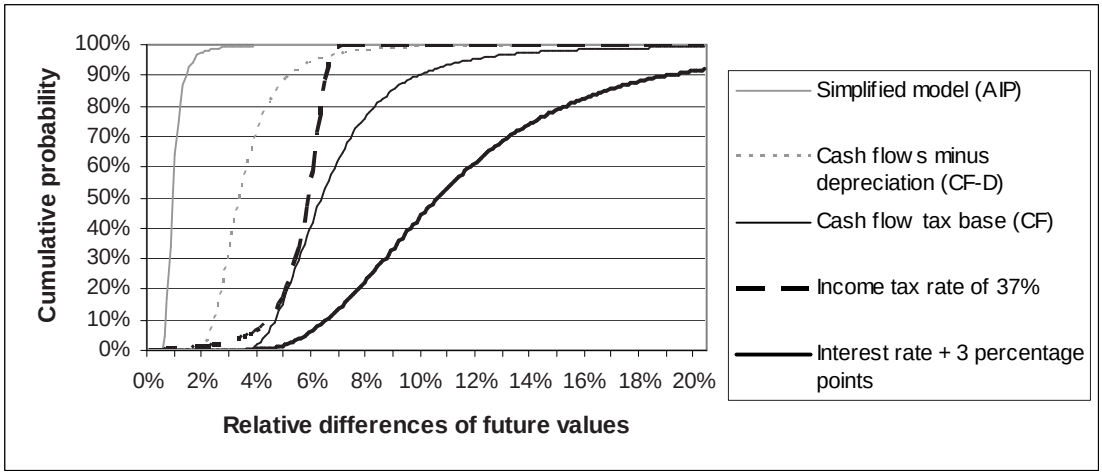
Figure 7: Empirical distribution functions of the differences of future values for the corporations in the building sector.



The distribution function of the relative differences of future values in case of incorrectly anticipated interest rates is dominated by all other distributions. The differences are considerable, because liabilities are always much higher than receivables and cash in hand and at banks. A rise in the interest rates of 3 percentage points would boost interest payments considerably, leading to much lower future values.

The same effect appears when sole proprietorships and partnerships of the wholesale trade are analysed. Figure 8 shows that the simplified model taking assets, inventories, and provisions into account dominates all other distributions. If the investment planning is made using cash flows minus depreciation as a tax base, the probability of small differences of future values is much higher compared with incorrectly anticipated interest rates or tax rates. By contrast, the distribution function of the differences in the case of a cash flow tax base is dominated by the distribution of the incorrect estimation of the income tax rate. A more precise investment planning can be reached by improving the estimation of interest rates or by taking depreciation allowances into account in the investment model. By contrast, a more accurate anticipation of the income tax rate is less important.

Figure 8: Empirical distribution functions of the differences of future values for the sole proprietorships and partnerships in the wholesale trade sector.



6 Conclusion

In theoretical models and business practice, capital budgeting necessarily takes place in consideration of taxes. But usually the applied models comprise a very simplified tax base. Well-established investment models take cash flows as well as depreciation into account, or they assume the tax base to be equal to cash flows.

On the basis of a business model simulation, the forecast errors of such a simplified tax planning are analysed. The model reproduces the cash flows of a company's supply, production, sales, and financing process for a period of 10 years. Using the cash flow statements, the income statements, and the balance sheets, the tax payments and interest payments of each period are deduced. An explicit linkage of subsequent periods can be realised by calculating the interest on the current cash in hand and at banks that depend on prior tax payments. The model is based on empirical data from various industries in Germany. Using Monte Carlo simulations, a wide variety of business developments are covered.

The business model simulation is used to deduce future values of investments, which are compared to the future values that result if some parameters are varied. It can be shown that using cash flows minus depreciation as an investment model's tax base generates deviations compared to investment planning with a detailed tax base. The resulting future values of companies can be too high or too low depending on the legal structure and industry of the company. If cash flows are used as a tax base, the anticipated future values are always too high compared to a detailed investment model. The overestimation of future values of sole proprietorships and partnerships

is always larger compared to those of corporations in the same sector.

The forecast errors are much lower if the investment planning model uses not only cash flows minus depreciation allowances, but also takes inventories and provisions into account. In most of the analysed sectors, the future values resulting from such a simplified tax planning deviate less than 0.5% from true future values.

The errors in estimates due to a simplified tax base depend on the differing structures of the profit and loss accounts and balance sheets of the companies from different sectors and with different legal structures. Sole proprietorships and partnerships possess more inventories and have fewer provisions than corporations with the same balance sheet total. If these two items are not taken into account in the investment planning, the anticipated present values of tax payments of corporations would always be too high and the anticipated future values of the investments would always be too low, while tax payments of sole proprietorships and partnerships are underrated and their future values would be overrated.

The results also differ according to the sectors of the companies, which is mainly due to provisions and inventories. There are more inventories in the trade, manufacturing, and building sectors than in other industries. If inventories are not taken into account in the investment planning, the present values of the tax payments of those companies are estimated too low and estimated future values will be too high. The level of provisions is high in the manufacturing, energy and water supply as well as the transport sectors. Without anticipation of provisions in the tax planning, the present values of tax payments are forecasted too high and the future values are forecasted too low.

Anticipating other non-cash expenses and non-cash income of the tax base, like receivables from goods and services, trades payable, a simplified inventory valuation system, accrued and deferred items, deposits paid, or straight-line instead of declining balance method of depreciation, influences the estimated future value very little. Tax planning without these items reduces the complexity considerably, but does not change the results significantly. A big fraction of the income and expenses such as cash paid sales, cash paid purchases, and salaries and wages are equal to cash flows. In comparison, most accruals that differ from cash flows are much less relevant and hardly affect the tax income and tax payment. Therefore it is of little account, if all tax accruals are anticipated in detail. Actual tax planning models need not be enlarged by integrating all accruals according to current law.

In comparison with this simplified anticipation of tax bases, the incorrect anticipation of interest rates or tax rates plays a more important role. A rise in the interest rates of 3 percentage points usually leads to mean differences of future values that

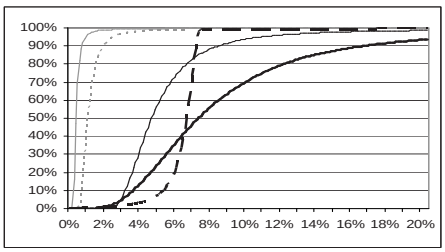
are several times larger than the differences resulting from tax planning using cash flows minus depreciation, unadjusted cash flows, or the simplified tax base that takes assets, inventories, and provisions into account.

If the income tax rate is reduced to 37%, while the anticipated tax rate is 42%, or if the corporate tax rate is reduced to 19%, while the anticipated tax rate is 25%, the future values and the deviations are often much higher compared to investment models with a simplified tax base. Depending on the industry, the deviations are smaller or larger compared with those resulting from tax planning models using cash flows minus depreciation or unadjusted cash flows as a tax base. The model taking assets, inventories, and provisions into account always produces much lower differences of future values.

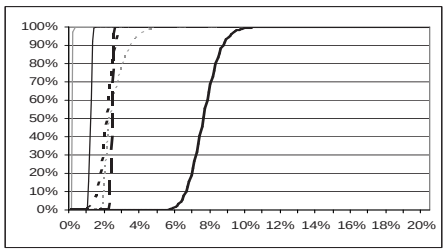
The paper shows that in capital budgeting, more attention should be paid to the forecast of interest rates and tax rates while less attention should be paid to reproducing a more detailed tax base of investment models.

Appendix

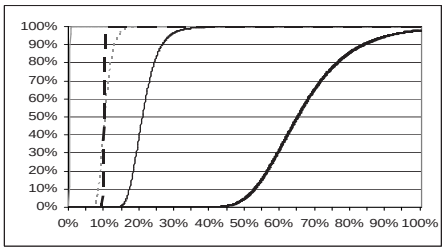
Figure 9: Empirical distribution functions of the differences of future values.



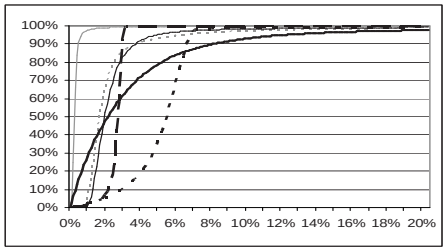
(a) Manufacturing (Partn.)



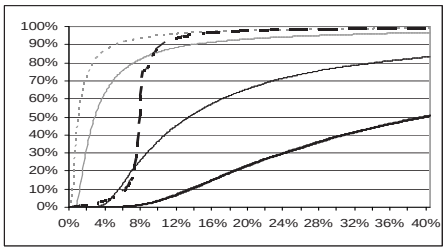
(b) Energy and water supply (Corp.)



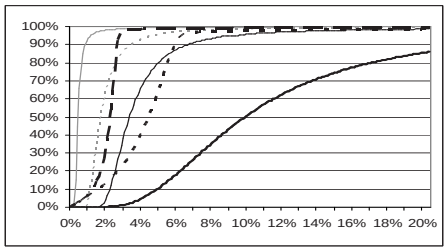
(c) Building industry (Partn.)



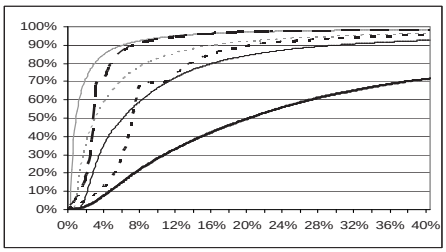
(d) Transport (Corp.)



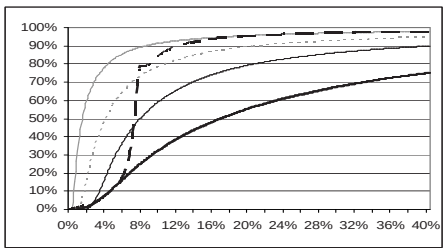
(e) Transport (Partn.)



(f) Wholesale trade (Corp.)



(g) Retail trade (Corp.)



(h) Retail trade (Partn.)

Simplified model Cash flow minus depreciation Cash flow tax base
Interest rate + 3 perc. points Income tax 37% Corp. tax 19%

References

Boadway, Robin W./Bruce, Neil (1984): A General Proposition on the Design of a Neutral Business Tax, in: Journal of Public Economics 24, pp. 231-239.

Brealey, Richard A./Myers, Stewart C./Allen, Franklin (2005): Principles of Corporate Finance, 8th ed., Boston.

Brown, E. Cary (1948): Business-Income Taxation and Investment Incentives, in: : Lloyd A. Metzler et al. (eds.), Income, Employment and Public Policy, New York, pp. 300-316.

Commission of the European Communities (2001): Company Taxation in the Internal Market, Brussels.

Deutsche Bundesbank (2001): Erträge und Finanzierungsverhältnisse deutscher Unternehmen nach Rechtsformen, in: Deutsche Bundesbank, Monatsbericht Dezember 2001, pp. 45-77.

Deutsche Bundesbank (1998): Methodische Grundlagen der Unternehmensbilanzstatistik der Deutschen Bundesbank, in: Deutsche Bundesbank, Monatsbericht Oktober 1998, pp.51-67.

Devereux, Michael P./Freeman, Harold (1991): A General Neutral Profits Tax, in: Fiscal Studies 12, pp. 1-15. European Communities (n.d.): BACH database - Bank for the Accounts of Companies Harmonised, http://europa.eu.int/comm/economy_finance/indicators/bachdatabase_en.htm, 24/01/2006.

Giannini, Silvia/Maggiulli, Carola (2002): The Effective Tax Rates in the EU Commission Study on Company Taxation: Methodological Aspects, Main Results and Policy Implications, in: CESifo Economic Studies 48, pp. 633-653.

Johansson, Sven-Erik (1969): Income Taxes and Investment Decisions, in: Swedish Journal of Economics 71, pp. 104-110.

Keen, Michael/King, John (2002): The Croatian Profit Tax: An ACE in Practice, in: Fiscal Studies 23, pp. 401-418.

König, Rolf/Sureth, Caren (2002): Die ökonomischen Auswirkungen der Änderungen der steuerlichen Abschreibungsmodalitäten, in: Die Betriebswirtschaft 62, pp. 260-272.

Kruschwitz, Lutz (2005): Investitionsrechnung, 10th ed., Munich.

Kruschwitz, Lutz/Löffer, Andreas (2005): Discounted cash flow. A Theory of the Valuation of Firms, Wiley Finance.

Mills, Lillian/Erickson, Merle M./Maydew, Edward L. (1998): Investments in Tax Planning, in: Journal of the American Taxation Association 20, pp. 1-20.

Niemann, Rainer (2004): Tax Rate Uncertainty, Investment Decisions, and Tax Neutrality, in: International Tax and Public Finance 11, pp. 265-281.

Niemann, Rainer/Bachmann, Mark/Knirsch, Deborah (2003): Was leisten die Effektivsteuersätze des European Tax Analyzer?, in: Die Betriebswirtschaft 63, pp. 123-137.

Niemann, Rainer/Sureth, Caren (2005): Capital Budgeting with Taxes under Uncertainty and Irreversibility, in: Journal of Economics and Statistics 225, pp. 77-95.

Plumlee, Marlene A. (2003): The Effect of Information Complexity on Analysts' Use of That Information, in: The Accounting Review 78, pp. 275-296.

Samuelson, Paul A. (1964): Tax Deductibility and Economic Depreciation to Ensure Invariant valuations, in: Journal of Political Economy 72, pp. 604-606.

Schneider, Dieter (1988): Was verlangt eine marktwirtschaftliche Steuerreform: Einschränkung des Verlust-Mantelkaufs oder Ausweitung des Verlustausgleichs durch handelbare Verlustverrechnungsgutscheine?, in: Betriebs-Berater 43, pp. 1222-1229.

Scholes, Myron S./Wolfson, Mark A./Erickson, Merle M./Maydew, Edward L./Shevlin, Terry (2002): Taxes and Business Strategy. A Planning Approach, 2nd ed., Upper Saddle River, New Jersey.

Schwenk, Anja (2003): Die Wirkung impliziter Steuervorteile des Bilanzrechts, Wiesbaden.

Wagner, Franz W./Dirrigl, Hans (1980): Die Steuerplanung der Unternehmung, Stuttgart.

Wagner, Franz W. (2005): Besteuerung, in: Vahlens Kompendium der Betriebswirtschaftslehre, Bd. 2, 5th ed., Munich, pp. 407-477.

Wagner, Franz W./Schwenk, Anja (2003): Empirische Steuerwirkungen als Grundlage einer Reform der Gewinnbesteuerung - Ergebnisse aus den DAX 100-Unternehmen, in: Manfred Schwaiger /Dietmar Harhoff (eds.), Empirie und Betriebswirtschaft, Stuttgart, pp. 373-398,

Wenger, Ekkehard (1983): Gleichmäßigkeit der Besteuerung von Arbeits- und Vermögenseinkünften, in: FinanzArchiv 41, pp. 207-252.